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## ATRIAL PACING IN SELECTIVE SITE WITH SELECT SECURE SYSTEM: FEASIBILITY OF IMPLANT AND MID TERM FOLLOW-UP ELECTRICAL DATA

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**Purpose** Many Recent studies have shown benefits of Atrial Selective Site Pacing (ASSP) in patients affected by atrial arrhythmias. ASSP by pre-exciting the left atrium, could minimize the total atrial activation time thus possibly prevent atrial arrhythmias recurrences.
Aim of our study was the evaluating of the feasibility and electrical performance of ASSP, using a dedicated system composed by a screw-in 4.1French lead and a steerable catheter, and the effect of ASSP in atrial arrhythmias related symptoms.
**Materials and methods** 99 patients (54 M, age 69±12 years), with standard pacing indication were enrolled. In the year before the implant, 6 pts had complained about episodes of angina, 31 about palpitations, 6 dyspnea, 11 dizziness and 20 pts had syncope, while 11 pts had none of these symptoms. 45 pts had one or more hospitalizations for cardiovascular events. The mean baseline EF% of the whole population is 54±11%.
**Results** In 63 pts the Select Secure Lead was screwed in inter atrial septum, in 24 pts in coronary sinus ostium and 12 in the Bachman bundle. No adverse event occurred during implants.
Acute electrical data of the whole population showed a threshold of 1.1±0.7 V at 0.5 ms and a sensing of 2.6±1.4 mV. 44 patients have already reached 1 year follow-up. Their acute and 1 year electrical performances are respectively: pacing thresholds 1.1±0.7 V and 0.8±0.4 V (p=NS) and sensing 2.5±1.4 mV and 2.6±1.0 mV (p=NS).
Moreover, electrical leads performances did not differ significantly considering the different atrial selective sites. 26 out of the 74 patients (35%) that were complaining about symptoms before the implant procedure, referred a subjective improvements in their health status having not experienced symptoms during the follow-up.
**Conclusions** ASSP is safe and feasible and electrical performance is stable in the follow up, with values comparable with those of standard implants. Our preliminary data seems to confirm the benefits of ASSP in reducing AF related symptoms.

## THEORETICAL GROUNDS OF CARDIAC INSUFFICIENCY DYNAMICS: PACING OF VENTRICLES

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**Background** It is known that the right ventricular apex (RVA) pacing promotes ventricular dyssynchrony with hemodynamic disruptions. Pacing from alternative sites does not always give good hemodynamic effect.
Objective. We intended to study causes and mechanisms of hemodynamic disruptions induced by right ventricle pacing.
**Methods** During the decade 4,578 pacemakers were implanted in the case of complete AV block (CAVB). The RVA was used for pacing of 3,945 patients, while in 621 patients the alternative sites were sought for (His bundle, IVS, RVOT, LVApex). 10 patients got BiV pacemakers because of heart failure during the RVA pacing. Four of them underwent consequential upgrading via IVS or His bundle pacing; four patients received one-time upgrade for BiV pacing; two patients were given IVS and His bundle pacing.
**Results** All patients with BiV pacing had significantly improvement of heart failure symptoms. In all these patients the CAVB was linked with the LBBB and considerable LV asynchrony. The conduction velocity through Purkinje fiber and bundle branches ten times faster than in myocardium therefore pacing from right ventricle with intact bundle branches excitates LV myocardium via the conduction system with compensating asynchrony. In the case of CAVB with LBBB LV gets excitation via the myocardium and this factor produces significant electrical and mechanical asynchrony.
**Conclusions** The cause of hemodynamic ineffectiveness of ventricular pacing is in the damaged distal part of the conduction system. To avoid negative hemodynamic effect of right ventrical pacing correct pacing site has to be choused from which more rapid conduction velocity would be achieved via the conduction system.
In the case of combination CAVB and LBBB BiV pacing should be choused only.

## IS HIGH SEPTUM RVOT PACING USING THE SELECT SECURE SYSTEM A GOOD ALTERNATIVE TO A RIGHT APICAL PACING?

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**Purpose** Many recent studies have shown that Right Ventricular Apical Permanent Pacing (RVAPP) is associated with long term detrimental effects of left ventricular function. These findings determined the needs for investigating other ways to pace ventricle, in particular Right Ventricular Outflow Tract (RVOT) pacing has been proposed as an effective alternative to RVAPP. The aim of this study is to evaluate the feasibility and the mid term electrical performance of high septal RVOT pacing using a dedicated system (Medtronic Select SecureÆ).
**Materials and methods** In 102 patients (49 M, age 69±21years) indicated to pacemaker and defibrillator implant according to the current guidelines, the Select Secure lead was implanted in the RVOT high septum. The implant indication was Sick Sinus Syndrome in 30 patients, AV block in 61 pts, both indications in 9 pts and VT/VF in 2 patients. The mean baseline EF was 46.1±15.3% and 11 pts have previous MI.
**Results** In all patients RVOT pacing has been easily achieved and the mean fluoroscopic implant time was 18.7±15.2 minutes. Acute data on the leads electrical performance have been collected: the threshold showed a value of 0.8±0.5V at 0.5 ms, the sensing a value of 10.6±6.0 mV and the impedance of 835±278 ohm. 33 patients have already reached the 1 year follow-up and their acute and chronic leads electrical performances show a pacing threshold of 0.9±0.6 and 1.1±0.6 respectively (p=NS) and a sensing of 9.7±5.9 and 9.5±6.6 respectively (p=NS). No adverse events occurred. At 1 year follow-up the mean EF is maintained 44±11% (p=NS vs. baseline).
**Conclusions** High septum RVOT pacing is feasible and safe using Medtronic Select Secure SystemÆ, the leads electrical performances are stable in the mid term follow up. Further data are needed to evaluate the clinical benefits of this pacing approach compared to traditional one.

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## WHICH IS THE BEST VENTRICULAR SELECTIVE SITE: RIGHT OUTFLOW TRACT OR HIS BUNDLE?

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**Purpose** Selective Site Pacing (SSP) has recently been proposed by many authors to avoid the detrimental effect of apical pacing and allow a more physiological ventricular activation and contraction. A system composed by a steerable catheter and a 4.1 Fr screw-in lead has been specifically designed for SSP. Aim of our study was to compare long-term term electrical performance of this system in the High Septum Right Ventricular Outflow Tract (HS RVOT) and in Direct His Bundle Pacing (DHBP).
**Materials and methods** 159 patients (95 M, age 74±18 years), with normal QRS duration and no left ventricular dysfunction, have been enrolled in 30 Italian centers. HS RVOT positioning was assessed through final fluoroscopic images.
DHBP has been considered achieved when paced QRS has the same morphology and duration as the intrinsic QRS in all 12 ECG leads recordings, the Vp-V interval is equal to H-V interval and increasing the pacing output the QRS becomes ìwiderî.
**Results** In 89 patients HS RVOT has been reached, while in 70 patients DHBP has been achieved. 23 HS RVOT and 34 DHBP patients reached the 1 year follow up. In HS RVOT, acute and 1 year follow-up threshold were respectively 0.8±0.5 V at 0.5 ms and 1.2±0.7 V at 0.5 ms (p=NS), while sensing was respectively of 10.5±5.9 mV and 8.9±6.3 mV (p=NS).
The DHBP patients have shown an acute and a 1 year follow up threshold respectively of 2.2±1.5 V at 0.5 ms and 2.7±2.7 V at 0.5 ms (p=NS). Sensing was respectively of 3.1±1.1 mV and 3.1±1.7 mV (p=NS).
**Conclusions** HS RVOT pacing showed lower pacing threshold and higher R wave amplitudes, while DHBP had higher pacing threshold and lower sensing values, however these parameters remained stable during the follow-up. Further data need to be evaluated to assess the clinical impact of pacing in different ventricular selective sites.

## IS THERE A DIFFERENCE IN LEADS ELECTRICAL PERFORMANCE IN SELECTIVE HIS BUNDLE VS. HISIAN REGION PACING?

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**Purpose** Due to the detrimental effect of apical pacing and the need of a more physiological ventricular activation, many authors proposed Selective Site Pacing (SSP). A system composed by a steerable catheter and a 4.1Fr screw-in lead has been specifically designed for SSP. Aim of our study was to compare long-term term electrical performance of this system in Direct His Bundle Pacing (DHBP) and in the hisian region (HRP).
**Materials and Methods** 180 patients (116 M, age 74±11 years), with normal QRS duration and no left ventricular dysfunction, have been enrolled in 20 Italian centers. DHBP has been considered achieved when the paced QRS has the same morphology and duration as the intrinsic QRS in all 12 ECG leads recordings and the Vp-V interval is equal to H-V interval. HRP is considered when the pacing lead is positioned in the His region but DHBP is not reached (i.e. para-His pacing or inflow tract pacing).
**Results** In 70 patients DHBP has been achieved, while the remaining 110 patients received HRP. 34 DHBP and 42 HRP patients reached the 1 year follow up.
DHBP patients showed an acute and a 1 year follow up threshold respectively of 2.2±1.5 V at 0.5 ms and 2.7±2.7 V at 0.5 ms (p=NS). Sensing was respectively of 3.1±1.1 mV and 3.1±1.7 mV (p=NS).
The HRP patients showed an acute and a 1 year follow up threshold respectively of 1.3±1.1 V at 0.5 ms and 2.1±2.3 V at 0.5 ms (p<0.05). Sensing was respectively of 7.0±5.0 mV and 5.2±3.6 mV (p=NS).
**Conclusions** patients with DHBP show a higher but stable threshold respect to patients with HRP while a lower and more stable sensing between the two groups evaluated. Further data are needed to evaluated the clinical impact and differences in pacing in His region.

## REVERSAL OF LEFT VENTRICULAR DIASTOLIC DYSSYNCHRONY AND FUNCTION AFTER UPGRADE OF LONGSTANDING RIGHT VENTRICULAR APICAL TO SEPTAL PACING

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**Purpose** Right ventricular septal (RVS) pacing may be superior to right ventricular apical (RVA) pacing in preserving left ventricular systolic function. However, the impact of RV pacing sites on LV diastolic dyssynchrony and function was uncertain.
**Methods** 20 pts (age: 73±12 yrs, 8 M) with permanent RVA pacing (>90% ventricular pacing, pacing duration: 13.3±9 yrs) and normal LVEF (>50%) admitted for device replacement. Pts were randomly assigned to continue in RVA (n=10) or RVS (n=10) pacing. 20 age-matched normal subjects were included. Echo with tissue Doppler imaging was acquired both at baseline and after 9 months follow-up. Time interval between the onset of QRS complex to peak systolic (Ts) and diastolic (Te) myocardial velocities were measured. LV systolic dyssynchrony was defined by the standard deviation of Ts (Ts-SD) >32ms. Hemodynamic changes were measured by isovolumic contraction (IVCT), relaxation (IVRT), ejection time (ET) and diastolic filling time (FT) from ventricular outflow track by pulse wave Doppler.
**Results** At baseline, LV dyssynchrony existed in 60% of pts with RVA pacing. Systolic and early diastolic myocardial velocities significantly decreased in pts group compared to normal subjects (3.9±1.7 vs 5.9±1.0; 4.4±2.3 vs 5.8±1.6 cm/s. both p<0.05). After 9 months, pacing QRS duration decreased from 163±17 to 157±10 ms (p=0.04) in RVS group, but remained unchanged in the RVA group. Te-SD and Ts-SD had 39% (p=0.04) and 18% decrease from baseline in RVS pacing. IVCT and IVRT had 30% and 13% decrease from baseline in RVS pacing significantly compared to RVA pacing (both p<0.05), LVFT had 17% increase in RVS pacing trend to significantly compared to RVA pacing (p=0.08).
**Conclusions** Pts with longstanding RVA pacing, impairment of LV diastolic relaxation and dyssynchrony occurred even in the presence of normal LVEF. Change of RVA to RVS can lead to an early reversal of diastolic dysfunction and dyssynchrony.

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## IS OUTPATIENT RADIOFREQUENCY CATHETER ABLATION FEASIBLE AND SAFE?

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**Purpose** The role of radiofrequency catheter ablation (RCA) as primary therapy for several arrhythmias has been described in position papers. Very few data exist in the literature regarding the feasibility of outpatients RCA. The purpose of this study was to prospectively evaluate the safety and feasibility of performing RCA on a selected outpatient basis.
**Methods** The study population comprised 400 consecutive patients (265 men, 135 women, mean age 62±15 years, mean ejection fraction 57±10%) who underwent RCA of the slow pathway for treatment of AV nodal reentrant tachycardia (88), cavotricuspide isthmus for atrial common flutter (296), and left and right accessory pathways (respectively 20 and 6) from August 2005 to May 2007 in our institution. Exclusion criteria were presence of prosthetic valve, previous stroke or transient neurologic attack, immediate complication of the procedure, and geographic and/or familial insulation. All patients underwent RCA after femoral venous access and were discharged 3 to 6 hours later. Echocardiographic control was performed only in patients who underwent transseptal catheterism (20). Patients were scheduled for a one-month follow-up. Hospitalization related to the procedure or arrhythmias recurrence, local puncture complications, symptomatic pericardial effusion, venous or arterial thromboembolic events, and arrhythmias on Holter-ECG were prospectively collected.
**Results** The procedure was successful in all cases. None death occurred. Two patients had a clinically significant local complication (hematoma and arteriovenous fistula), and both required surgical repair. None symptomatic thromboembolic episodes, stroke or pericardial effusion were reported. Three patients had a recurrence of common atrial flutter and one of AV nodal reentrant tachycardia. The rate of rehospitalization within one month of the procedure was 0.75%.
Conclusion: RCA safety appears to be not compromised when an early discharge is limited to patients who are appropriate candidates for outpatient therapy.

## RELATIONSHIP BETWEEN CATHETER FORCE "POPPING" AND CHAR FORMATION: EXPERIENCE WITH THE HANSEN MEDICAL ROBOTIC INTELLISENSE SYSTEM

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**Introduction** Popping, char and perforation is a complication of ablation. Intellisense provides the number of grams of perpendicular force the catheter is applying to the endocardium. We evaluated lesions placed using this system to determine the relationship of catheter pressure (grams) to lesion formation. We evaluated the relationship between this pressure and the development of char formation, popping, crater formation, and perforation.
**Methods** Using a robotic navigation system, transeptal puncture was performed and an ablation catheter was advanced into the left atrium (LA) in 5 dogs. After creation of LA maps using Ensite/NAVX, lesions were placed in the LA atrium at 6 settings (Table 1), using a constant duration (40 sec) and flow rate (30cc/min). To ensure each lesion was distinct its location was recorded on the Ensite/NAVX map. Lesion delivery was monitored using intracardiac echocardiography (ICE). Sudden impedance rise, audible pops, and bubble showers were noted. Necropsy was then performed and each lesion evaluated for crater formation, char, and perforation.
**Results** Lesions using 30 W were more likely to be transmural at higher (>40) than lower (<30) pressures (50% vs 16%, $p<0.05$). Significantly higher number of lesions using >40g of pressure demonstrated "popping" and crater formation as compared to lesions with 20-30g of pressure (41% vs 16%, $p<0.05$). The majority of lesions placed using higher power (45W) with higher pressures (>40) were associated with char and crater formation (66.1%). No lesions using 10g of pressure were transmural, regardless of power.
**Conclusions** When using an open irrigated catheter, high levels of catheter pressure as measured by Intellisense are associated with transmurality. However, this appears to also be directly related to char, crater formation and "popping". Moderate pressures (20-30g) were associated with transmurality with low incidence of complication.

| Group | Power (W) | Pressure (g) |
|---|---|---|
| Group 1 | 30 | 10 |
| Group 2 | 45 | 10 |
| Group 3 | 30 | 20-30 |
| Group 4 | 45 | 20-30 |
| Group 5 | 30 | >40 |
| Group 6 | 45 | >40 |

## IMPEDANCE PHASE ANGLE OPTIMIZES ELECTRODE TIP-TISSUE ELECTRICAL COUPLING AND IS SUPERIOR TO CONTACT FORCE TO PREDICT RF LESION FORMATION AND COLLATERAL DAMAGE

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**Introduction** RF catheter ablation via open-irrigation electrodes allow higher energy delivery resulting in larger lesions. However, lack of temperature feedback may compromise safety of AF ablation and in trabeculated myocardium. RF lesion creation depends on power delivered to the myocardium which is dependent of electrode-tissue electrical coupling.
**Purposes** To evaluate electrical coupling measured using impedance phase angle (IPA) and to compare IPA to electrode-tissue contact force (CF) in creating lesions.
**Methods** A swine thigh muscle preparation was used. The thigh muscle was exposed and covered with 37°C heparinized blood circulating at 250 ml/min. 62 RF lesions were created with a 7Fr, 4mm open irrigation (13 ml/min) catheters (IBI CoolPath) using 20 W or 30 W for 30 s, 0 g, 10 g and 20 g CF, and parallel or perpendicular electrode orientation. Pseudo trabeculations (PT) were created by separating muscle bundles to fit the electrode. ANOVA and regression analysis tested the accuracy of IPA and CF as predictors of lesion size.
**Results** Lesion size was a linear function of IPA for smooth and PT tissue. Lesion size was a quadratic function of CF for smooth tissue but was not correlated for PT tissue. IPA was more accurate than CF in predicting lesion size on smooth tissue (82% vs 56%) and significantly better in PT (67% vs 0%).
**Conclusions** Electrode tip-tissue electrical coupling as measured by IPA is superior to CF to predict RF lesion formation, particularly in trabeculated tissue where electrical coupling is high resulting in tis-

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sue overheating and potential steam pop. IPA may be used to titrate power for creating adequate lesion size while minimizing collateral damages. This novel technology remains to be evaluated clinically.

## ROBOTIC MAGNETIC NAVIGATION: CAN IT REPLACE AN ELECTROPHYSIOLOGIST'S HANDS?

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**Intro** Robotic Magnetic Navigation (RMN) for mapping and ablation has been demonstrated to have advantages to conventional manual catheter manipulation (CONV), such as improved fluoroscopy times, precision and stability, and integration with electroanatomic mapping. Nevertheless, widespread adoption has been limited.
**Purpose** To determine the degree of utilization, performance, and outcomes of RMN in a community hospital environment.
**Methods** From January 2006 to July 2007 all patients presenting for mapping/ablation of SVT {AV junction (AVJ), AVNRT, accessory pathway (AP), and non-isthmus-dependent atrial tachycardia (AT)} were considered for RMN with the Stereotaxis system. A 4 mm tip magnetic catheter was used for all RMN cases. 3D mapping was used except in AVJ ablation. A prospective, consecutive cohort of patients was analyzed. Reasons for non-utilization, arrhythmia type, ablation success, crossover to CONV, and complications were recorded.
**Results** 106 mapping/ablation procedures were performed over 18 mo. The RMN system was used in 91 cases (86%). Reasons for non-utilization were: 1. need for alternative ablation catheter (ALTABL) (cryo, irrigated, or 8 mm electrode): 8 (8%) 2. technical problems with RMN 3 (3%) 3. patient size: 2 (2%) or 4. other: 2 (2%). RMN cases included 17 AVJ (16%), 40 AVNRT (38%) , 18 AP (17%), and 16 AT (15%). Success rate without need for CONV was 81% (AVJ 13/17 (76%), AVNRT: 34/40 (85%), AP 14/18 (78%), AT 13/16 (81%). If patients requiring ALTABL for success are excluded, success rates for RMN ablation is 89% (AVJ: 13/14 (93%), AVNRT: 34/37 (92%), AP: 14/16 (88%), AT: 13/16 (81%). No crossovers to 4 mm CONV occurred in the last 5 months of the study. There were 3 (2.8%) complications.
**Conclusions** RMN is effective as a primary method for mapping and ablation for SVT and can replace conventional catheter manipulation. Newer magnetic catheters with large- and irrigated- tip electrodes will enhance implementation of RMN.

## INFLAMMATORY MARKERS AND RENIN-ANGIOTENSIN-ALDOSTERON SYSTEM MARKERS IN ATRIAL TACHYCARDIA PATIENTS TREATED WITH CATHETER ABLATION

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**Background** Recently, the elevation of C-reactive protein (CRP) and raised aldosterone have been well documented in atrial tachycardia and may have direct arrhythmogenic properties. Inflammation and Rennin-angiotensin-aldosteron system (RAAS) activation may be involved in the pathogenesis of atrial arrhythmia. However, the inflammatory reaction and RAAS feedback respond to atrial tachycardia curative treatment are still unclear.
**Purpose** We evaluated the inflammatory markers and RAAS biomarkers in the atrial fibrillation (Af) and atrial flutter (AFL) cases before and after catheter ablation (CA).
**Methods** We measured CRP, white blood cell count (WBC), neutrophil count (NC) and fibrinogen in 49 atrial arrhythmia patients (group A) and 87 non-arrhythmia patients (group N) along with evaluation of brain natriuretic peptide (BNP), plasma renin activity (PRA) and aldosterone. Group A patients were including 10 Af patients and 39 AFL patients. CRP, WBC, NC, fibrinogen, BNP, PRA and aldosterone were compared between group A and group N. In Af patients CA with pulmonary vein isolation were performed and in AFL patients CA with linear ablation of isthmus in right atrium were performed successfully. At 6-month follow up each markers were followed and compared with those at baseline in group A.
**Results** Baseline CRP, WBC, NC, BNP and aldosterone in group A group were higher than those in group N. There was no significant difference of fibrinogen and PRA between two groups. CRP, WBC, NC, fibrinogen and BNP in group A decreased significantly after successful CA. By contrast, PRA and aldosterone did not show significant change at 6-month follow up.
**Conclusions** Our results suggested that inflammation was associated with atrial tachycardia remarkably. Judging from our study curative treatment with catheter ablation may suppress CRP production and neutrophilia lead by atrial tachycardia. Non-pharmacological therapy could reduce BNP release but not inactivate RAAS.

## SAFETY AND EFFICACY OF A CARDIOBLATE MINI-MAZE PROCEDURE IN MITRAL VALVE SURGERY: COMPARISON WITH A MATCHED CONTROL GROUP

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**Purpose** This study is aimed to evaluate early and mid-term results of a "cardioblate" mini-maze procedure combined to mitral valve surgery.
**Materials and methods** Between November 2002 and June 2004, 40 patients with chronic AF underwent a mini-maze procedure (cardioblade system) combined to mitral valve surgery (mini-maze group or MMG). They were compared to 108 patients matched for age, sex, left ventricular function and associated risk factors who underwent isolated mitral surgery in the same period and not affected by preoperative chronic AF (valve group or VG).
**Results** Hospital mortality was 5% (2 patients) in the MMG and 4,6% (5 patients) in the VG (p=NS). Hospital stay was 10,6±4,7 days in MMG and 10,3±4,2 days in VG (p=NS). There was no difference in the mean intensive care unit stay time between the two groups. Mean follow-up was 31,6±4,5 months in the MMG and 30,4±4,5 months in the VG. Three-year survival was 92,5%±0,042 in the MG and 93,2%±0,037 in the VG (p=NS). At the follow-up 31 patients (77.5%) were on sinus rhythm, 8 (20.0%) went back to AF, and 1 (2.5%) required permanent pacing. Three-years freedom from thromboembolic events was 97,4%±0,026 in the MMG and 98,7%±0,031 in the VG (p=NS).
**Conclusion** Our retrospective study shows that the "cardioblate" mini-maze procedure does not increase early and midterm mortality of mitral valve surgery while appears effective in restoring and maintaining the sinus rhythm in a large proportion of patients.

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## PREDICTION OF PAROXYSMAL ATRIAL FIBRILLATION OCCURRENCE WITH P WAVE WAVELET ANALYSIS

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**Purpose** The aim of this study was to evaluate the P wave wavelet analysis with the Morlet wavelet for the prediction of paroxysmal atrial fibrillation (PAF) occurrence.
**Methods** One hundred and forty-five patients (58 males, mean age 61±11 years) with a history of PAF consisted Group I. At the enrollment 60 (41%) patients had the first episode of PAF, while 85 patients (59%) had an AF history of 5.6±4.9 years. The control Group II consisted of 92 individuals (40 males, mean age 60±11) without any history of PAF. The P wave was analyzed using the Morlet wavelet and wavelet parameters expressing the mean and max energy of P wave were calculated in the three orthogonal leads (X, Y, Z) and in the vector magnitude (VM), in three frequency bands (1st: 200-160 Hz, 2nd: 150-100 Hz and 3rd: 90-50 Hz). Left atrial (LA) diameter was calculated from the M-mode parasternal long axis view.
**Results** AF patients were differentiated from normal subjects by the higher mean and max energy values in all frequency bands at Z axis along with lower mean and max energy in the 3rd frequency band at X axis, the longer P wave duration (Pdur) at X, Z axis and VM and the larger LA diameter.
Multivariate logistic regression analysis showed that PdurZ, max energy in the 3rd band at Z axis (max3Z) and similarly the mean energy at X axis (mean3Z), were significant and independent predictors of PAF occurrence. These variables at cut-off values of 82 msec, 33.1 ÏV and 14.7 ÏV respectively had 80% sensitivity, 73% specificity, 77% total predictive value (TPV) with 84% positive PV and 66% negative PV.
**Conclusions** PAF occurrence associated with a different atrial activation pattern that can be explained by the presence of slow and anisotropic conduction.

## DETECTING ATRIAL FIBRILLATION BY RR-INTERVAL VARIABILITY MEASUREMENT AFTER PULMONARY VEIN ISOLATION. A FEASIBILITY STUDY USING NEW DEVICE TECHNOLOGY

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Asymptomatic episodes of atrial fibrillation (AF) are common after pulmonary vein isolation (PVI). The lack of correlation between symptoms and arrhythmias underscores the importance of long-time arrhythmia monitoring. We sought to test AF episodes by using a new external recording device (AF Alarm, Medtronic Inc.).
**Methods and results** The device is employed to monitor AF episodes based on a RR-variance measurement by detecting the R-waves in every 2-minute interval. RR-interval variability histograms are created from delta-RR values. Three parameters were extracted: The number of bins addressed occasionally, the number addressed at least one time and the maximum bin count. When the AF score exceeded a predefined threshold, ECG storage is triggered. When the AF score drops below 80% of the AF threshold, the episode is regarded completed and ECG is stored again.
27 patients (7 female, mean age 58±9 years, 19 with paroxysmal and 8 with persistent AF) who underwent segmental PVI 5-8 months earlier, were included. 9 patients (4 persistent) had documented recurrence by 24-hour ECG at the time of follow-up. One week of continuous home monitoring was performed. Altogether 967 recorded AF episodes were analysed (mean 35.8±18 per patient). Patients were asked to mark every symptomatic AF episode, 7 markings were not done during AF. 11 recordings in 7 patients were considered to be AF, 5 of them (in 4 patients) were symptomatic. 236 recordings were interpreted as premature beats, 30 as atrial tachycardia and 47 as irregular sinus rhythm. Remaining episodes were either due to time triggering (90), noise (236) or device misinterpretation (324).
**Conclusions** Recurrence of AF is common after PVI and can be asymptomatic. Triggered recordings based on RR-variance seem to be feasible to detect AF episodes during follow-up, but the specificity is low due to the frequent premature beats in many patients.

## RISK STRATIFICATION OF ATRIAL FIBRILLATION AFTER CONVENTIONAL AND BEATING HEART CORONARY ARTERY BYPASS SURGERY BY NONINVASIVE METHODS OF INVESTIGATION

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**Background** According to different studies the incidence of atrial fibrillation (AF) after coronary artery bypass grafting (CABG) varies from 5 to 40%, what exceeds its incidence in the general population and in the nonsurgical population of patients with coronary artery disease (CAD). The evidence from both observational and randomized trials on the incidence of AF after conventional and mini-invasive CABG is quite controversial. Postoperative AF can cause hemodynamic instability, embolic phenomenon and increased length of hospital stay. Pathophysiology of postoperative AF is incompletely understood.
**Purpose** To determine incidence of atrial fibrillation (AF) after conventional and off-pump coronary artery bypass grafting (CABG), and identify its predictors.
**Methods and results** 70 patients (pts), all male, underwent isolated CABG. Pts with history of AF, concomitant valve pathology, severe heart failure, thyroid dysfunction were excluded. Total occurrence of AF was 20%, following on-pump CABG 21%, off-pump CABG 19% (p=0,45). Multivariate logistic regression analysis identified following independent predictors: age>58 years (beta=1.9), history of coronary artery disease (CAD) more than 9 years (beta=1.7), signal-averaged P-wave duration (SAPD) more than 155msec (beta=1.8), cardiopulmonary bypass (CPB) time >175 min and aortic cross-clamp time >85 min (beta=1.7) and requirement of intraoperative intra-aortic balloon pump (beta=1.9).
**Conclusion** Increasing age, longer history of CAD and SAPD were most powerful preoperative predictors of postoperative AF. Insignificant difference in the incidence of AF after conventional and beating heart CABG allows assuming that CPB is not the main trigger in the pathophysiology of this arrhythmia.

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## USE OF IMPLANTABLE LOOP RECORDER FOR UNEXPLAINED PALPITATIONS: IS IT COST-EFFECTIVE?

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In subjects with palpitations that remain unexplained after initial evaluation, conventional diagnostic strategy (CDS) includes Holter recording, ECG recorders (ER), and electrophysiological study (EPS). Aim of our prospective, randomized study was to compare the cost-effectiveness ratio of implantable loop recorders (ILR) and CDS in patients with unexplained palpitations.

**Methods** We studied 50 consecutive patients without severe structural heart disease (SHD) (ejection fraction>35%), with infrequent (<=1 episode per month), sustained (>1 minute), clinically significant palpitations remained unexplained after initial evaluation.

Patients were randomized either to CDS (n=24) or ILR implantation (Reveal Plus®, Medtronic) (n=26) with 1-year monitoring. Full hospital costs of each investigation were calculated: staff involved; equipment used; electrophysiology room; removal procedure in the case of ILR.

**Results** A diagnosis was obtained in 5 patients in CDS group, and in 19 in ILR group (21% vs 73%, p<0.001). No deaths or significant adverse events were observed.

The mean cost per patient was significantly higher (€2,233±€265 vs €1,410±€1,389, p<0.001), while the mean cost per diagnosis was significantly lower (€3,056±€363 vs €6,768±€6,672, p=0.012) in ILR group than in CDS group. The incremental cost-effectiveness ratio for ILR strategy was low (€1,576) in relation to the costs of further investigations and acute events management, which are necessary when the diagnoses are fewer. Sensitivity analysis showed that the mean cost per diagnosis remained significantly lower in ILR group, except for EPS 50%. Data confirm that EPS constituted the main driver of cost in CDS, and that it is not cost-effective in patients without SHD.

**Conclusions** In subjects without severe SHD and with infrequent palpitations, ILR is a safe and more cost-effective diagnostic approach than CDS, and it may be a useful primary strategy in the evaluation of these patients.

## BIATRIAL PACING WITH ACTIVE FIXATION IN THE PROXIMAL CORONARY SINUS

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**Background** Paroxysmal atrial fibrillation is a potential and recurrent problem in patients with and without a sick sinus syndrome. To reduce the occurrence of paroxysmal atrial fibrillation in these patients special algorithms, septal pacing and bi-atrial pacing has been proposed. Atrial lead tip positioning was selected in the coronary sinus (CS).

**Aim** To evaluate the implant of a new combination of pacing lead positions and an atrial pacing algorithm, with respect to the clinical success of bi-atrial pacing.

**Methods** A bi-atrial pacemaker (Stratos LA, Biotronik) with special algorithms for preventive pacing was implanted in combination two atrial leads: one standard lead in the right atrium (auricular or lateral wall) and the other in the proximal (or distal) CS for left atrial stimulation. Active fixation leads were used in the CS position (Medtronic 3830 a 4Fr lumen less pacing lead). A signal ratio between atrium and ventricle>4 was preferred in the CS. Patients could express their clinical status with respect to atrial arrhythmias on a scale of 1-10.

**Results** In 10 pts (60±11 year old, all men) implant was successful. Procedure and fluoroscopy times of the pacemaker implant were respectively 90±28 (range 60-50) and 13±8 (range 5-31) min. Threshold and sensing values of the CS lead were 1,0±0,5 (range 0,5-2,0) Volt at 0,5 ms and 2,9±1,9 (range 0,5-5,5) mV. Patients improved in their clinical status from 3,7±1,7 (range 1-6) to 7,6±1,4 (range 6-10). However, 1 patient developed persistent atrial fibrillation and another complained still of paroxysmal atrial fibrillation.

Conclusions In general a successful implant and beneficial effect was seen of bi-atrial pacing, special preventive pacing algorithms in combination with the active fixation of the left atrial lead in the coronary sinus.

## CARDIAC RESYNCHRONIZATION THERAPY IN PATIENTS WITH ATRIAL FIBRILLATION WITHOUT ATRIOVENTRICULAR NODE ABLATION

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**Background** The role of cardiac resynchronization therapy (CRT) in patients with atrial fibrillation treated with medication for heart control has been poorly evaluated.

**Objectives** The aim of this study was to compare the effects of CRT on ventricular function and reverse remodeling in heart failure patients with sinus rhythm (SR) and permanent atrial fibrillation (AF) who do not undergo atrioventricular (AV) junction ablation.

**Methods** We assessed left ventricule (LV) dyssynchrony (by M-mode echocardiography and tissue Doppler imaging) and LV function at baseline and after 6 months implantation of a biventricular pacemaker.

**Results** 55 patients were included: 15 were on AF and 40 were on SR. There were no differences on baseline QRS wide, LV function, and echocardiographic dyssynchrony. Device programming, QRS wide reduction, and ventricular dyssynchrony after biventricular pacing were similar. A significant improvement on end-systolic volume (ESV) and ejection fraction (EF) were observed in both groups. However patients on SR showed higher reverse remodeling (ESV reduction 30.9±24.6% versus 12.5±18.6%; p=0.024) and relative increasing in ejection fraction (5.0±7.2% versus 15.4±12.6%; p=0.010).

**Conclusions** Heart failure patients with permanent AF treated with CRT and no AV junctional ablation showed improvements of left ventricular function and reverse remodeling, but this improvement was lower than observed in patients in SR.

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## FREEDOM (A FREQUENT OPTIMIZATION STUDY USING THE QUICKOPTTM METHOD) STUDY DESIGN

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Cardiac resynchronization therapy (CRT) through simultaneous biventricular (BiV) pacing has emerged as an effective treatment in patients (pts) with heart failure (HF). Paced and sensed atrio-ventricular (AV) delays in CRT are critical parameters for hemodynamic performance. Clinical studies have also shown that optimization of the inter-ventricular (VV) pacing delay during BiV pacing can incrementally improve acutely the cardiac function over simultaneous BiV pacing. However, due to limitations (i.e. lengthy and expensive procedures) of currently utilized optimization procedures, not all pts have these delays optimized. Additionally, recent studies have shown that AV and VV delays change over time and the delays may have to be re-optimized periodically to maintain and possibly improve the benefit of CRT in these pts. The FREEDOM study is thus designed to prospectively evaluate the clinical benefits of regular AV and VV delay optimization in pts with CRT-D devices.

FREEDOM is an international, prospective, double blind, randomized multicenter study in which 1500 pts implanted with a CRT-D system will be enrolled. At enrollment, pts will be randomized to either the periodic AV and VV optimization arm (at enrollment, 3, 6, 9 and 12 months) or the control arm (i.e. standard of care, limited to a maximum of a one time optimization using any non- intracardiac electrogram (IEGM) based method). This study will utilize the novel IEGM based algorithm (QuickOpt, St Jude Medical) to estimate pt specific optimal AV and VV delays in the treatment arm. The primary and secondary endpoints for the study are a HF clinical composite score and all-cause, cardiovascular mortality/hospitalization, respectively.

FREEDOM represents the first large prospective randomized trial evaluating the clinical benefits of frequent AV and VV optimization in CRT-D pts. Results from the FREEDOM trial will provide evidence-based guidance for the future management of CRT pt and is actively recruiting pts.

## COMPARISON OF THE OPTIMIZED V-V INTERVAL DETERMINED BY INTERVENTRICULAR CONDUCTION TIMES VERSUS INVASIVE MEASUREMENT OF LV DP/DTMAX

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**Background** In devices for cardiac resynchronization (CRT) an algorithm using the interventricular conduction times is incorporated for optimization of the interventricular pacing (V-V) interval. We compared the outcome the calculated optimal V-V interval of this algorithm using the interventricular conduction (IVC) measurements at implant with the optimized V-V interval obtained by invasive measurement of LV dP/dtmax.

**Methods** In 32 patients, 5 females, age 67.5±7.8 years, with heart failure, CRT devices were implanted. After implantation of the atrial lead, right ventricular lead and left ventricular lead in one of the postero-lateral tributaries of the coronary sinus the intrinsic interventricular conduction time (RVs-LVs), the LV pace-RVsense (LVp-RVs) and the RVpace-LVsense (RVp-LVs)interval were measured. The optimal V-V interval was calculated employing the formula V-V interval=0.5 {RVs-LVs + (LVp-RVs - RVp-LVs)} ms. The optimized V-V interval was also determined by invasive measurement of LV dP/dtmax using the RADI pressure wire.

**Results** The optimal V-V interval calculated from the IVC intervals was 52.7±18 ms and determined by LVdP/dt measurements 24.1±32.7 ms (p=0.0001). The average value of the LVdP/dtmax at invasive optimization was 945±188 mm Hg/s. The corresponding value of LVdP/dtmax at the V-V interval calculated from IVC intervals was 914±202 mm Hg/s (p=0.003). The baseline LV dP/dtmax was 750±163 mm Hg/s. The increase in LVdP/dtmax by using IVC intervals was 21.8% and by LVdP/dt measurement 26.0%.

**Conclusion** There is a significant difference in the optimal V-V interval determined by IVC intervals and optimal V-V interval determined by LV dP/dtmax measurement. This difference in optimal V-V interval gives also rise to a significant difference of the LVdP/dt max at the corresponding V-V intervals.

## PREDICTION OF OPTIMAL ATRIOVENTRICULAR DELAY IN PATIENTS WITH CARDIAC RESYNCHRONIZATION THERAPY USING PHONOCARDIOGRAM

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**Introduction** This study was aimed to predict optimal atrioventricular (AV) delay in patients with cardiac resynchronization therapy using phonocardiogram.

**Methods used** The amplitude of first heart sound (S1) recorded phonocardiogram was measured with different AV delays. AV delay was prolonged stepwise by 20 msec ranging from 60 msec to 240 msec in six patents implanted with biventricular pacemakers. We analyzed the relation between amplitude of S1 with various length of AV delays and the predicted optimal AV delay using pulse Dopplered echocardiography.

**Summary of results** The correlation between the amplitude of S1 and the length of AV delay was showed cubic curve ($y=-0.0004x^3+0.0137x^2-0.084x+0.5323$, $R^2=0.9422$). The length of AV delay at the inflection point of this cubic curve showed a significant positive correlation with the optimal AV delay determined by echocardiography ($R=0.9231$, $P<0.01$).

**Conclusions** This study revealed that optimal AV delay in patients with cardiac resynchronization therapy could be predicted using phonocardiogram.

## CAN INTRACARDIAC IMPEDANCE BE A TOOL FOR CARDIAC RESYNCHRONIZATION THERAPY OPTIMIZATION?

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**Purpose** The feasibility of optimizing the coronary sinus lead implant position (CSIP) and the atrio-ventricular delay (AVD) in CRT implants using intracardiac impedance measurement was evaluated.

**Methods** During implantation of a CRT device, 11 patients (10 male, NYHA 10xIII 1xII, EF: 26.5±6.7%, QRS: 165±35 ms, age: 70.4±5 years), underwent a transient pacing protocol (AAI/DDD-BiV) with variation of CSIP and AVD. LV pressure was measured using a micromanometer catheter. Pacing and LV admittance measurements were performed using an external pacemaker. The parameters LV dP/dtmax, end diastolic admittance (EDY) and end systolic admittance (ESY) were determined at BiV and AAI pacing. The best CSIP and AVD were determined by the maximum relative benefit of dP/dtmax and admittance parameters for BiV pacing.

**Results** The observed dP/dtmax benefit due to BiV pacing varied between 6±23% for the worst and 16±24% for the best CSIP, and

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between 10±18% for the worst and 19±21% for the best AVD. The dP/dtmax benefit for the best and worst values were significantly different (p<0.01). The best admittance parameters were EDY and ESY for CSIP and AVD optimization respectively. The achieved dP/dtmax benefit by admittance optimization was only 0.1±0.3% (CSIP) and 2.1±3.1% (AVD) below the maximum possible value. The absolute dP/dtmax during BiV pacing, when optimized by dP/dtmax (778±175/860±260 mm Hg/s for CSIP/AVD), and when optimized by admittance (792±169/880±230 mm Hg/s for CSIP/AVD) were not significantly different. The difference of AVD selected by both methods was 9±21ms, the CSIP were identical besides one patient, where the difference in dP/dtmax benefit between the sites was only 1%.
**Conclusions** The achieved dP/dtmax during BiV pacing was not significantly different when CSIP and AVD were selected by dP/dtmax or by admittance. The difference in the achieved dP/dtmax benefit was not clinically relevant. LV admittance is a potential method for automatic CSIP and AVD optimization.

## THE IMPORTANCE OF HEMODYNAMIC OPTIMIZATION IN CRT DEVICES: A POSSIBILITY TO CONVERT A PRIMARY NON-RESPONDER INTO A RESPONDER

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**Objective** The positive effect of CRT in selected patients is well proven. This invasive investigation was performed for system optimization to improve cardiac contractility. We used an intraventricular beat to beat analyses of the left ventricular pressure slope (LVdP/dt).
**Methods** 18 patients with the age of 65±8 years were included. One group with a QRS>150 ms the other with a moderate QRS duration between 120 and 150 ms. In the first group were 7 patients (QRS 134±9 ms, EF 23,25±4,6%), in the second group were 11 patients (QRS 179±17 ms, EF 24,38±6,2%). After implantation of a CRT device a pressure wire was positioned in the left ventricle. The LVP was measured beat to beat and LVdP/dt was calculated online. For standard stimulation an av-time of 120 ms and a vv-time of 0 ms were defined. Measurements were performed different av- and vv-delays. Hemodynamic data were compared during intrinsic conduction and biventricular pacing. A patient with an increase in LVdP/dt>10% was defined as a responder.
**Results** In the group with moderate QRS there was no primary responder under standard condition with an increase in LVdP/dt of 1,72±8%. With av-time optimization the LVdP/dt increase was 7,38±6%, under vv-time optimization by 6,8±7%. By optimizing the av- and vv-time the LVdP/dt increased by 12,91±7% (responder, p=0,03). In the group with QRS>150 ms there was a significant increase in contractility under standard conditions, LVdP/dt increased by 13,8±10% (p=0,04 responder). With av-time optimization the LVdP/dt increased by 18,8±11%, with vv-time optimization by 19,8±12% but by optimizing av- and vv-time the LVdP/dt increased by 24,3±15% (p=0,03).
**Conclusion** The benefit of av- and vv-optimization was seen in all patients. It was more important in patients with moderate QRS duration because there were the higher amount of non responders. It offers a possibility to convert a primary non responder into a responder.

## SHOULD WE PROGRAM A RATE ADAPTIVE AV DELAY IN BIVENTRICULAR HEART FAILURE PACING?

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By diastolic optimisation, the hemodynamically optimal AV delay (AVD) can generally be defined by the sum of individually measured implant-related interatrial conduction time (IACT), duration of the left atrial electromechanical action (LAEA) and duration of the left ventricular latency period (LVLP) using the formula AVD = IACT + LAEA - LVLP.
**Aims** To measure the influence of the AVD determinants on the total duration of the optimal AVD during rest and submaximal exercise in biventricular paced heart failure (HF) patients.
Methods: By simultaneously recording transmitral flow velocity and an esophageal left atrial electrogram on the echo monitor, we separately measured the duration of the three AVD determinants and calculated the optimal AVDs for VDD and DDD operation in 20 biventricular paced heart failure patients (mean age: 64.0+10.7 years) during rest and submaximal ergometric exercise.
**Results** During ergometric exercise-related mean rate increase of 22.5±9.6 bpm, the three determinants and the resulting optimal AVDs showed the following behaviour: IACTs in VDD and DDD operation varied by 3.1±12.0 ms (p=0.254) and 0.6±4.9 ms (p=0.594), resp. Major variations of -0.7±16.1 ms (p=0,008) were found in the duration of LAEA. In contrast, the duration of LVLP varied by -0.3±15.1 ms (p=0.705), only. The resulting AVD variations were -6.2±16.1 ms (p=0.101) and -8.8±14.5 ms (p=0.014) in VDD and DDD operation, resp.
**Conclusions** In biventricular HF pacing, 1. AVD variations during exercise are mainly caused by a significant rate-responsive shortening of the LAEA duration. Nevertheless, 2. rate-response and resulting variations of the total AV delay in VDD and DDD pacing are small. 3. This results justify to either program very low rate-responsive shortening or to switch off the rate adaptation of the AVD in HF pacing.

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## GENDER-RELATED DIFFERENCES IN CATHETER ABLATION OF ATRIAL FIBRILLATION

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Women have an increased risk for atrial fibrillation (AF)-related complications and there is evidence toward a reduced efficacy of the rhythm control strategy than men. A catheter-based strategy is therefore widely attractive, but the impact of gender on catheter ablation (CA) of AF remains undefined.
**Methods** We included 221 consecutive patients (150 men) who underwent CA of drug-refractory AF. Gender differences in clinical presentation and outcomes were compared.
**Results** Women were older (P=0.002), had a longer history of AF (P=0.04) and were more likely to have hypertension (P=0.04). Moreover a concomitant valvular heart disease tended to be more common in women (32.4% vs 23.3%; P=0.28) and left atrium dimensions were significantly larger (P=0.003). However acute success rate and complications rate were similar between genders. After 22.5±11.8 months of follow-up, the overall freedom from arrhythmia recurrences was not dissimilar (83.1% vs 82.7% in men), and a similar improvement in SF-36 quality of life scores was achieved in both groups.
**Conclusion** Women are referred for AF ablation later with a more complex clinical preoperative presentation. Despite this higher risk profile in women, no differences were detected in clinical outcomes. Our findings indicate that CA of AF appears to be as safe and effective in women as in men.

## ANATOMICAL AND ELECTROPHYSIOLOGICAL FEATURES OF ATRIAL FIBRILLATION IN YOUNG PATIENTS

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**Purpose** To reveal the predispositions for arrhythmia development in young patients with atrial fibrillation (AF).
**Material and methods** From February 2000 to June 2007 443 patients (320 men and 109 women, age 9-70 years, mean age 46,4±11,6 years). Underwent radiofrequency ablation of the LV ostia and/or the LA. Among them 33 patients were under 35 years of age (mean age 27,5±5,6 years). In this group paroxysmal form AF was in 12 (36,4%), persistent AF in 5 (15,2%), stable AF in 8 (24,2%), atrial tachycardia from the PV in 8 (24,2%). All patients underwent spiral computer angiography (SCT AG) of the LA and the PV. We made analysis of SCT AG data in patients under 35 years of age (group 1) and of the comparable group of older patients (group 2) – 30 patients (mean age 49,4±8,0 years).
**Results** Mean LA volume in group 1 was 82,6±29,5 ml, which is significantly lower than in group 2 – 100,1±8,3 (∂<0,03). Right pulmonary veins were significantly larger in patients under 35 years, than in the comparison group, while left pulmonary veins and collectors also were larger, but the difference was not significant. Common collector of the left pulmonary veins was a significantly more frequent finding in patients under 35 – in 12 (37,5%) cases, while in older patients – only in 4 (13,8%) cases (∂<0,03).
**Conclusion** The LA volume in young patients is significantly lower in comparison with older patients. At the same time, frequent presence of left pulmonary veins' collector and large pulmonary veins are predisposing factors for AF development in this category of patients.

## ANALYSIS OF THE NEUROHORMONAL PROFILE IN A POPULATION UNDERGONE ATRIAL FIBRILLATION ABLATION

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**Background** Ablation is a new and growing therapy to face atrial fibrillation (AF) and its results are bettering, even if techniques used are quite different. There are no results about the real benefit of the rhythm restoration and about hemodinamic and neurohormonal variations in patients undergone this kind of treatment.
**Methods and results** One hundred patients affected by parossistic or persistent AF were subjected to circumferential ablation of pulmonary veins + left atrial lines; we organized a follow-up of these patients at 2,6 and 12 months in order to estimate the hemodinamic compensation through a clinic examination, echocardiography (EF in % increased from 51±8 at baseline to 58±4 at 12 months, p<0,001; Volume [ml] changed from 38±17 at baseline to 50±17 at 2 months, to 47±20 at 6 months and to 39±27 at 1 year, p<0,001) and neurohormonal profile (BNP, endothelin, TNF alpha, aldosterone etc.). BNP values changed from 54,9±75 [pg/ml] at baseline to 42,8±51,2 at 2 months, to 44,2±60 at 6 months and to 27,6±39 at 1 year, p<0,01).
**Conclusions** In patients with AF subjected to ablation we can observe that in follow-up visits the hemodinamic compensation is bettering, the ejection fraction increased, atrial dimensions diminished and BNP profile improved.

## ATRIAL FIBRILLATION ABLATION SUPPORTED BY IMAGING INTEGRATION: ACCURACY AND RADIATION EXPOSURE COMPARING ECG-GATED WITH NON-GATED COMPUTED TOMOGRAPHY IMAGES

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Pulmonary vein (PV) anatomy is clearly defined by imaging integration to support atrial fibrillation (AF) ablation. However, radiation exposure (RE) related to pre-procedure computed tomography (CT) is an important issue.
**Aim** To assess the accuracy in identification of the PV ostia by imaging integration with CartoMerge and to assess RE comparing ECG-gated with non-gated 64-slice CT images. Methods: 44 AF pts (33 M; age 59+7 yrs) submitted to PV electrical isolation (EI) were considered: 30 pts underwent ECG-gated CT (Group-1) and 14 pts to non-gated CT (Group-2), respectively. The match accuracy between the electroanatomic mapping (EAM) and CT images was defined both by manual (excellent match if maximum distance –MD– between correspondent CT/EAM PV ostia was <2mm, acceptable if 2<MD<5mm, unacceptable if MD>5mm) and automatic calculations.
**Results** Match was excellent in 95/118 (80.5%) PVs in Group-1 and in 47/54 (87%) PVs in Group-2. Match was unacceptable in 15/118 (13%) PVs in Group-1 and in 4/54 (7%) PVs in Group-2. Match was excellent and/or acceptable in >3 PV ostia in 25/30 pts (83%) in Group-1 and in 12/14 pts (86%) in Group-2: in each group the mean distance between the 2 surfaces was significantly inferior to that observed

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in the pts with a mismatch of >2 PV ostia (Group-1 2+0.3 mm vs 2.5+0.5 mm; p=0.017/Group-2 1.8+0.2 mm vs 2.5+0.2 mm; p<0.01). Match accuracy was independent from the type of rhythm during CT/EAM acquisitions, the number of EAM points and LA volume in both groups. RE was 10-13 mS in Group-1, while 0.7-1.7 mS in Group-2 (p<0.001). Successful EI was achieved in all the targeted PVs.
**Conclusions** In our population integration of both ECG-gated and non-gated CT images with EAM results in excellent match in >80% of the PV ostia allowing real-time guided ablation in most pts. Non-gated CT is associated with a significantly decreased RE.

## CORONARY SINUS AS CRITICAL COMPONENT OF ATYPICAL ATRIAL FLUTTER IN PATIENTS AFTER RFA OF ATRIAL FIBRILLATION

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**Purpose** To access role of coronary sinus (CS) as component of atypical atrial flutter (AAF) reentry circuit after RFA of atrial fibrillation (AFib) pts.
**Methods** Study was conducted on 102 consecutive patients (44 women, 54.3±13.6 years of age) with the paroxysmal (51%), persistent (22%) and chronic (27%) AFib underwent RFA guided by CARTO system. AAF manifested in 22 (22%) pts after primary RF-ablation in the period of 23±15 days. Electrical and/or drug cardioversion was effective in 13 pts. Repeated RFA was performed in 9 (9%) pts with sustained drug-refractory AAF.
**Results** Activation mapping guided by CARTO system revealed reentry circuits (cycle length – 220 and 230 ms) at the vicinity of right pulmonary veins in 2 pts and atrial perimitral reentry with mean cycle length of 240±15 ms in 7 pts. Left mitral isthmus-dependent AAF was verified by entrainment technique and successfully ablated in those 7 cases. Distal CS RF-isolation (12-1 to 3 clock on LAO projection) was performed in all cases as first step without any corresponding cycle length changes of AAF. As a second step AAF was terminated during left mitral ablation only in 2 pts. As a third step linear RF-lessions from right pulmonary vein ostium to mitral annulus was performed and turned out to be associated with increasing of AAF cycle length (from 240±10 ms to 340±20 ms, p<0.001) in 5 cases. Additional RF-application applied inside the proximal CS roof (fourth-step) terminated AAF in 5 pts. There was no arrhythmias induction while of control left auricular burst and programmed stimulation. Follow up was 6.7±2.4 mos. There were neither AFib nor AAF during follow up observed.
**Conclusion** Structures of proximal CS corresponding to low common pathway insertion could be critical part of reentry circuit in some cases of atypical atrial flutter in pts after RFA of AFib.

## INTERVENTIONAL TREATMENT OF ATRIAL FIBRILLATION IN PATIENTS WITH COMMON PULMONARY VEINS' COLLECTOR

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**Purpose of study** To analyze arrhythmogenic properties of the pulmonary veins (PV) and to evaluate the effectiveness of interventional treatment of different forms of atrial fibrillation (AF) and ectopic atrial tachycardia in the presence of left pulmonary venous collector (LPVC).
**Material and Methods** From 2000 to March 2007 447 patients with atrial fibrillation have been operated in the Bakoulev Center. Spiral CT revealed left PV collector in 73 of them. Prophylactic therapy with class I-III antiarrhythmic drugs proved ineffective in all patients. Paroxysmal AF was revealed in 49 (67,2%) patients, among them 17 (23,2%) patients had persistent AF, chronic AF – in 6 (8,2%). The average diameter of the left PV collectors was 29,5±3,7mm. We noted the prevalence of male patients in the total group of AF (76% men). In the group of patients with paroxysmal AF and LPVC sex distribution of patients was evened (53% and 47%).
**Results** In patients with paroxysmal AF and LAT, LPVC had arrhythmogenic properties in 33 cases (67,3%). In the group with persistent AF, arrhythmogenic properties of LPVC were revealed in 9 patients (60%). Spontaneous arrhythmogenesis did not occur during RFA in neither pulmonary vein in 12 (24,4%) patients with paroxysmal AF and in 6 patients (40%) with persistent AF. During the early follow-up the effectiveness after one procedure was 67% (49 patients), after two procedures -98%.
**Conclusions** The treatment of patients with AF and PV collector is associated with difficulties, caused by large dimensions of PV collectors. LPVC always possesses arrhythmogenic properties and either initiates arrhythmia, or contributes to its maintenance. Two-stage approach significantly increases the effectiveness of treatment of such patients using cooled RFA method.

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## SITE SPECIFIC ATRIAL FIBROSIS IN MYOTONIC DYSTROPHY PATIENTS AND EFFECTS ON ATRIAL PACEMAKER LEAD

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Unaffected myocardium in Myotonic Dystrophy type 1 (MD1) patients is progressively replaced by scar, causing pacemaker (PMK) sensing and pacing defects. Aim of this study was to identify the optimal site for atrial lead implantation.

**Methods** Twenty-two consecutive patients (15 males; 32±7 years) necessitating PMK implantation were enrolled in the present study. The atrial pacing lead was positioned in the high lateral right atrial wall (Site A), then in the right atrial appendage (Site B) and finally on the right side of the interatrial septum (Site C). Correct localization was confirmed by fluoroscopic imaging and paced P wave configuration.

**Results** Mean pacing threshold, at a pacing pulse width of 0.5 sec, were 1.46±0.32 V at Site A, 1.45±0.33 V at Site B and 0.84±0.24 V at Site C. The P wave amplitude was 1.52±0.45 mV at Site A, 1.52±0.49 mV at Site B and 2.60±0.48 mV at Site C. Atrial lead was implanted and fixed at Site C in all patients without complications.

**Conclusions** Interatrial septum in MD1 patients seems to be less affected by fibrosis than other sites. To avoid sensing and pacing defects, atrial lead in MD1 patients can be safely inserted in the interatrial septum using an active fixation lead.

## HIGH INCIDENCE OF CARDIAC COMPLICATIONS EVEN IN THE ABSENCE OF MUSCULAR INVOLVEMENT IN LIMB GIRDLE MUSCULAR DYSTROPHY TYPE 1B

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**Introduction** Limb girdle muscular dystrophy type 1B due to Lamin A/C gene mutation is characterized by proximal muscle weakness, dilated cardiomyopathy (DCM), AVB, dysrhythmias and a high risk of sudden death. Cardiologists are infrequently confronted with this genetic disease. However its diagnosis is crucial for cardiac management. We report a novel mutation responsible of severe cardiac complications.

**Methods** The index case and 12 relatives underwent examination both by a neurologist and a cardiologist. They all had: Echocardiogram, ECG, and Holter monitoring. After genetic counselling, blood sample was sent for genetic analysis.

**Results** Seven patients carried the same new lamin A/C mutation (IVS9-3C>G): 3 were affected and 4 were unaffected carriers. The index case was a 62 y/o female that had a severe form with symptomatic atrial fibrillation (AF) since age 30, high degree AVB at age 40 leading to pacemaker (PM) implantation and late-onset proximal limb weakness. Her 64 y/o brother had dysrhythmias at age 31 and a PM for AVB at age 43. Later, he developed AF and DCM (LVEF=30%), leading to ICD implantation. Another brother and a sister presented sudden death respectively at age 51 and 55. Another family member 29 y/o male presented syncope at age 18 and a PM implantation ten years later for AVB. Two asymptomatic subjects (39 y/o male, 34 y/o female) had documented low degree AVB. Two males aged 30 and 33 years are asymptomatic carriers with normal ECG, Holter, and echocardiogram.

**Conclusion** This study shows a new gene mutation with severe cardiac complications. The problem is how to manage the 4 young unaffected carriers? There is no satisfactory answer. But associated arrhythmias, DCM and AVB should be an incentive for cardiologists to be aware of this rarely recognized disease and maybe to consider an ICD rather than a PM for these patients.

## SCN5A IVS2 –24 C>T MUTATION UNDERLYING LOW RISK BRUGADA SYNDROME: A GENOTYPE-PHENOTYPE STUDY

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**Background** Brugada syndrome is a potentially fatal inherited arrhythmogenic disease. The first and only gene linked to this disease is SCN5A gene that encodes for the alpha subunit of the cardiac sodium channel. The genetic bases and pathogenesis of the disease has been progressively unveiled and shown to have an extremely high degree of genetic heterogeneity. Current risk stratification is only based on anamnestic, clinical and instrumental issues. The development of genotype-phenotype correlation study, by identifying high risk mutation, could be a key advance for the growing integration of clinical and genetics data in risk assessment of patient with Brugada syndrome.

**Methods and Results** We carried out a genetic screening of SCN5a gene in 20 unrelated Italian patients with clinically diagnosed Brugada syndrome using automatic direct sequencing. In two patients we identified the previous described IVS2 –24 c>t heterozygous mutation that we are currently functionally evaluating. Notably both patients showed the same clinical characteristics: no familiarity for sudden death, a type 1 Brugada ECG pattern, a negative electrophysiological study and a positive flecainide test.

**Conclusions** This is the first report that investigates the genotype-phenotype relationship of the IVS2 –24 c>t mutation. Our findings suggest that subjects carrying the IVS2 –24 c>t mutation in the SCN5A gene are at low-risk to develop malignant tachyarrhythmias.

## ARRHYTHMOGENIC LEFT VENTRICULAR NONCOMPACTION: CLINICAL FEATURES, DEVICE THERAPY, AND FOLLOW-UP

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**Purpose** Left ventricular noncompaction (LVNC) is an inherited cardiomyopathy characterized by trabeculations and deep recesses within the endomyocardium. LVNC may be manifested by arrhythmias and sudden death, heart failure, and thromboembolism. We report our experience with LVNC patients with ventricular arrhythmias associated with normal and reduced left ventricular systolic function, and with and without delayed gadolinium hyperenhancement (DE) on cardiac magnetic resonance imaging (CMR).

**Methods** LVNC was diagnosed if CMR showed a noncompacted endocardial layer which was twice as thick as the compacted segment at end-systole. Patients had an echocardiogram (ECHO) performed prior to CMR. Subjects were excluded if they had clinically significant coexisting cardiac disease.

**Results** Since 2002 CMR identified 59 patients with LVNC at our center; in 29 patients LVNC was not identified by prior ECHO. Average age was 47 years (range 11-82) and 30 were male. Of the 59 patients, 33 had normal left ventricular systolic function (non-dilated, LVEF>55%) and no DE on CMR (NORMAL), and 26 patients had left ventricular systolic dysfunction (mean LVEF=36%±0.5) and DE on

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CMR (ABNORMAL). Ventricular arrhythmias occurred in 12 of the 33 NORMAL patients including ventricular fibrillation (VF; n=1), ventricular tachycardia (VT; n=7), and ventricular ectopy (VPC; n=4); 5 of these 12 patients presented with syncope and 9 received implantable cardioverter defibrillators (ICD). Of the 26 ABNORMAL patients, 8 had VT and received ICDs. During 33±15 months of follow-up, all patients were alive; 2 NORMAL patients received ICD therapy (1 shock; 1 antitachycardia pacing) and 2 ABNORMAL patients were appropriately shocked.

**Conclusions** Potentially lethal ventricular arrhythmias are common in patients who have LVNC. The absence of left ventricular systolic dysfunction and delayed gadolinium hyperenhancement (fibrosis) does not predict which patients are at risk for VT/VF and sudden death. ECHO may miss LVNC and thus CMR should be considered for patients who have primary or idiopathic VT/VF.

## QT PROLONGATION OF POST PREMATURE BEATS IN NORMAL SUBJECTS DURING HOLTER MONITORING

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In pt with and without the long QT syndrome, changes in repolarizaton morphology occur after premature beats (PBs). However, changes in repolarization duration after PBs have not been well characterized. Because we noted that some of our gene carriers without manifest long QT developed significant QT prolongation after a PB, we wondered if such an observation might provide a new diagnostic tool. However, in order to use this observation clinically, the maximal duration of QT prolongation after PBs must be characterized first in normals, and then examined and compared in gene carriers of the long QT syndrome without ECG manifestations during sinus rhythm (SR). Towards this first step, we determined the change in QT interval that occurred after atrial and ventricular PBs in 166 patients (pt) with normal QT on ECG who underwent Holter monitoring (HM) for evaluation of non-specific symptoms and whose HM showed normal conduction and repolarization during SR. For each pt, QT was measured for sinus cycles preceding all PBs, for all PBs, and for the post PB sinus beat. Data were subgrouped for atrial and ventricular PBs. Results: the QT of the post PBs increased following atrial and ventricular PBs in many but not all pts; was variable among pts and in a single pt during a 24 hr cycle; decreased as the coupling interval (CI) decreased; tended to be shorter after ventricular PBs than after atrial for any given CL (consistent with the repolarization-shortening effect of wide QRS complexes); BUT IMPORTENTLY, WAS NEVER LONGER THAN 480 ms. Conclusions: the QT interval post PBs can lengthen but in normals does not appear to exceed 480 ms. If further characterization in long QT gene carriers demonstrates greater prolongation, despite normal QT values in SR, this may provide a new electrocardiographic diagnostic clue for this condition.

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## LEFT VENTRICULAR PACING. IS IT ENOUGH?

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**Background** Recent arguments support the concept that left ventricular pacing (LVP) alone by reversing intra ventricular dyssynchrony may be sufficient to improve LV function and clinical status to the same extent as BVP.
**Objectives** To compare the short term clinical and hemdoynamic variables obtained by LVP and BVP in pts with advanced HF.
**Patients and Methods** Twenty seven pts with a mean age of 51.19+11.09 yrs with severe HF and ventricular dyssynchrony as evidenced by QRS duration>150 ms and/or intra ventricular mechanical delay (IVMD)>60 ms by Tissue Doppler (TDI) were subjected to baseline clinical and echocardiographic assessment. After implantation of a multisite pacing device, all pts. were randomized into two phases (3 months each) of LV and BV pacing in a crossover design and at the end of each phase clinical and echocardiographic assessment were repeated.
**Results** Compared to baseline, both LVP and BVP caused similar significant improvement in EF% from 28.7+4.9% to 37.6+6.4% (P<0.001) and 39.1+8% (P<0.001) and in mitral regurgitation area from 6.7+4.9 $cm^2$ to 5.2+4.3 $cm^2$ (P=0.005) and 4.4+4.6 $cm^2$ (P<0.001) for LVP and BVP respectively. Both modes of pacing resulted in reverse remodeling as evidenced by significant reduction of LVEDD as well as significant reduction in LVESD. Both LVP and BVP resulted in similar significant increase in the diastolic filling time from 224+78 ms to 282+87 ms (P=0.002) and 296+107 ms (P=0.001) for LVP and BVP respectively. Although BVP alone resulted in significant shortening in the QRS width, yet both modes of pacing induced significant reduction of IVMD. Both modes resulted in almost the same degree of clinical improvement.
**Conclusion** Our data show that LV pacing could achieve similar though insignificantly less improvement in EF% and LV dimensions and MR area.

## EFFECTS OF SINGLE-SITE LEFT-VENTRICULAR PACING VERSUS BIVENTRICULAR PACING IN PATIENTS WITH IDIOPATHIC DILATED CARDIOMYOPATHY

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**Introduction** Single-site left-ventricular pacing {LVP} results in acute hemodynamic benefit that is comparable to biventricular pacing {BV}. However, the long-term effects of LVP and its influence on ventricular dyssynchrony are still not well known. In order to avoid the influence of post-infarction scars on ventricular activation, this issue was studied only in patients with idiopathic dilated cardiomyopathy {DCM}.
**Methods** A total of 27 patients with DCM and conventional indication for CRT were included in the study. They were randomized to either BV or LVP, and clinical and echocardiographic outcomes were studied every 3months. Clinical responders were defined by improvement of NYHA class >1.
**Results** The baseline characteristics were comparable between groups. Although both BV and LVP were associated with improvement in NYHA class and the distance during 6-min walk test, LVP was superior to BV. The number of non-responders was 4/13 in BV and 2/14 in LVP group (p=0.006). Considerable reduction in mitral regurgitation and increase in LVEF was observed during LVP only. There was a trend toward reduction of LVEDD in both groups. Interestingly, both LVP and BV prolonged significantly preejection period of the right ventricle without corresponding change of the left ventricular preejection period. As a result, interventricular delay was significantly reduced. In contrast to LVP, BV tended to prolong left ventricular diastolic filling time {see table}.
**Conclusions** Although both pacing modes reduce interventricular dyssynchrony in patients with idiopathic DCM, LVP is superior to BV in terms of clinical improvement and impact on LVEF and mitral regurgitation.
This study was supported by the Research Grant NR 8541-3/2005 of the Internal Grant Agency of the Ministry of Health of the Czech Republic.

## TRANSSEPTAL ENDOCARDIAL LEFT VENTRICULAR PACING; AN ALTERNATIVE TECHNIQUE FOR CORONARY SINUS LEAD PLACEMENT IN CARDIAC RESYNCHRONIZATION THERAPY

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**Background** Coronary sinus (CS) lead placement for transvenous left ventricular (LV) pacing in cardiac resynchronization therapy (CRT) has a failure rate at implant and short term follow-up between 10 and 15%. In a number of this failed procedure an epicardial approach is not an attractive alternative due to physical and cardial status of the patients. We studied the feasibility of transseptal endocardial LV lead placement in patients in whom transvenous CS lead placement had failed.
**Methods** An atrial transseptal left ventricular lead placement was attempted in 11 patients (6 female, age 69.7 ¡À 9.2 years), in whom CS lead placement for CRT had failed. After transseptal puncture and septal dilatation from the femoral route, the left atrium was cannulated with a combination of catheters and guide wires from the left or right subclavian vein. After advancement of this guide catheter into the left ventricle a standard bipolar screw-in lead could be implanted in the postero-lateral wall. All patients were maintained on anticoagulant therapy with wafarin after implant.

**TABLE**

| | NYHA test (m) | 6-walk (mm) | LVEDD (%) | LVEF (ms) | Mi reg. (ms) | RV-PEP (%RR interval) | LV-PEP | DFT (ms) | |
|---|---|---|---|---|---|---|---|---|---|
| BV (n=13) bas | 3.1±0.3 | 302±101 | 71.5±7.9 | 22.3±4.5 | 2.0±1.3 | 111±19 | 187±33 | 317±58 | (36±4%) |
| 3m | 2.5±0.5* | 332±102 | 65.4±7.3 | 24.7±7.7 | 1.7±0.8 | 140±40* | 187±30 | 385±65 | (43±5.5%) |
| LVP (n=14) bas | 3.1±0.3 | 376±91 | 75.4±9.4 | 21.2±5.4 | 2.6±0.8 | 109±29 | 171±27 | 362±71 | (41±7%) |
| 3m | 1.8±0.7* | 426±83* | 71.5±13 | 24.1±5.3* | 2.3±1.0* | 155±43* | 185±41 | 333±61 | (40±6%) |
| p=(BVxLVP) | 0.02 | 0.03 | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. | |

*significant change between baseline and follow-up status

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**Results** A LV lead could be successfully implanted in 10 out of the 11 patients. Stimulation threshold was 0.76 ¡À 0.30 V, R wave amplitude 13.5 ¡À 9.3 mV. At 2 months follow-up stimulation threshold was 1.48 ¡À 0.35 V at 0.064 ¡À 0.027 ms pulse width. There was no phrenic nerve stimulation observed in any of the patients. There were no thrombo-embolic complications at follow-up of 13.3 ¡À 4.2 months. In 2 patients an increase in mitral regurgitation (¡Ü1 grade) was observed.
**Conclusions** LV transseptal endocardial lead implantation from the pectoral area is a feasible approach in patients in whom epicardial surgical lead placement is no option in case of a failed CS approach. Longer follow up is warranted to determine the risk of tromboembolic complications.

## MAGNETICALLY GUIDED LEFT VENTRICULAR LEAD IMPLANTATION BASED ON A 3-D RECONSTRUCTED IMAGE OF THE CORONARY SINUS

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**Background** Left ventricular lead implantation is feasible using remote magnetic navigation of a guide-wire (Stereotaxis, St. Louis, MO, USA). A novel software that performs a 3-D reconstruction of vessels based on 2 or more angiographic views has recently been developed (PAEION, Haifa, Israel).
**Objectives** (1) To evaluate the performance of the 3D reconstruction software to reproduce de anatomy of the CS, (2) to evaluate the efficacy of remotely navigating a magnetic guide-wire within the CS based on this reconstruction.
**Methods** In patients undergoing CRT implantation a 3-D reconstruction of the CS was performed using PAEION and imported into the Stereotaxis (figure). Based on the reconstruction magnetic vectors to navigate within the CS were automatically selected. They could also be manually adjusted if needed. Feasibility of deploying the guide-wire and LV lead into the selected side branch (SB), fluoroscopy time (FT) required for cannulation of the target SB and total FT were also evaluated.
**Results** Twelve patients were included. In one case the software could not reconstruct the CS. Quality of the reconstruction was excellent in 10 and poor in 1. In 8 cases manual adjustments to the traced edges of the CS was required to perform the 3-D reconstruction and in 3 no adjustments were needed. In 11 patients the target SB was engaged based on the automatically selected vectors. In 1 case manual modification of the vector was required distally in the vessel. In one case the lead had to be definitively deployed in an anterior SB due to lack of acceptable pacing threshold. Mean total FT was 22±11 min and FT required to cannulate the target SB was 1.4±1.5 min.
**Conclusion** A 3-D reconstruction of the CS can be accurately performed using 2 angiographic views. This reconstruction allows precise magnetic navigation of a guide-wire within the CS.

## BETTER CARDIAC RESYNCHRONIZATION THERAPY BY ENDOCARDIAL LEFT VENTRICULAR PACING IN CANINE LBBB HEARTS

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**Introduction** Cardiac resynchronization therapy (CRT) by biventricular (BiV) or left ventricular (LV) pacing is usually achieved using epicardial (EPI) LV pacing. Physiological activation starts from the LV endocardium (ENDO), but LV ENDO pacing is avoided due to inherent risks. Technical improvements, like novel leadless pacing may make ENDO pacing feasible.
Hypothesis: LV ENDO pacing provides more synchronous activation and better pump function during CRT than LV EPI pacing.
**Methods** In 6 anesthetized dogs left bundle branch block (LBBB) was induced by radio-frequency ablation. Pacing leads were positioned in right atrium (RA), right ventricle (RV) and at 8 paired (EPI and ENDO) LV sites. LV and RV pressure were measured, yielding LVdP/dtmax and mechanical interventricular asynchrony (timeshift between RV and LV pressure curves). IntraLV asynchrony was determined using ~100 electrodes on the epicardium and endocardium of RV and LV. For each LV site measurements were performed during BiV pacing and during LV pacing over a range of AV-delays. *=p<0.05 ENDO compared to EPI.
**Results** During BiV pacing the % reduction in intraLV asynchrony (10.0±8.1% (EPI) vs 23.4±7.4% (ENDO,*), mean±SD for 8 sites) and % increase in LVdP/dtmax (12.1±5.1% (EPI) and 20.7±7.3% (ENDO*)) were consistently higher during ENDO than during EPI pacing for each LV pacing site. Mechanical interventricular asynchrony was reduced from 26.3±5.4 ms to 15.8±8.9 (EPI) and 10.5±10.3 ms (ENDO*). During LV pacing the range of AV-delays with a >10% change in LV asynchrony (79±31 vs 32±24 ms*) and LVdP/dtmax (92±29 vs 63±39 ms) was significantly longer for ENDO than for EPI pacing. A >10% increase in LVdP/dtmax occurred more frequently during ENDO (96±6%) than during EPI pacing (64±8%*).
**Conclusions** In this acute model of LBBB, the electrical and hemodynamic benefits of CRT are considerably larger during LV ENDO than during conventional LV EPI stimulation and these benefits are less dependent on timing and site of LV stimulation.

## INITIAL EXPERIENCE WITH A NEW ACTIVE FIXATION LEFT VETRICULAR LEAD

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**Introduction** Cardiac Resynchronization therapy (CRT) requires positioning of a left ventricular (LV) pacing electrode in a lateral or posterolateral coronary sinus branch. However, many LV lead implants remain difficult and technically challenging. Even after a difficult access, the best lead site can be unstable. The aim of this study was to evaluate the safety, feasibility and stability of a new active fixation LV lead.
**Methods** We studied 20 patients (15 m, mean age 69±10,2 y) with CRT conventional indication (ischemic etiology in 44% patients), in whom a new left ventricular active fixation lead (Attain StarFix, Medtronic) was evaluated. Its design includes three soft lobes near the lead tip that, when expanded, enable stable placement of the lead tip within a target vein.
**Results** All patients but 1 received an ICD-CRT device. The implant was successful in all patients with positioning of the lead in a lateral or posterolateral vein (16 and 4 cases). The mean time from CS cannulation to final LV lead positioning was 27±21 min (below 40 min in 16 patients, range 1-38 min); longest times were observed in sharply angulated veins. Mean fluoroscopy time was 33±17 min, and the total procedure time was 118±35 min. Acute pacing threshold was 2.0±1.5 V, impedance 1147±411 Ù and R sensed was 14±7 mV. Both electrical parameters and lead tip position remained without significant changes after lobes deployment. The ability to push the lead to desired vein segment was judged as good in 70% of the cases. There were no complications.
**Conclusions** In our serie the perfomance of this left ventricular lead with an active fixation system was characterized by safety in the advancement and delivery of the lobes, difficulty in the advancement of the lead in very angulated veins, and great stability of the lead.

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## DIFFERENCES IN ANATOMICAL LOCATION AND CONDUCTION PROPERTIES OF ACCESSORY PATHWAYS IN SYMPTOMATIC WPW PATIENTS WITH AND WITHOUT CLINICAL DOCUMENTED TACHYCARDIAS

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Radiofrequency ablation is the preferred treatment for symptomatic WPW syndrome (S). However, clinicians have to face symptomatic WPWS patients (P) with non-documented ECG clinical tachycardia (CTa), in whom therapeutic doubts arise, specially in case of presumed high risk ECG appearance (midseptal location).
**Purpose** Analyse the anatomical location and conduction capabilities of accessory pathways (AccP) in P with symptomatic WPWS with and without documented ECG CTa before ablation.
Methods: 74 consecutive WPWS P considered for ablation. Group A consisted of 41 P with documented ECG CTa and Group B, 33 P (45%) with symptoms of palpitations, dizziness or syncope, but without documented ECG CTa.
**Results** Left-sided AccP was more frequent in group A compared to group B (68% vs 36%, p<0.001). Septal location, was found in 11 (27%) of group A and in 14 (42%) of group B (p=NS), being located close to AV conduction system (midseptal o perihisian) in 3 (27%) and 7 (50%) respectively (p=NS). Only anterograde conductive AccP was found more frequently in group B than in group A (30% vs 7%, p<0.02). Orthodromic tachycardia inducibility rate was similar in group A and in group B with bidirectional conduction (92% vs 88%).
**Conclusion** 1. An important subset of symptomatic WPWS P (45%) considered for ablation have not documented ECG CTa before the procedure, being septal location and close to AV conduction system quite frequent in these P. 2. Exclusive anterogradely conductive AccP were found more frequent in non-documented ECG CTa group compared to documented ECG CTa group. 3. In non-documented ECG CTa P those with bidirectional conductive AccP (70%), had similar rate of inducible orthodromic tachycardia compared to documented ECG CTa group, maintaining indication for ablation in the majority of these P, although careful consideration if "high risk" WPW ECG profile is present (septal location near AV system)

## SMALL INITIAL R WAVE IN LEAD AVR CAN RELIABLY EXCLUDE PREEXCITATION ON A 12 LEAD ECG

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We hypothesise that the rSR' pattern in lead aVR can reliably exclude preexcitation on a 12 lead ECG.
Surface ECGs from 131 consecutive patients with a diagnosis of the Wolff-Parkinson-White syndrome were obtained before and six weeks after successful ablation of the accessory pathway. We carefully analysed the morphology of the QRS complex in all leads and focused on a presence of a small initial r wave in lead aVR (rSR' pattern). We compared this feature with a septal q wave in lead V6 that has already been described to exclude preexcitation on a surface ECG.
The small initial r wave in lead aVR was seen in only two patients with preexcited ECG (1.5%) whereas the septal q wave in lead V6 was observed in 8 patients (6.1%). rSR' pattern in lead aVR became much more common after the ablation (92 patients, 70.2%) as well as the septal q wave in lead V6 (102 patients, 77.9%).
Both septal q wave in lead V6 and initial r wave in lead aVR are caused by the activation of the septum through the AV node. This pattern is obscured by the activation of the ventricle via the accessory pathway. It seems that the small initial r waves in lead aVR exclude manifest preexcitation with much higher accuracy than septal q waves in lead V6. In lead V6 it is sometimes difficult to distinguish between septal q wave and S wave following a discreet isoelectric delta.
We conclude that the presence of the rSR' pattern in lead aVR is highly unlikely to be associated with preexcitation. In the future it can be used as a part of the ECG algorithm that would exclude preexcitation beyond any doubt.

## ELECTROCARDIOGRAPHIC PATTERN OF LEFT ANTEROSEPTAL ACCESSORY PATHWAYS

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**Introduction** During a long time there have been controversies about the existence of atrioventricular accessory pathways (AP) in the anteroseptal region of the mitral annulus. Previous reported diagnosis algorithms have not considered the ECG pattern of these AP.
**Objectives** To Identify the ECG pattern of left anteroseptal AP.
**Methods** Baseline 12-lead surface ECGs of 2 patients with WPW located in the left anteroseptal region were compared with the ECGs of 24 patients with rigth anteroseptal and left anterior AP confirmed by successful radiofrecuency catheter ablation. Delta wave polarity was defined as positive, negative, isoelectric or bifasic.
**Results** Delta wave polarity was positive in the inferior leads of all AP. It was bifasic or isoelectric in V1, with precordial R wave transition in V2 when AP was localized in anteroseptal region and positive in V1 when AP was localized in left anterior region. Delta wave was negative in aVL in both left anterior and anteroseptal AP, and positive in the right anteroseptal AP.
**Conclusion** A delta wave with isoelectric or bifasic polarity in V1, a precordial R wave transition in V2 and a negative delta wave in AVL was found as the ECG pattern that suggests a left anteroseptal accessory pathway.

## RADIOFREQUENCY CATHETER ABLATION OF MAHAIM TACHYCARDIA BY TARGETING MAHAIM POTENTIALS AT THE TRICUSPID ANNULUS IN THE RIGHT MIDSEPTAL REGION

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Reentrant tachycardias associated with Mahaim pathways that exhibit decremental atrioventricular (AV) node-like conduction properties, are rare but potentially troublesome. Various electrophysiological substrates have been postulated and radiofrequency (RF) catheter ablation at several sites has been described. The majority of these pathways are long right atriofascicular pathways and RF catheter ablation, guided by a distinct Mahaim potential recorded at the anterolateral-to-posterolateral tricuspid annulus or in the right ventricular free wall, is safe and highly effective. Nodoventricular or nodofascicular Mahaim pathways usually also capable of only anterograde conduction, appear to be rare and are associated with pre-excited tachycardia of left bundle branch block morphology not distinguishable from the preexcitation pattern of right atriofascicular pathways. The aim of this study is to reported the first evidence of Mahaim potentials recorded on the tricuspid annulus in the midseptal region

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for the delivery of RF energy in the treatment of Mahaim tachycardia. Two out of 98 consecutive patients referred for RF catheter ablation of atrioventricular reentry tachycardia had presented with tachycardia of left bundle branch block configuration or had this induced at electrophysiological study. Both had additional tachycardia substrates (dual atrioventricular nodal pathways). The Mahaim potentials were identified during sinus rhythm at the tricuspid annulus in the right midseptal region and RF catheter ablation at this site result in a significantly potential reduction or abolishing which was consistent with elimination of tachycardia. During follow-up (22 months) both patient remained symptom free without medication. In conclusion, this is the first report of Mahaim potentials recorded at the tricuspid annulus in the midseptal region. Successful RF ablation was performed without impairing the normal AV conduction system.

## DURATION OF THE A(H)A(MD) INTERVAL PREDICTS OCCURRENCE OF AV-BLOCK DURING RADIOFREQUENCY ABLATION OF THE SLOW PATHWAY

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**Introduction** Modification of the slow pathway using radiofrequency (RF) is currently the most effective treatment for atrioventricular nodal reentry tachycardia (AVNRT). However, transient or permanent atrioventricular conduction block (AVB) may be a serious complication of this therapy. X-ray distance (XR) during RF delivery between the ablation catheter and the His-electrode is used clinically to estimate the risk of occurrence of AVB. Since XR of the 2 catheters depends on the angle of the base of the triangle of Koch, its value in predicting AVB was compared with the electrical A(H)A(Md) interval, which was measured from beginning of the atrial signal on the His-bundle electrode to the one on the ablation catheter right before the start of RF delivery.

**Methods** X-ray distance between the ablation and the His-catheter (XR), A(H)A(Md) interval as well as the occurrence of VAB during JA, transient or permanent AVB were analyzed retrospectively for 1585 RF deliveries in 393 patients diagnosed with AVNRT between 1999 and 2005 (58% female, 42% male) at our institution.

**Results** A mean of 2.7 RF therapies were delivered per patient and A(H)A(Md) was closely correlated with the number of ablations per patient ($R=0.144$; $p<0.0001$) and XR ($R=0.165$; $p<0.0001$). VAB during JA was found during 348 ablations, and 38 cases of transient AVB (9 AVB I, 13 AVB II, 16 AVB III) and 13 cases of permanent AVB (8 AVB I and 5 AVB III) were documented. In a multivariate analysis A(H)A(Md) was the best predictor for VAB or AVB ($p<0.0001$).

**Conclusion** A(H)A(Md) interval is a better predictor for occurrence of AVB after ablation for AVNRT than the radiological distance of the ablation catheter to the compact AV-node. Therefore A(H)A(Md) measurements before RF delivery should be performed to avoid AV conduction block as a consequence of slow-pathway ablation.

## IS ICEMAPPING NECESSARY DURING CRYOABLATION IN PATIENTS WITH ATRIOVENTRICULAR NODAL REENTRANT TACHYCARDIA?

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**Purpose** Icemapping-guided cryoablation is known as a useful, safe ablation technique for atrioventricular nodal reentrant tachycardia (AVNRT). However, it tends to prolong the procedure time. The aim of this study is to evaluate the necessity of icemapping during cryoablation of slow pathway in AVNRT.

**Methods** This analysis included 38 AVNRT patients (15 males, mean age 48.8±12.1 years) who underwent slow pathway (SP) ablation. They were classified as icemapping-guided group (n=23) and non icemapping-guided group (n=12). Success rate, total procedure time, fluoroscopy time and complications including AV block were compared between the two groups. Icemapping and cryoablation were performed at the Koch triangle region targeting slow pathway potentials. Icemapping was performed at -30ºC for 45-60 seconds and cryoablation at -70ºC for 4 minutes.

**Results** Total procedure time of cryoablation in the icemapping-guided group was significantly longer than that of non icemapping-guided group (105.4±31.3 min vs. 81±27.0 min, $p=0.04$). Fluoroscopy time, total ablation numbers and complications were comparable. In seven patients of icemapping-guided group (7/23, 30%), SVT was induced during icemapping but not during cryoablation. Transient atrioventricular (AV) block developed in two cases during icemapping but not in non icemapping-guided group.

**Conclusion** Icemapping alone does not seem to be sensitive enough to guide successful cryoablation site. Direct cryoablation without icemapping could be an alternative method to increase sensitivity for successful ablation and decrease total procedural time without increasing complication rate.

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## INDIRECT MEASUREMENT OF RETROGRADE P-WAVES AMPLITUDE DURING PACEMAKER FOLLOW-UP

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**Background** The accurate programming of atrial sensitivity is crucial for adequate functioning of pacemakers (PM). During PM follow-up it could be challenged in patients having natural or drug-induced severe sinus bradycardia and persistence sinus arrest.
Purpose: to evaluate p-waves amplitude in the absence of intrinsic atrial activity during dual-chamber PM follow-up.
**Material and methods** Seven patients had no atrial activity during follow-up visit after they had been implanted conventional dual-chamber PM (Diamond DR, Vitatron). Indirect measurements of p-waves amplitude were done by using automatic VA-interval test. During this test PM paces a ventricle with measuring distanse between spike and onset activation in atrial channel. Changes of atrial sensitivity and PVAB are avaliable during test. PVAB was set to 150-175 ms to prevent far field R-wave sensing. By gradually decreasing atrial sensitivity we achieved disappearance of VA-interval capture or dramatic losing its stability. The last setting of sensitivity before that were decided to be maximum p-wave amplitude. Additional indication for atrial origin of activation was gradual prolongation of VA-interval in response to increasing pacing rate.
**Results** Precise reproducible measurements were done in all patients with average VA interval 227±42 ms and maximum p-wave amplitude 2,8±1,5 mV. Programming sensitivity was settled three-four times less than measured p-waves. During six month survey appropriate PM functions connecting to atrial sensitivity were observed. Three patients had sinus rhythm restoration episodes with good correlation between p-waves measured by direct and indirect way.
**Conclusion** Described technic could be helpful to make atrial sensitivity adjustments in patients with severe sinus bradycardia those have dual-chamber PM without real time IEGM and thus direct measurements of p-waves amplitude are impossible.
**Limitations** Absence of retrograde VA conduction may result in failure of measurements or lead to mistaken conclusion of significant undersensing. It may be also some difference between amplitudes of retrograde and intrinsic p-waves.

## TRANS-VALVULAR IMPEDANCE IN SUPRAVENTRICULAR TACHYCARDIA

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The electric impedance recorded between right atrium and ventricle (Trans-Valvular Impedance: TVI) changes during the cardiac cycle, increasing from a minimum end-diastolic value (EDTVI) to a maximum reached in telesystole (ESTVI), and decreasing back to the minimum during passive and active ventricular filling. It has previously been suggested that EDTVI can be inversely related with cardiac preload, while TVI excursion from diastole to end-systole (peak-peak TVI) can be directly related with the stroke volume. We tested this hypothesis by recording TVI with a dedicated external device, in 6 patients undergoing diagnostic induction of AV-nodal reentry tachycardia during electrophysiological studies. Quadripolar leads were positioned in high right atrium and right ventricular apex and TVI was derived between the second atrial and ventricular electrodes from the distal tip. In sinus rhythm (rate 101±27 bpm), EDTVI and peak-peak TVI averaged 459±163 and 60±14 Ohm, respectively. Short tachycardia bursts induced a strong decrease in peak-peak TVI, essentially because EDTVI remained elevated and close to the systolic value for few consecutive cycles, suggesting an impairment of diastolic filling. Conversely, EDTVI decreased below its basal value after a compensatory pause with prolonged diastolic filling. During sustained tachycardia, the heart rate ranged from 131 to 256 bpm in different patients, increasing by 84% to 130% with respect to sinus rhythm conditions. By normalizing TVI values to the peak-peak amplitude measured in sinus rhythm, peak-peak TVI decreased by -39±12%, due to EDTVI increase by 27±8% and ESTVI decrease by -12±15%. In spite of the reduction in peak-peak amplitude, TVI fluctuation was consistently recorded at every cardiac beat, suggesting that the hemodynamic function was stable. Our observations indicate that TVI can reflect the alterations in cardiac hemodynamics induced by supraventricular tachycardia in acute conditions, and support the use of TVI as hemodynamic sensor in permanent pacing devices.

## EJECTION ASSESSMENT AT EVERY CARDIAC BEAT WITH THE TRANS-VALVULAR IMPEDANCE SENSOR

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The trans-valvular cardiac impedance (TVI) is derived between right atrium and ventricle with standard pacing electrodes. It shows regular periodic fluctuation synchronized with the cardiac cycle, increasing throughout the QT period (systole) and decreasing in diastole and after a P wave. TVI fluctuation is an expression of ventricular volume changes: if ejection is prevented, the TVI excursion is abolished, even in the presence of electrical activity or isometric contraction. The TVI sensor is implemented in the Sophòs pacemaker family (Medico, Padova, Italy) and can be applied to verify the actual ejection occurrence at every beat, after either ventricular pacing or sensing. In the former case, the system provides hemodynamic capture confirmation aimed at pacing energy regulation. The present study has evaluated TVI reliability in capture recognition in 26 patients, implanted with a Sophòs DDD-R pacemaker for sick sinus syndrome or AV block (20 new implants and 6 replacements). All underwent ventricular pacing threshold test at the follow-up, which was performed in VVI mode, in supine and sitting position. The procedure was controlled by the TVI sensor, which gave alarm and automatically restored the permanent pacing energy in the event of capture loss. The sensor-based diagnosis was compared with the evidence given by the surface ECG. A suitable TVI signal was obtained in 81% of the cases, where TVI showed 100% sensitivity and 86% specificity in detection of capture failure during ventricular threshold analysis. In daily-life conditions, the average prevalence of capture loss alarms was 0.3±0.2 (% of cardiac cycles±sd). These results confirm that TVI is a sensitive tool to assess the effectiveness of ventricular stimulation. However, the system should be properly tuned to improve its specificity and reduce the likelihood of false alarms.

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## EFFECTS OF RIGHT VENTRICULAR APICAL PACING ON VENTRICULAR SYNCHRONIZATION ASSESSED BY THE TVI SENSOR

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Ventricular dyssynchrony induced by right ventricular apical pacing (RVAP) can result in myocardial stress and mitral regurgitation and affect coronary perfusion, increasing the risk of atrial fibrillation and heart failure. Assessment of RVAP effects on ventricular synchronization during implantation might allow choosing an alternative pacing site, or biventricular stimulation upgrading, in selected cases. The transvalvular impedance (TVI) sensor could be suitable for this purpose. TVI is derived between atrial and ventricular electrodes with standard pacing leads. It increases throughout ventricular systole and decreases during passive and active filling, suggesting an inverse relationship with RV volume. TVI waveform was recorded under intrinsic AV conduction (IAVC) and RVAP in 8 patients affected by sick-sinus syndrome, implanted with the pacemaker Sophòs 151 (Medico, Padova, Italy). Moreover, the delay between the activation of LV basal septum and lateral wall (SWD) and between the onset of pulmonary and aortic flow (PAD) were assessed by echocardiography. At two months follow-up, RVAP induced a non-significant increase in both SWD (from 7±18 to 20±22 ms) and PAD (from 0.9±24 to 15±21 ms), and a reduction in the amplitude of TVI fluctuation from diastole to systole (-14±13%). Clear evidence of RVAP-related interventricular desynchronization was found in one patient (PAD=53 ms), who also showed the largest reduction in TVI excursion (-29%) and a TVI waveform with two positive peaks instead than one during the QT interval. Six months later, RVAP resulted in PAD>50 ms in the same case plus a new one. Both exhibited a paced TVI waveform with two peaks within the QT, a feature never observed in other patients (100% sensitivity and specificity in discrimination of interventricular desynchronization). This suggests that TVI could be applied as a tool to easily get information on changes in ventricular mechanics induced by RVAP, whenever echocardiography is not convenient or practicable.

## UNNECESSARY RV PACING REDUCTION IN NON-SELECTED DUAL-CHAMBER ICD PATIENTS: OVERALL PERFORMANCE OF THE DEDICATED SAFE-R PACING MODE

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Reducing the unnecessary ventricular pacing (Vp) has been shown relevant in the clinical outcome of all ICD patients (pts) without the need of resynchronization. The SafeR (SORIN Group) pacing mode was developed to that purpose, combining the clinical advantages of the AAI mode with the safety of back-up Vp in DDD mode. Aim of this study was to assess the performances of SafeR mode in 91 non-selected dual-chamber ICD pts.

**Methods** The SafeR mode operates in true AAI mode (no AV delay triggered after any atrial events) until AV blocks (AVB) occur, immediately triggering a switch to DDD. A periodic attempt to switch back to AAI is operated while functioning in DDD, if spontaneous AV conduction resumes. The % of Vp cumulated from follow-up (f-up) to f-up was measured, considering the longest available f-up period for each of 91 consecutive pts (88% males, 65±11y old [min 22y; max 84y]) implanted with a dual-chamber ICD (Ovatio DR, SORIN Group) programmed in SafeR mode. ICD indications were of primary prevention in 22% of pts. Bundle branch block and/or some degree of AVB were present in 27% of all pts; 15% of pts had isolated sinus node dysfunction.

**Results** The mean overall f-up duration was 62±38 days [min 10 d; max 232 d], the mean Vp was 4,9±16% ([min 0%; max 89%], median 0%). 22% of pts had no switch at all to DDD mode. 71,5% of pts (65/91) had Vp<1% and 17,5% of pts (16/91) had 1%<=Vp<10%. Interestingly, only 2 pts were known for AVB episodes, among the remaining 10 pts (with Vp>=10%) that have appropriately switched frequently to DDD.

**Conclusions** The SafeR pacing mode is capable of consistently reducing the amount of unnecessary Vp also in case of unexpected paroxysmal AVB, while maintaining Vp<1% in 71,5% of non-selected dual-chamber ICD pts.

## POST-IMPLANT FAST HOSPITAL DISCHARGE: THE OEDIPE TRIAL

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**Study objective** ŒDIPE clinical study was designed to demonstrate that a short in-hospital surveillance period after dual chamber pacemaker implantation or replacement, with a Philos II DR-T (Biotronik) using Home Monitoring, provides equivalent safety features than a conventional hospitalization program.

**Methods** After inclusion, patients were randomized into 2 groups:

- active group: discharge after 1 night of in-hospital surveillance for primary implantation and the same day for replacement, with a 4 week continuous home monitoring follow-up;
- control group: according to the centre standard of care time schedule, with a classical follow-up at 4 weeks.

**Results** 406 patients were included in the study and 379 analyzed. The primary endpoint was satisfied: there was no statistical difference regarding serious adverse events between the active group (18/184) and the control group (26/195). 87% of patients from the active group were discharged after less than 24h post implantation, and the mean total hospitalization duration was 3.2 days. Moreover, the use of Home Monitoring allowed early detection of adverse events in the ŒDIPE group (mean of 18.5 days before the scheduled 4 week follow-up, and mean reaction time by the physician of 3.8 days after the event reception). Quality of life was not affected by telecardiology, and there was a significant reduction of associated costs in the active group related to lower hospital bed day utilization. Interestingly, in both groups, 46% of the patients did not transmit any home monitoring event during the first month.

**Conclusion** Early patient discharge with Home Monitoring follow-up is safe after primary pacemaker implantation or replacement. This system appears to be sensitive and specific for adverse event detection.

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## THE BOLOGNA DATABASE OF THE EURO HEART FAILURE II SURVEY

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**Introduction** Acutely decompensated heart failure (ADHF) patients have been enrolled in the EURO HEART FAILURE SURVEY II (EHFII). They had a severe prognosis at discharge and at follow-up (FU).

**Patients and Methods** In EHFII 60 patients have been enrolled in Bologna. Clinical characteristics of these patients and the occurrence of heart failure death (HFD), and sudden death (SD), has been evaluated at 3-6-12 months FU. 28% showed a new episode of ADHF, while 72% were decompensated CHF patients. 63% had acute pulmonary edema. The mean age was 77.0 and 51% were males. Cardiomegaly was documented in 83%. 30 showed a concomitant renal failure, and diabetes was present in 20 of them. Almost 58% received a cardiac catheterization and coronary arteriography. 10% had permanent pacing and CRT and 3% had already an ICD. Almost 100% were already on diuretic agents, 62% on ACEi, 88% on beta-blockers, probably not at the maximum tolerated doses. 15/60 had an ACS as the cause of ADHF, the remaining 45/60 were patients with an already known CHF. The best non pharmacological treatment (NPT) was instituted and 4 patients received CRT treatment and two more, ICD therapy. At discharge, we lost 10/60 mainly patients with an ACS, at 3 months, we lost 7 other patients and at 6 months we lost other 8 patients. We lost 26/60 (43.3%) of the patients, at 12 months FU, 3 SD were observed (5.2%) + 2 appropriate ICD shocks (15%).

**Conclusion** ADHF bears an ominous prognosis, mainly for patients with already documented CHF and for patients suffering ACS. A more aggressive treatment, including primary PTCA and CABG or cardiac surgery, when indicated, is required. For CHF with a new ADHF episodes, a further approach, with an NPT can be required, after stabilisation of the clinical picture.

## RETROSPECTIVE STUDY OF PROARRHYTHMIC EFFECTS OF LEVOSIMENDAN ADMINISTERED FOR TREATMENT OF ACUTE HEART FAILURE

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Levosimendan is an effective, new inodilator agent, which is a new alternate drug beside conventional inotropic drugs for treatment of acute and chronic heart failure. Positive inotropic effects of levosimendan is based on myocardial Ca-sensitising. Few clinical data is available about the proarrhythmic effects of levosimendan, particularly administrated in parallel with catecholamines. Method: 55 levosimendan treated patient's data were processed in our retrospective study. Indication of levosimendan therapy was acute heart failure due to acute myocardial infarction (AMI) in 30 cases and acute decompensation of chronic heart failure (CHF, NYHA state III-IV) in 25 cases. After a 10 minute bolus levosimendan infusion was administered at rate of 0,1µg/kg/min for 6 hours in AMI and 24 hours in CHF groups respectively. We investigated the occurrence of sustained ventricular or supraventricular arrhythmias for the first 48 hours from the beginning of infusion. Results: The ratio of hypertension, diabetes, earlier myocardial infarction and ACBG were 62%, 29%, 35% and 15%, respectively in the monitored population (17 female, 38 male; mean age: 66 years). Three ventricular and one supraventricular arrhythmia were observed during the 48 hours period, all of them occurred at acute heart failure patients with acute myocardial infarction. Parallel usage of catecholamines (noradrenalin and/or dopamine) and levosimendan therapy was observed in four cases, at one of them ventricular tachycardia was observed three hours after starting levosimendan infusion. However no arrhythmia was observed at CHF patients. The incidence of proarrhythmic effects during levosimendan therapy was 7,27% at whole analysed population and was 13,3% in AMI group. Concluding these results authors would like to draw attention to the proarrhythmic effects of levosimendan during acute heart failure therapy, especially in case of parallel usage with catecholamin therapy.

## N-3 PUFA TREATMENT REDUCES MORTALITY AND ARRHYTHMOGENIC ELECTRICAL REMODELING IN ANGIOTENSIN II-INDUCED CARDIAC DAMAGE

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**Purpose** n-3 PUFA as ingredients from fish oil are supposed to reduce cardiovascular mortality. We investigated whether treatment with n-3 PUFA ameliorates mortality and arrhythmogenic electrical remodeling in a rat model with high Ang II levels.

**Methods** We studied cardiac damage in double transgenic rats harboring both human renin and angiotensinogen genes (dTGR) from week 4 to 10 of age. We performed ECG, Cardiac Magnetic Field Mapping (CMFM) and EP studies for electrophysiological characterization and echocardiography in all animals. Results were compared to dTGR treated with n-3 PUFA (25 g/kg diet up from week 5) and non-transgenic Sprague-Dawley (SD) rats as controls.

**Results** Cardiac n-3 PUFA levels rose significantly with treatment. Mortality of untreated dTGR was 31% (5/16) at week 7, whereas no animal died in the n-3 PUFA and SD group. Systolic blood pressure (BP) reached 208±5 mm Hg at week 7 in untreated dTGR. n-3 PUFA treatment slightly reduced BP (180±3 mm Hg, $p<0.05$), while SD were normotensive. Cardiac hypertrophy was similar in untreated and n-3 PUFA treated dTGR (LV IVSd+HWd 4.32±0.2 vs. 4.39±0.3 mm; SD 2.97±0.1 mm, $p<0.05$).

ECG showed significantly prolonged P wave, QRS, QTPeak and QTc durations in untreated dTGR compared to SD, which was reduced by treatment with n-3 PUFA. T-wave dispersion, assessed by CMFM, was also reduced by n-3 PUFA treatment. High inducibility of arrhythmias by programmed electrical stimulation in untreated dTGR was markedly reduced by n-3 PUFA (75 vs. 17%, SD 0%, $p<0.05$).

**Conclusion** Our findings indicate that n-3 PUFA improved survival and arrhythmogenic electrical remodeling. Therefore, n-3 PUFA treatment might be useful in patients with hypertension-induced heart disease.

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## IMPLANTABLE CARDIOVERTER DEFIBRILLATORS IN PATIENTS WITH DILATED CARDIOMYOPATHY: COULD THE CRP PREIMPLANTATION LEVELS BE AN OUTCOME PREDICTOR?

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**Background** The C-reactive protein (CRP) has been advocated as a predictor of mortality in Chronic Heart Failure. There are some reports that its production may be associated with electrophysiological abnormalities. We hypothesized that this marker levels may be predict the outcome and the future shocks in patients with dilated cardiomyopathy and implantable cardioverter defibrillators (ICDs). Thus, the aim of our study was to elucidate if a pre-implant CRP level will predict the prevalence of the future ICD shocks.
**Methods** We included 65 consecutive patients, 44 men mean age 52±11 years, with dilated cardiomyopathy underwent firs-time ICD implantation. Serum CRP levels were obtained the morning prior to ICD implant. We followed the patients up every 3 months post-implantation for device interrogation to detect shocks delivery. We analyzed only patients receiving appropriate shocks, based on stored electrograms. Mean follow-up was 34±6 months.
**Results** The mean EF was 28±12%. A pre-implant history of sustained ventricular arrhythmia had 67% of patients, non-sustained 28% and cardiac arrest 5% of patients. During the follow-up 28 patients (43%) received appropriate ICD shocks (mean 6±9 shocks per patient). The levels of basic biomarkers (serum creatinine, electrolytes, uric acid , hepatic enzymes) , the usage of beta-blockers, statins, ACE-inhibitors and spironolactone did not differ between shocks and non shocks patients. By univariate analysis, the ejection fraction (p=0.023), CRP levels (p=0.016) and not taking amiodarone (p=0.021) were risk factors for ICD shock. By multivariate analysis using logistic regression, only CRP was a significant predictor (odds ratio 1.7 per CRP, 95% CI=1.01-1.22, p=0.018). Mean CRP at implantation was 11±1.87 mg/dl versus 1.8±0.04 mg/dl in shock and no-shock patients respectively p=0.014).
**Conclusions** The pre-implant CRP level is independent predictor of ICD shock in patients with dilated cardiomyopathy underwent first-time ICD implantation.

## IMPACT OF MODERATE EXERCISE WORKLOAD ON IEGM PREDICTED OPTIMAL PV AND VV DELAYS DETERMINED BY QUICKOPT ALGORITHM

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**Purpose** Cardiac resynchronization therapy (CRT) is widely accepted for treatment of heart failure. Optimization of PV and VV delays has shown to be effective at improving patient outcomes by increasing cardiac output and reducing non-responder rates. Recently, a fast intracardiac electrogram based method (QuickOpt, St. Jude Medical) has been shown to produce hemodynamic performance similar to that obtained by echo guided aortic VTI (AVTI) maximization. The aim of this study is to evaluate the impact of moderate exercise workload on optimized PV and VV delays as determined by the QuickOpt method.
**Methods** 61 patients [65±9 years; 12% female; LVEF=28±7%; 47% CAD and 53% DCM] were enrolled 18±14 months after implantation of a CRT-D device. QuickOpt PV/VV optimization was conducted three times in each patient: 1) At rest (REST). 2) Subsequent to a six minute walk test (6MWT). 3) Following a 3 minutes recovery period (RECOV).
**Results** Although significant difference in terms of heart rate was reached (68±9 bpm (REST) vs. 79±11 bpm (6MWT) p<0.05) no differences were observed between QuickOpt based optimized PV/VV delays at different exercise levels.
Opt. PV=128±14 ms (REST) vs. 129±16 ms (6 MWT) vs. 129±16 ms (RECOV); p=n.s.
Opt. VV=15±24 ms (REST) vs. 15±21 ms (6 MWT) vs. 15±24 ms (RECOV); p=n.s. (Positive Values of VV delay indicate LV First.)
Optimized PV and VV Delays within a patient were very stable at different exercise levels and differed <= ±10ms (REST vs. 6MWT) in the vast majority of patients (Opt. PV: 90% resp. Opt. VV: 81%).
**Conclusions** Optimized timing cycle delays were independent from exercise status within a particular patient but varied between patients. This provides rationale for a consequent routine PV/VV optimization in each CRT patient. QuickOpt is a fast, convenient and reliable method that provides highly reproducible results, which could be obtained either at rest or at moderate exercise.

## INTEGRATED BACKSCATTER ECHOCARDIOGRAPHIC ANALYSIS DETECTS MYOCARDIAL FIBROSIS REGRESSION AFTER CARDIAC RESYNCHRONIZATION THERAPY

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**Purpose** Recent biochemical, MRI and bioptic studies demonstrated that Cardiac resynchronization therapy (CRT) not only reverses left ventricular (LV) chamber, but also may have an impact on myocardial ultrastructure remodelling. Aim of the study was to investigate the role of Integrated Backscatter (IBS) analysis, a technique useful to characterize myocardial ultrastructure, in evaluating fibrosis reduction after CRT.
Materials and Methods: Thirty-two consecutive patients with refractory chronic heart failure (CHF) undergoing CRT (22 male; mean age 68.5 years; 18 ischemic patients) were enrolled and evaluated baseline and 6 months after implantation.
**Results** During follow-up, 2 patients died because of heart failure worsening and 2 patients were excluded for loss of biventricular pacing due to LV lead dislodgement. At 6 months, we observed 23 (82%) clinical responders, who showed a significant improvement of clinical status (NYHA class from 2.8±0.4 to 1.9±0.4, p<0.01; MLHFQ from 39±19 to 21±11, p<0.01) and functional capacity (6MWT from 358±121 to 415±123 mts, p<0.001). Regarding echocardiographic parameters, we observed sixteen (57%) volumetric responders (LVEDV from 205±60 to 190±68 ml and LVEF from 23±8.4 to 31±10%, p<0.001), who showed a reduction in cardiac dyssynchrony (AI from 42±33 to 24±17, p<0.01) at TDI analysis. IBS analysis showed a significant reduction of myocardial echo intensity at septum (from 59±18 to 53±18 dB, p<0.05) and LV posterior wall (from 34±13 to 31±11 dB, p=0.05), associated with an improvement of cyclic variation index (septum: from -2.5±17 to 6.7±15%; posterior wall: from 10±18 to 20±24, p<0.01).
**Conclusions** After 6 months of CRT, IBS detected a reduction in LV myocardial echo intensity related to reverse remodelling, probably due to LV myocardial fibrosis reduction.
Authors disclose any potential conflict of interest for this research.

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## POLYMORPHISM OF ACE GENE IN PATIENTS WITH LONE ATRIAL FIBRILLATION

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**The aim of study** Evaluation of influence of I/D ACE gene polymorphism (I-D ACE GP) and HR on development of tachycardiomyopathy (TCP) and early results of transoesophageal electrical cardioversion (OCV) in patents with lone atrial fibrillation (lAF).
We observed 30 pts (25 men 5 woman) aged 47-76 years with lAF selected from 115 consecutive pts referred to elective OCV due to intolerable symptoms.
I-D ACE-GP, HRrest and mean 24-hour HR (HR24) before OCV and energy of OCV were assessed in all pts. Echocardiography examination was made before and 1 month after OCV.
The following groups were formed group A – 14 pts with TCP and group B – 16 pts with normal LVEF during AF and with II (8 pts), ID (14 pts) and DD (8 pts) type of ACE-GP and.
**Results** In gr I Mean LVEF increased from 34,5% to 57,5% after OCV, in gr II did nit diferr significantly (56,8% and 56,9%).
Patients with II type of ACE-GP had the lowest values of LVEF before OCV.
In gr.I: HRrest (116,4 vs 92,5 bpm) and HR24 (96,8 vs 81,7 bpm) before OCV were higher (p<0,03) than in gr II.
Type II of ACE-GP were more frequent in TCP pts (35,7% vs 18,8%), type DD - in normal LVEF pts during AF (31,3% vs 21,4%).
Higher LA diameters were observed in heterozygotic patients (ID) than in homozygotic ones (49,5 mm vs 42,8[II] and 44,0 [DD]).

| ACE-GP | II | ID | DD | p |
|---|---|---|---|---|
| LVEFpre | 38,8% | 46,6% | 50,1%, | p<0,03 |
| LVEFpost | 57,8% | 50,1% | 52,5% | NS |
| HRrest | 116,2 bpm | 99,5 bpm | 107,8 bpm | |
| HR24 | 113,5 bpm | 85,3 bpm | 87,7 bpm | |
| LA | 46,0 mm | 49,0 mm | 45,5 mm | |
| OCV energy | 30,1 J | 35,4 J | 38,9 J | |

**Conclusion**
1. Type II ACE gene polymorphism is more frequent in patients with lone atrial fibrillation who develop tachycardiomyopathy.
2. Higher values of rest and mean 24-hour HR were observed in patients with lone atrial fibrillation and tachycardiomyopathy.
3. Type of ACE gene polymorphism rather do not influence on energy needed to sinus rhythm restoration by transoesophageal electrical cardioversion in patient with lone atrial fibrillation.

## IS ATRIAL ELECTROMECHANICAL DYSSYNCHRONY IMPORTANT IN SICK SINUS SYNDROME PATIENTS WITH OR WITHOUT PAROXYSMAL ATRIAL FIBRILLATION?

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**Background** Sick sinus syndrome (SSS) is associated with an increased incidence of atria fibrillation (AF). It remains unclear whether atrial electromechanical dyssynchrony is present in patients (pts) with SSS, and contributes the development of AF.
Methods: We studied the presence of intra- and inter-atrial dyssynchrony in SSS pts with (n=19) or without paroxysmal AF (PAF) (n=11). All pts had symptomatic SSS requiring DDDR pacemaker implantation and normal LVEF. The presence of PAF was documented by the electrogram recording from the device. Echocardiogram with Tissue Doppler Imaging (TDI) was performed during sinus rhythm. The peak atrial contraction velocities (Va) and the timing of mechanical events (Ta) were measured at the mid of left atrial (LA) and right atrial free wall (RA).
**Results** There were no difference in age (71±9 vs 73±9 yrs), P wave duration (142±18 vs 136±18 ms), LVEF (57±10 vs 57±8%), mitral inflow E velocity (87±23 vs 87±20 cm/s), LA ejection fraction (50±11 vs 54±15%) and LA volume index (42±14 vs 34±15 ml/m2) between pts with or without PAF (all P>0.05). Nevertheless, mitral inflow A velocity (70±19 vs 91±17 cm/s, p=0.005), LA active empting fraction (24±14 vs 36±13%, p=0.027) and the mean Va of LA by TDI (2.6±0.9 vs 3.4±0.9 cm/s, p=0.028), but not the Va of RA (4.1±1.5 vs 4.6±2.1 cm/s) were significantly lower in pts with PAF compared with those without PAF. Although the standard deviation of Ta (45±51 vs 37±46) and the maximum difference of Ta among 6 segments of LA (108±113 vs 84±91 ms) showed no difference between two groups (P>0.05), the interatrial delay was significantly prolonged in pts with PAF compared with those without AF (33±25 vs 12±19 ms, p=0.022).
**Conclusion** In pts with SSS combined with PAF, worsening of LA mechanical contraction and inter-artrial dyssynchrony occurred even in normal left ventricular systolic function. Appropriate atrial pacing for those patients should be considered.

## EFFECTS OF ACUTE ATRIAL DILATATION ON CONDUCTION VELOCITY AND VULNERABILITY TO ATRIAL FIBRILLATION IN THE HUMAN ATRIUM

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**Background** The mechanism by which atrial stretch favours the development of a substrate for atrial fibrillation is not fully understood. While several experimental and clinical studies investigated the effect of stretch on atrial refractoriness, few information exist concerning the effect of stretch on conduction properties. In the present study we investigate the role of stretch-induced conduction disturbances in the creation of a substrate for atrial fibrillation by quantifying the spatial distribution of local conduction velocities in the human right atrium during acute atrial dilatation.
**Methods** Seven patients undergoing radiofrequency catheter ablation of paroxysmal supraventricular tachycardia were studied. Electroanatomic mapping of the right atrium was performed during coronary sinus pacing in control condition and during acute atrial dilatation. Acute atrial stretch was obtained by simultaneous atrioventricular (AV) pacing at a cycle length of 450-500 ms. Local conduction velocities were measured by a triangulation method and spatially mapped over the whole right atrial endocardial surface.
Results. Simultaneous AV pacing increased right atrial volume on average from 80±34 ml to 96±36 ml (p<0.001). The increase of atrial volume determined a shift in the distribution of local conduction velocity towards slow conduction velocities. An average increase in volume of 23% determined a decrease of median conduction velocity from 62±12 cm/sec to 43±7 cm/sec (p<0.01) and an increase in the incidence of slow conduction from 20% to 34% (p<0.05). Moreover, the increase of atrial volume increased atrial fibrillation vulnerability to 60%.
**Conclusions** Acute atrial dilatation of the human right atrium results in slowing of conduction and increase in atrial fibrillation vulnerability. These stretch-related changes in atrial conduction are likely to be important factors in the creation of a substrate for atrial fibrillation.

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## ACETYLCHOLINE TERMINATES ATRIAL FIBRILLATION IN RATS

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**Introduction** The usefulness of the currently existing approaches to treat atrial fibrillation (AF) is limited because of their relatively low effectiveness and/or potential for adverse effects. We tested the hypothesis that uniform, transient activation of muscarinic $K^+$ channels throughout the atria could destabilize and terminate the arrhythmia thereby turning the heart into the sinus rhythm.
**Aim** To explore the effectiveness of rapidly hydrolysable cholinergic agonists for AF termination.
**Methods** Sustained AF episodes were elicited in anesthetized Wistar rats by programmed electrical stimulation via transesophageal catheter. Rats were randomly and blindly assigned with a model drug, acetylcholine (n=17), or saline injection (n=15) either via the tail vein or into the right ventricular cavity, three minutes after the AF initiation.
**Results** In all ten rats tested, AF was successfully converted into sinus rhythms by intravenous acetylcholine injection, while injections of the same quantities of saline had no effect whatsoever. AF episodes were terminated almost immediately (within 8.4±1.9 seconds) following acetylcholine administration, while the episodes in untreated AF were significantly longer (average 8.6±2.2 minutes, $p<0.0001$). The termination of AF episode was always accompanied with transient bradycardia; the sinus rhythm gradually accelerated and reached its pre-AF values within 10-20 seconds following the injection. Similar results, but with shorter recovery of sinus rhythm, were obtained with intracardiac acetylcholine delivery (n=7).
**Conclusions** These experiments provide a first evidence of the effectiveness of acetylcholine to terminate AF in rats.

## FROM SINUS IMPULSE TO SINUS NODE COMPLEX: REVERSE ELECTRICAL ATRIAL REMODELING IN PATIENTS WITH PERMANENT ATRIAL FIBRILLATION

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**Background** The concept of atrial electrical remodeling (ER) was first advanced by Wijffels when they demonstrated that AF-induced shortening of refractoriness in goats led to perpetuation of AF ("AF begets AF"). Regional conduction time and conduction velocity (CV) are still incompletely understood because of the complexity of atrial anatomical architecture and the limitations of measurements methods. The aim of this study was to characterize the reverse electrical atrial remodeling (REAR) after electrical cardioversion (EC) in patients with atrial fibrillation (AF).
**Methods** Twelve patients (60.17±6.48 years) with permanent AF (166.5±34.23 days) were studied 30 min and 24 hours after sinus rhythm (SR) restoration. Twelve age-matched controls were studied. We evaluated: the site and the morphology of the sinus node complex (SNC), the regional CV, and the regional voltage of the right atrium as determined by electroanatomical CARTO system map.
**Results** After EC the site of SNC was localized in the 58% of pts in the anterior wall, in the 16% and 26% respectively in the anterior-lateral and lateral wall. After 24 hours of sinus rhythm there are a site variation in 10/12 pts, with a major distribution to the anterior-lateral wall (41%) and to the lateral wall (50%). SNC at 30 min showed a significantly higher unicentric pattern; SNC at 24 hours showed a significantly higher multicentric pattern with a significantly increased in the SNC area ($p<0.01$). There was significant regional atrial CV slowing after 24 hours. The morphology and extension of SNC and the CV after 24 hrs of SR are not significant different to control group.
**Conclusions** Our study show that in man, 24 hours maintenance of stable SR, induces: 1) reverse modification of the morphology and extension of SNC and 2) a significative variations of the CV.

## BIPOLAR ELECTROGRAM CHARACTERISTICS IN PATIENTS WITH FOCAL ATRIAL TACHYCARDIA – INSIGHTS CONCERNING THE ANATOMICAL AND ELECTROPHYSIOLOGICAL SUBSTRATE OF THE TACHYCARDIA

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**Background** Fractionated bipolar electrograms are often noted during mapping of focal atrial tachycardia (FAT). This finding suggests partial cell-to-cell electrical uncoupling, which may play a role in the process of ectopic impulse initiation and propagation. The aim of the present study was to assess the characteristics of bipolar electrograms in these patients.
**Methods** 13 patients with FAT (age 48±17 years) who underwent catheter ablation were investigated. Mapping was performed with the CARTO system. Analysis of bipolar electrograms consisted of peak-to-peak voltage, duration, number of negative deflections, and total number of deflections. Electrogram metrics in the region surrounding the focus and in the remaining atrium were studied.
**Results** Bipolar voltage was 0.91±0.54 mV in the region activated during the first 5 ms from the onset of activation («focal area») vs 1.48±1.07 mV in the region activated during the next 10 ms («early activated area») vs 1.61±1.11 mV in the remaining atrium ($p<0.0001$). The incidence of electrograms with multiple negative deflections was 97% in the «focal area» vs 84% in the «early activated area» vs 80% in the remaining atrium ($p<0.0001$). Neither the bipolar voltage nor the number of negative deflections varied significantly within the «focal area». The «focal area» measured 0.80±1.05 $cm^2$ (range 0.10-3.50 $cm^2$). Together, the «focal area» and «early activated area» measured 4.88±3.59 $cm^2$ (range 0.9-12.5 $cm^2$). No differences in electrogram duration and total number of deflections were found between the 3 atrial regions.
**Conclusions** Bipolar voltage decreased progressively while the incidence of electrograms with multiple negative deflections increased progressively towards the «focal area». These findings together with the size of the «focal area» and «early activated area» suggest that a non-discrete atrial region with gradually changing electrophysiologic properties may underlie the substrate of FAT.

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## COMBINED ANTIARRHYTHMIC DRUGS (CLASS IC AND CLASS III) IN PREVENTING ATRIAL FIBRILLATION RECURRENCE AND RESTORING SINUS RHYTHM

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**Purpose** Success of ECV is limited by a high recurrence rate in spite the use of antiarrhythmic therapy. Two weeks after ECV more of one-third of pts presents AF reccurence.
**Methods** We performed electrical cardioversion (ECV) in 35 consecutive patients (mean age 69±4 years, left atrium diameter 45±4 mm, LVEF 57±5%) affected by persistent atrial fibrillation (mean duration 12,7±50 months). All patients received effective anticoagulant therapy. Antiarrhythmic treatment was: 8 pts flecainide, 12 amiodarone, 15 amiodarone+ flecainide, We evaluated AF recurrence at one week after ECV, 1 month, 3, 6 and 12 months.
**Results** At one week after ECV 11 /35 pts (31%) presented AF recurrence (8 pts on amiodarone treatment, 2 pts on amiodarone and flecainide, 1 pt on flecainide) In 2 patients with AF recurrence on amiodarone+ flecainide we chose rate control strategy. In all 8 pts in treatment with amiodarone, 150 mg/die of flecainide were added restoring sinus rhythm within a week. In the 1 pt on IC drugs the dose of antiarrhythmic was increased and restored SR within a week. At 3 months follow-up AF recurred in 1 more pt on amiodarone and flecainide (1/33, 3%). One year after ECV 1 more pt on amiodarone+flecainide presented AF recurrence (1/32, 3%). Statistical analysis (X2) one week after ECV showed: amiodarone+ flecainide vs amiodarone (p=0,004), amiodarone and flecainide vs flecainide (p=ns). At 3,6 and 12 months the combination of amiodarone and flecainide is superior to amiodarone alone but not statistically significant (p=ns).
**Conclusions** Combining amiodarone and flecainide is effective and safe and superior to amiodarone alone the first weeks after cardioversion. In our study adding flecainide in pts on amiodarone treatment and AF recurrence one week after cardioversion showed to be highly effective on restoring and maintaining SR.

## TRANSTORACIC ELECTRICAL CARDIOVERSION OF PERSISTENT ATRIAL FIBRILATION WITH LIGHT SEDATION

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Transtoracic electrical cardioversion is highly effective in restoring sinus rhythm in patients with persistent atrial fibrillation. We evaluated the efficacy and tolerability of the Transtoracic electrical cardioversion under light sedation with midazolam.
**Materials and methods** We evaluated consecutive 63 pts, 47 male and 13female (mean age 68±9 ys, mean weight 79±13 Kg, height 170±8 cm, mean atrial diameter 46±6 mm, EF 55%) affected by atrial fibrillation (mean duration 11±22 months). 42 pts were receiving treatment for hypertension and 18 for hypercholesterolemia. 43 pts were at the first episode of AF, while 13 pts were previous treated with electrical cardioversion for AF. We performed ECV after iv infusion of midazolam (mean dose 4±2,1 mg). During ECV, ECG, arterial pression and oxygen saturation were recorded. Adhesive paddles were placed in the antero-posterior position and ECV was performed with a step-up protocol of energy, until the presence of due consecutive P waves (ECV considered effective) for a max 3 consecutive shocks. ERAF was treated with a new shock.
**Results** Mean duration of the ECV was 13,1±6 min. In 60/63 ECV restored SR (95%). 10/63 presented ERAF and were treated with a new shock. Mean effective energy was 140±38 J and mean total energy/pt was 195±124 J. Mean No of shocks was 1,4±0,7, We evaluated the discomfort experienced by the pts with a disconfort score scale (soggective evaluation of discomfort experienced, by a scale for 0-10) was 1,3±1,8. Non complications were observed.
**Conclusions** Transthoracic electrical cardioversion of AF under light sedation is highly effective, safe and well tolerated by the patient. Can be easily managed by the cardiologist, that facilitate and reduce the time of the procedure. Sedation with midazolam does not cause complications, thus may be considered as a safe and effective procedure for restoring sinus rhythm in atrial fibrillation.

## HEMODYNAMIC AND RESPIRATORY MONITORING DURING ELECTIVE EXTERNAL CARDIOVERSION FOR ATRIAL TACHYARRHYTHMIAS

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Transthoracic external cardioversion (ECV) can be optimizid with respect to the quality of patient care and a high workload for the anaesthesiologist, cardiologist and nurses. We report on hemodynamic and respiratory parameters during ECV and conscious sedation exercised by a single physician.
**Patients** A total of 355 patients underwent ECV with recording of the rhythm, blood pressure and saturation before, during and after sedation. The patient characteristics are: 143 female (28%), age 59±14 (range 21-88) years, BSA 1.99±0.27 (range 1.42-3.07) Duration of arrhythmia was 3.5±14.4 months (range 4 hours to 15 years). LA size on echocardiogram M-mode was 49±7 (range 31-70) mm.
**Methods** Major arrhythmia is atrial fibrillation and 10% had other atrial arrhythmias, mainly flutter. Patients were sedated with benzodiazepines (5 mg IV) and ethomidate (1-1.5 mg/10 kg bodyweight). A Zoll defibrillator was used with predominantly biphasic shocks and usually set at 120 Joule. Patches are placed on the thoracic skin just before the paddles of the defibrillator are put in position. Blood pressure was monitored as well as the saturation in all patients.
**Results** The average blood pressure and saturation remained as average constant. However, 21 pts developed severe undersaturation during the sedation (12 pts (3,5%) >80 and <90% and 9 pts (2,5%) <80%.
High blood pressure (defined by diastolic pressure >100 mm Hg) was detected in 75 pts (21.1%), during sedation in 14.6% and persisting to the end in 12.9%.
Low blood pressure (defined by systolic pressure <90 mm Hg) was present 9 times in 7 pts (2%) without clinical signs hemodynamic dysfunctioning. No major events occurred.
**Conclusion** Conscious sedation on an elective basis in the emergency department performed by a single physician is safe and effective, with minor problems.

## ATRIAL ACTIVATION OCURRING IMMEDIATELY AFTER SUCCESSFUL CARDIOVERSION OF ATRIAL FIBRILLATION

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**Background and Objective** Electrical defibrillation is very effective in interrupting atrial fibrillation (AF). However its mechanism is not completely understood. We report our observations in patients subjected to external electric cardioversion (ECV) of atrial fibrillation and

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contrast them with recent theories about defibrillation mechanism.
**Methods** In 13 consecutive patients transthoracic ECV for AF was performed during an electrophysiological study (11 monophasic -200-360 J- and 9 biphasic shocks -50-150 J-). 10-16 electrograms were obtained with multipolar catheters recording right atrium, coronary sinus and right pulmonary artery. AF was defined by inter-electrogram intervals and changing sequences among recordings, indicating complete lack of organization.
We evaluated presence of propagated activations immediately (<300 ms) after successful shocks (one or more discrete electrogram in all recordings). In unsuccessful shocks we evaluated changes in electrogram morphology (discrete/fragmented) and inter-electrogram intervals for 2 s before/after defibrillation.
**Results** 16/20 shocks terminated AF. In 6/16 one or two cycles of atrial activation were registered just after the shock and before AF ended. In 10/16 AF was interrupted immediately after the shock.
4/20 shocks did not interrupt the arrhythmia. After these shocks transient organization of recorded activity with longer inter-electrogram cycle length (144 vs 179 ms; p<0.01) and disappearance of fragmented activity (30.8% vs 9.6%; p=0.02) were transiently observed.
**Conclusion** Our clinical findings in atrial defibrillation in vivo reproduce experimental data that show myocardial activations early after successful DC shocks. These observations suggest that successful defibrillation depends, not only on the immediate effects of the shock, but also on transient effects on myocardial electrophysiological properties, capable of interrupting persistent or reinitiated activations.

## PREDICTION OF RECURRENCES IN PATIENTS WITH LONE RECURRENT ATRIAL FIBRILLATION

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The aim of this study was to evaluate the P wave wavelet analysis along with the left atrial (LA) dimensions for the prediction of recurrences in lone recurrent paroxysmal atrial fibrillation (PAF).
**Methods** Ninety-three patients (43 males, mean aged 55±10 years) followed for 5,04±3,9 years, divided in 3 Groups. Group A consisted of 33 patients (17 males, mean aged 53±11 years) with an average of 1,4±1 recurrences/year, while Group B consisted of 10 patients (7 men, mean aged 57±8 years) with more than 5 recurrences/year. Group C consisted of 50 normal controls (19 males, mean aged 56±9 years) without history of PAF. P wave was analyzed using the Morlet wavelet and wavelet parameters expressing the mean and max energy of P wave were calculated in the three orthogonal leads (X, Y, Z) and in the vector magnitude (VM), in three frequency bands ($1^{st}$: 200-160 Hz, $2^{nd}$: 150-100 Hz and $3^{rd}$: 90-50 Hz). The difference of P wave duration between Z and X axis (PdurZ-X) was also measured.
Apart from long parasternal view, LA diameter was calculated by the apical 4-champer view along the major axis at the end-systolic (Lalas) and the end-diastolic period (Lalad) and along the minor axis at the respectively periods (Lasas, Lasad).
**Results** Multivariate logistic regression analysis showed that lower max3 energy at X axis along with greater PdurZ-X were significant and independent predictors of low recurrences,while higher mean1 energy at Z axis along with larger Lalad, of multiple recurrences. Max3X and PdurZ-X at cut-off values 25 ÌV and 9.5 msec held sensitivity, specificity and positive predictive value of 80%, 82% and 85% respectively, while mean1Z and Lalad at 1.96 ÌV and 5.125 cm held 81%, 71% and 91% respectively.
**Conclusions** The development of recurrences in lone recurrent AF associated with specific differences in atrial excitation patterns and atrial dimensions.

## ACUTE VERSUS LONG-TERM EFFICACY OF DOFETILIDE IN PATIENTS WITH PERSISTENT ATRIAL FIBRILLATION/FLUTTER

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**Introduction** Dofetilide (D) has been reported to convert persistent atrial fibrillation (AF) and atrial flutter (AFL) to sinus rhythm. The purpose of this study was to determine the acute success, long term efficacy, and adverse events of D in persistent AF/AFL.
**Methods** We followed in-patients initiated on oral D for persistent AF/AFL. Patients were kept under telemetry monitoring, and underwent frequent 12 lead electrocardiograms, and renal function tests.
**Results** We studied 51 patients (age 64±14; 19 women; 80% structural heart disease) with persistent AF/AFL initiated on oral D (mean dose 406±146 µgm) while on telemetry. Twenty-four patients (47%) had previously failed a mean of 1.7±1.9 antiarrhythmic drugs. Restoration of sinus rhythm occurred in 31/51 (61%) patients after 2±1 doses (average D dose = 431±124 µgm). The other 20 patients on D required direct current (DC) cardioversion to terminate the arrhythmia. Time to first recurrence of AF/AFL in the D and DC groups was similar (205+385 versus 183+212 days, NS). After a follow up period of 6, 12, and 21±19 months, complete efficacy was observed in 51%, 47%, and 37% of patients, and did not differ between groups (D=48%, 45%, and 35%; DC=55%, 50%, and 40%, NS). Clinical improvement despite occasional recurrence was similar in both groups (D=81%, DC=65% at 21±19 months). Significant cardiac adverse events were observed in 4 patients (8%): out of hospital cardiac arrest in 2 men and inpatient torsades de pointes in 2 women.
**Conclusions** 1) D acutely converts 61% of persistent AF/AFL to sinus rhythm; 2) This acute success does not predict long-term efficacy; and, 3) Significant proarrhythmia can occur even with careful dose selection and in-hospital telemetry monitoring.

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## LONGEVITY OF ICDS: ARE THEY ALL COMPARABLE?

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**Background** ICD longevity differs among different manufacturers, so that comparison studies have never been reported.
We prospectively investigated longevity of ICDs implanted in 2000, 2001,2002 according to their type and manufacturers.
**Methods** Longevity of single chamber (SC), double chamber (DC), and biventricular (BiV) ICDs from Medtronic (MDT), Guidant (GDT) and St. Jude Medical (SJM) was measured in all the patients who reached device replacement. The observation follow up ended at July 15th 2007; patients prematurely dead or transplanted before battery exhaustion were excluded from the analysis.
Number of device charges and percentage ventricular pacing were accounted for to calculate adjusted longevity.
**Results** 163 patients received an ICD in the abovementioned period. Six underwent heart transplantation, and 22 died before device replacement; ninety had a SC device, 59 a DC device , and 14 a BiV device.

| Longevity (months) | SC | DC | BiV |
|---|---|---|---|
| MDT | 73±14 (29-95) | 74±15 (50-87) | 67±54 (35-81) |
| GDT | 60±17 (51-86) | 50±8 (34-69) | 44±3 (42-46) |
| SJM | 55±10 (29-71) | 46±14 (19-79) | 51±12 (42-65) |

The average number of shock/patient/year was 1.5 (MDT), 1.4 (GDT), 3.5 (SJM) for SC devices, whereas it was 0.25 (MDT), 3.1 (GDT), 1.4 (SJM) for DC devices, and 1.7 (MDT), 0 (GDT), 0.5 (SJM) for BiV ICDs. An arrhythmia storm occurred in 2 patients with a SC SJM device , and in 1 with a SC GDT device.
Ventricular pacing was <1% in all SC and DC ICDs, whereas it was >99% in all BiV devices. A single BiV patient (MDT) had a pacing threshold >4 V.
**Conclusions** Battery longevity is significantly different among manufacturers, as observed by clinical outcome in the real-life scenario. Although shock delivery was slightly higher in SC SJM devices and GDT DC devices, it could not explain the reduced battery longevity compared to MDT. Product performance must be assessed by outcome rather than by laboratory testing.

## ANALYSIS OF IMPLANTABLE DEFIBRILLATOR LONGEVITY UNDER CLINICAL CIRCUMSTANCES

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**Introduction** Information about implantable cardioverter-defibrillator (ICD) longevity is mostly calculated from measurements under ideal laboratory conditions. However, little information about longevities (L's), under clinical circumstances, is available. This survey gives an overview on ICD service times after generator replacements in a cohort of consecutive ICD patients.
**Methods** Indications for replacement were classified as device advisory or recall actions, premature end-of-service (EOS), normal EOS, system malfunction and infection. Premature EOS was defined as EOS within 36 months after implantation. From the premature and normal EOS group, longevity from single chamber (SC), dual chamber (DC) and cardiac resynchronisation therapy ICDs (CRT-D), rate responsive (RR) settings, high output pacing, and indication for ICD therapy was compared. High output pacing was defined as more than 50% pacing at 3,5 Volt and 0,4 milliseconds minimal. Longevity is expressed in months (m).
**Results** Between October 1998 and September 2006, 203 ICD replacements (165 patients) were performed in a total population of 854 patients. Replacement indications were device advisory or recall (n=30), premature EOS (n=59), normal EOS (n=95), system malfunction (n=9) and infection (n=10). Premature and normal EOS replacements consisted of 32 SC, 98 DC and 24 CRT-D systems. Longevity was significantly longer in SC systems compared to DC and CRT-D systems (54±19 m vs 40±17 m and 41±15 m; p=0,008). Longevity between non-RR (n=143) and RR (n=11) settings was not significantly different (50±11 m vs 54±15 m). High output pacing did not significantly decreased longevity compared to systems without high output pacing (43±19 m vs 45±17 m). Longevity of ICDs was not significantly different between primary and secondary prevention.
**Conclusion** SC ICD generators have a longer service time compared to DC and CRT-D systems. Indication for ICD therapy, RR setting, and high output pacing does not seem to have an effect on generator longevity.

## DEFIBRILLATION THRESHOLD COMPARISON OF 65% TILT VERSUS OPTIMIZED WAVEFORMS

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**Background** Theoretical considerations on defibrillation threshold (DT) yield that pulse duration (PD) or tilt should be tuned to time constant (RC) which is output capacitance C times load resistance R. Efficacy decreases with increasing RC. Our theory assumes optimal truncation of an ICD if rheobase is reached. The study should prove the correctness of our theory.
**Material and Method** 12 pigs (between 19.5 and 28.2 kg) were treated with biphasic shocks (BS) generated by a high voltage stimulator. BS were recorded with an oscilloscope. From leading and trailing edge voltages and the time in between, RC was calculated to program optimal truncation. A 65% tilt waveform was chosen for comparison. The double failure test method was used for threshold determination.
**Results** DT for 65% tilt waveform were determined at the beginning and at the end of each investigation. The DT after 121 min (mean value) proved to be lowered by 3.7%. Prolongation of PD from optimal to 65% tilt increased the voltage by 17.6%, stored energy by 38.4%. DT do not vary remarkably during two hours experiments.
**Discussion** An oscilloscope for DT measurements is indispensable. Voltages as indicated by high voltage generators are always too high. The increase of the voltage/energy for the 65% tilt waveform by 17.6%/38.4% is a clear sign that voltages below rheobase are not only useless but may be maleficent.
**Conclusions** PD or tilt must be adjusted to RC to reach optimum. Our tilts varied between 44.5% and 54.1% demonstrating that today's PDs are too long or tilts are too large.

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## THE COST OF ICD THERAPY IS RELATED TO DEVICE LONGEVITY

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**Background** ICD therapy is cost-effective, as based on available literature. Beyond device technical specificities, longevity is the main parameter to consider to improve cost-effectiveness. We evaluated the cost of ICDs from different manufacturers based on their actual longevity as measured at device replacement.
**Methods** Longevity of single chamber (SC), double chamber (DC), and biventricular (BiV) ICDs from Medtronic (MDT), Guidant (GDT) and St. Jude Medical (SJM) was measured in all the patients implanted in years 2000, 2001,2002 who were follow up to July 2007. The cost of each ICD (device + lead/s) was averaged for its own longevity.
**Results** 135 patients received an ICD in the abovementioned period. SC devices replacement occurred in 3/13 (MDT), 17/26 (GDT), 26/35 (SJM). Longevity was 73±14, 60±17, 55±10 months respectively.
DC devices replacement occurred in 2/5 (MDT), 16/17 (GDT), 25/28 (SJM). Longevity was 74±15, 50±8, 46±14 months respectively.
BiV devices replacement occurred in 2/7 (MDT), 2/2 (GDT), 3/3 (SJM). Longevity was 67±54, 44±3, 51±12 months respectively.

| Cost/month of treatment (€) | SC | DC | BiV |
|---|---|---|---|
| MDT | 188±48 (141-309) | 253±68 (208-371) | 293±74 (245-446) |
| GDT | 261±109 (164-627) | 386±61 (246-574) | 470±29 (449-490) |
| SJM | 224±68 (148-512) | 421±155 (225-1003) | 395±84 (299-460) |

**Conclusions** Cost effectiveness of ICD treatment is strictly dependent on device longevity, whereas device upfront cost is of limited clinical meaning. Appropriate assessment of cost-effectiveness should be based on ICD longevity in the real-life scenario.

## UNEXPECTEDLY HIGH FAILURE RATE OF A THIN ICD LEAD

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**Introduction** Thin ICD leads have been increasingly popular in the USA. It has been suggested, however, that they may be characterized by high complication rates. A recent report by Hauser et al raises the possibility that the Medtronic Sprint Fidelis lead family may be particularly prone to early fracture. One of the study limitations is that it is based on a single center experience and, thus, may not be reproducible.
**Objectives** We reviewed our records to identify patients who underwent insertion of a Medtronic 6949 Sprint Fidelis active-fixation lead between January 2005 and January 2007. All implants were performed by 3 electrophysiologists, skilled in the technique of extrathoracic subclavian or axillary vein puncture for vascular access. The purpose of this study was to estimate the incidence of symptomatic lead failure during follow-up and to compare it with the manufacturer-reported data.
**Results** 195 patients underwent insertion of the index lead. Mean follow-up was 16±11 months. Lead failure, defined as the occurrence of multiple, inappropriate shocks, associated with an increase in shocking impedance consistent with lead fracture, was diagnosed in 7 patients, with an incidence of 1.5% at 1 year and 5% at 2 years. This contrasts data from the Medtronic longevity study, which indicate a survival for the 6949 Sprint Fidelis lead of 98.9% at 2 years. Of note is the fact that 4/7 patients with lead fracture from our database would not be included in the manufacturer database, because the lead was utilized during implantation of an ICD generator from a different manufacturer.
**Conclusions** The Medtronic 6949 ICD lead is characterized by a high failure rate. This phenomenon appears to be underestimated, most likely due to the practice of using products from different manufacturers during the same implant, which may have a negative impact on product registration and postmarketing safety studies.

## INCIDENCE OF ADVERSE EVENTS RELATED TO IMPLANTABLE DEFIBRILLATOR REPLACEMENT

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**Introduction** Despite the widespread use of implantable cardioverter-defibrillators (ICDs), little information is available regarding the incidence of adverse events related to generator replacements. This analysis describes adverse events reported in a cohort of ICD patients after generator replacement.
**Methods** All adverse events reported after ICD replacement were collected and adjudicated by the investigators. Adverse events were classified as system, lead, or procedure related. Invasive or non-invasive resolvement of reported adverse events is also reported in this analysis.
**Results** From October 1998 to September 2006, 854 patients received an ICD. Of these patients, 165 (19%) had 203 generator replacements. Indications for generator replacement were normal end-of-service (n=95), premature end-of-service (n=59), recall or device advisory (n=30), system malfunction (n=6), insufficient maximum energy (n=3), and infection (n=10). After replacement, 4 procedure-related adverse events were reported (3 infections and 1 pocket haematoma). System and lead-related complications were reported in 6 patients. RV lead defects were observed in 4 patients, and header/connector problems in 4 patients. The major complications attributable to infections and RV lead defects (3% of all replacements) required reoperation. The minor complications, like header/connector problems could be resolved during the procedure without clinical consequences.
**Conclusions** ICD generator replacement is associated with a substantial rate of complications requiring reoperation.

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## CORONARY SINUS STENTING IS EFFECTIVE FOR THE PREVENTION AND TREATMENT OF CORONARY SINUS LEAD DISLOCATION

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Coronary sinus (CS) leads used for cardiac resynchronization have undergone significant development in the last years. However, dislocation rate remained high (5-9%). The aim of our study was to investigate the effectiveness and safety of stent implantation in a CS side branch to stabilize the left ventricular lead position after postoperative or intraoperative lead dislocation.
118 patients (age: 66±10 years, 69 primary, 49 ischemic cardiomyopathy, NYHA class III: 105, IV: 13) were treated with stenting. The procedure was performed because of postoperative dislocation in 10 patients, while dislocation, microdislocation or phrenic nerve stimulation was observed during the implantation in 108 cases. The electrode was repositioned into the desired position, and a bare metal coronary stent was introduced via another guide wire through the same CS sheath. The stent was deployed at 5 to 30 mm proximal to the tip of the electrode with a pressure of 6 to 14 atmospheres. Control angiography showed no blood flow compromise in any of the side branches or in the CS. Control echocardiography did not show pericardial effusion due to stenting. During follow-up (10.2±9.7; 1-34 months) left ventricular pacing threshold increased from 2.2 to 5.6 V in one patient, but dislocation was not found by fluoroscopy. Clinically important pacing threshold increase was not detected in the other cases. Impedance measurements did not suggest lead insulation failure. Reoperation was not necessary in our patients with CS lead stenting because of lead dislocation. In two cases the electrodes and the CRT devices were explanted due to infection three and five months after the implantation. The stented CS leads were extracted transvenously without any complications.
Stent implantation to stabilize the left ventricular lead position seems to be a useful and safe procedure in the treatment of patients with complicated coronary sinus anatomy or CS lead instability.

## A NEW TECHNIQUE FOR ACHIEVING CORONARY SINUS CANNULATION IN CHALLENGING BIVENTRICULAR IMPLANTS: A RANDOMIZED STUDY

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Biventricular implantation may be challenging and prolonged. A critical step is coronary sinus (CS) cannulation achievable using guiding catheters alone or with the aid of an electrophysiology catheter (EC) advanced inside (EC aided positioning – EPA strategy).
We tested a new technique based on the combined use of a diagnostic decapolar EC positioned in the CS via the right internal jugular vein (RIJV) used as a road-map for CS and a deflectable EC reaching CS via the left subclavian vein (JUgular vein and DEflectable aided positioning – JUDE strategy) and evaluated its usefulness in challenging cases.
Fifty consecutive patients were randomly assigned to Group 1 (25) or Group 2 (25). In Group 1 the EPA technique was initially performed. If CS cannulation was not obtained after 30 minutes, the operator crossed-over to the JUDE technique. In Group 2 the EPA technique was initially performed. If CS cannulation was not obtained after 15 minutes, the operator crossed-over to the JUDE technique.
In Group 1 successful CS cannulation was achieved in 21 of 25 patients (84%) with EPA technique. Four patients were crossed-over to JUDE technique, effective in all. In Group 2 successful CS cannulation was achieved in 20 of 25 patients (75%) with EPA technique. Five patients were crossed-over to JUDE technique, effective in all. Time to successful catheterization of CS was 18±26 minutes in Group 1 versus 8±10 minutes in Group 2 (p=0.02). Fluoroscopy time was 11±16 minutes in Group 1 versus 4±6 minutes in Group 2 (p=0.03). No procedure-related complications were recorded.
When CS cannulation is technically difficult, the use of JUDE technique allows a successful CS cannulation in all cases and can reduce procedural time and fluoroscopy time.

## OUTCOME OF ABANDONED NON-FUNCTIONAL TRANSVENOUS LEADS IN YOUNG PATIENTS

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**Purpose** In children needing permanent pacemakers (PM), transvenous leads may fail for technical reasons or patient's growth and may be extracted and replaced or abandoned and substituted. No study is entirely dedicated to the outcome of the latter.
**Material and Methods** We evaluated the outcomes of abandoned endocardial leads, with a retrospective analysis. Data are reported as median (range).
**Results** In 18 (7%) of 245 patients with endocardial pacing systems, with first PM implanted at 4 (0.3-19) years of age, VVIR in 15 and DDD in 3 patients, 19 leads (16 V, 3 A) failed (abnormal threshold increase in 7 patients, exit block in 8 including 3 faulty atrial leads, insulation break in 3) after 10 (3-15) years, and were abandoned and substituted at 13 (6-30) years. Seven patients implanted VDD, 7 VVIR, 3 DDD PM, 1 an epicardial system. Number of abandoned leads is 1 (1-2), total leads are 2 (3 in 4 patients). In 5 patients, 3 with subclavian vein occlusion, a controlateral procedure was performed. All the procedures were successfully completed. Follow-up (FU) duration is 4 (1-10) years. New leads showed normal function. Tricuspid valve dysfunction or new venous occlusion did not occur. Two cases of lead endocarditis occurred in patients with 2 leads, after 5 (VDD PM) and 10 years (VVIR PM) of FU. No specific risk factors for endocarditis were identified.
**Conclusions** This is a palliative procedure, technically feasible. Two patients had endocarditis of the leads. We can not exclude that the presence of the abandoned lead might predispose to infectious complications.

## USEFULNESS OF EXCIMER COOL LASER ASSISTED PERCUTANEOUS PM/ICD LEAD EXTRACTION TO COMPLETELY REMOVE LEAD PARTS LEFT AFTER SURGICAL EXTRACTION FAILURE

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**Background** Excimer cool Laser technique can be used to extract infected pacemaker (PM) and ICD leads. The laser sheath (Spectranetics®) uses optical fibres, delivering pulsed ultraviolet (cool) excimer laser light, to vaporize fibrotic tissue binding intravenous cardiac leads to the vein or heart wall during lead extraction. We present our experience regarding its use in the subset of percutaneous extraction of leads damaged during surgical removal attempts.
**Methods and Results** From January 2006 to January 2007, 4 patients (pts) (mean age 60.5 years, range 56 – 68) were referred to Our Centre

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because of a PM/ICD related infection who had indication for surgical PM/ICD and leads extraction, such as endocarditic vegetations on leads or on both leads and valves, with or without septicaemia, and in whom surgical intervention failed to completely extract the leads (2 dual-chamber PM, 1 single-chamber PM and 1 dual-chamber ICD); all leads had a left subclavian access and a passive fixation tip; the defibrillation lead of the ICD was double-coiled; mean leads implantation time was 158.6 months (range 111 – 229). All leads were cut at superior vena cava level and there distal parts were easily removed during surgical intervention but it was not possible to remove proximal parts because of strong adherences at subclavian vein angle; a percutaneous intervention using Excimer Laser technique was then attempted: such intervention was differed for the first pt while for the other patients a skilled equipe in reverse stand-by was planned, so it was performed simultaneously to surgical intervention. All 6 leads were completely extracted without complications; mean extraction time was 17 min (range 7 – 28).
**Conclusions** Excimer cool Laser assisted lead extraction is a safe procedure and can be successfully used to extract PM and ICD lead parts that surgical intervention failed to remove.

## COMPARISON OF SWABS AND TISSUE/CATHETER CULTURES FOR DIAGNOSIS OF PM/ICD INFECTIONS

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**Background** Infection of PM/ICD is becoming a more frequent occurrence. Chronic draining sinus seldom heals with local interventions, but the need to treat it as a local infection is not yet clear.
**Material and methods** Between May 2003 and June 2007, at our Centre, 101 leads were extracted from 54 patients, of which 87.5% had indication of infection. Before explant, patients affected by a local infection, chronic draining sinus or sepsis underwent a blood culture and a bacteriological examination of the device pocket. After extraction, both lead tip and pin were also examined.
**Results** Cultures from explanted lead pins returned positive results in 100% of local infections and in 92.5% of chronic draining sinus cases, with a difference not significant. This demonstrates that chronic draining sinus, with culture-negative local analyses, is often sustained by an infection. In sepsis, positivity of blood samples is lesser than that observed in lead samples (58 vs 83).The difference is statistically significant for tip samples (86.7 culture positivity, p=0.02). So, bacteriological cultures from explanted leads, mainly from tip fragments, are more sensitive than blood cultures for infection diagnosis. Concordance between bacterial isolates from pocket and lead, and from pocket and pin is quite low, approaching 45%, for a contamination effect. Concordance between bacterial isolates within the lead (from pin and tip), is quite high, approaching 70%. So isolates from the lead may be clearly associated to infection. Concordance between isolates from lead and blood, and mainly from tip and blood is very high, approaching 85%.So, bacterial isolates from the lead, and particularly from the lead tip, are expression of the clinical infection.
**Conclusions** The high rate of isolates from lead samples in chronic draining sinus strongly support the hypothesis that it is often sustained by an infection and lead samples clearly increase the diagnostic sensitivity.

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## CRYOABLATION OF THE CAVOTRICUSPID ISTHMUS IN ATRIAL FLUTTER: COMPARISON OF A MEDIOSEPTAL WITH A MEDIOLATERAL ABLATION LINE

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**Introduction** Catheter ablation of the vena cava-tricuspid isthmus is the first line therapy in common atrial flutter. Recent studies have shown cryoablation as a safe, efficient and pain free alternative to conventional radiofrequency ablation. The aim of this prospective randomized study was to compare a medioseptal versus a mediolateral ablation line with cryothermia relating to effect, safety and long-term success rate.
**Methods** Patients were randomly assigned to a medioseptal (septal/posteroseptal) or a mediolateral (posterolateral) ablation line. In medioseptal group (S), 50 patients were included, and 46 in mediolateral (L), respectively. Ablations were performed by a deflectable 8 mm cryocatheter (Freezor®Max, Cryocath, Montreal, Canada). Target temperature was -80°C for 240 seconds. Procedure end points were defined as a complete bidirectional isthmus block according to combined methods (differential-pacing, duration of trans-isthmus-conduction time, conduction intervals, intervals of double-potentials, polarity of P-waves in ECG).
If bidirectional block was not obtained within 20 cryoinjections, ablation line was changed to the opposite site. It was in the decision of the investigator to continue in the same or in a second session.
**Results** Patient characteristics were comparable in both groups. Number of cryoinjections (14,3±9,1 S; 13,1±7,7 L), duration time of procedures (140±53 min S; 134±49 min L) and mean fluoroscopic time (16,9±8,3 min L; 20,5±12,3 min S) did not differ significantly between the groups. Bidirectional block was obtained in all patients. Change of the ablation line was necessary in 13% (6/46) of L-group and 12% (6/50) of S-group, respectively. Long term success rate was 98% in L-group and 90% in S-group (total 6,5%). There were no procedure-related complications.
**Conclusions** Cryoablation of the CTI is a safe and efficient therapy for common AFL. The effect and success rate are comparable in a medioseptal and a mediolateral ablation line. Mediolateral ablation line is associated with a higher long-term success rate.

## FLUOROSCOPY FREE ABLATION OF THE CAVOTRICUSPID ISTHMUS: RESULTS OF A PILOT MULTICENTER STUDY

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Fluoroscopy use for arrhythmia ablation is undesirable both because of radiation and because the dependence on expensive facilities for fluoroscopy generation and protection. Some investigators have proposed a fluoroscopy-free approach for supraventricular tachycardia ablation but this has never been investigated for atrial flutter or in a multicenter study.
**Methods** This was a multicenter study of 5 centers and 13 operators. 51 patients with common atrial flutter scheduled for catheter ablation were prospectively enrolled. Conventional electrophysiology catheters were introduced percutaneously into the inferior cava vein and moved to the right atrium without fluoroscopy but the guidance of a non-fluoroscopy navigation system (Ensite-NavX®). Geometrical reconstruction of the right atrium, the cava veins, and the coronary sinus was obtained by the system by displacement of the electrophysiology catheters. Following cavotricuspid isthmus dependency demonstration, the atrial flutter was ablated conventionally but whithout fluoroscopy.
**Results** All ablation procedures were performed without fluoroscopy in all patients except in 7 (14%), in whom 8.7±7.2 min (1.2-20 min) fluoroscopy was used. The duration of the whole procedure was 126±6 min and ablation was performed in 15±5 min. Cavotricuspid isthmus ablation was achieved in all patients but in 5, in whom ablation was unsuccessful, even despite the use of fluoroscopy in 3. All failures and more than half (4 out of 7) of the procedures with fluoroscopy use were concentrated in a single center. There were no complications except for transient AV block in a patient.
**Conclusions** cavotricuspid isthmus ablation without fluoroscopy is feasible and apparently safe. Whether the result of this approach is similar to the conventional approach in terms of efficacy and procedure duration, has to be investigated in a randomized trial.

## EARLY AND LATE OCCURRENCE OF ATRIAL FIBRILLATION AFTER SUCCESSFUL ABLATION OF TYPICAL ATRIAL FLUTTER: LONG-TERM RESULTS

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Catheter ablation of typical atrial flutter (AFL) is an established therapy. In the clinical setting, AFL and atrial fibrillation (AF) often coexist in the same patient (P) and AF may become clinically relevant after AFL ablation.
**Aim** To evaluate the incidence of AF after AFL ablation in P with and without previous AF. Population and
**Methods** 56 P (64±13 years), who underwent successful AFL ablation. Thirty eight P (68%) had structural heart disease. Large-tip (8-mm) ablation catheters were used in 19P and irrigated-tip catheters in 37P. The number of RF applications was 18±14, and the number of linear lesions 2.3±1.3/per patient, with no significant differences between both types of catheters. We considered two groups: AF before AFL ablation (group I, n=16), and without previously documented AF (group II, n=40). Continuous in-hospital electrocardiographic monitoring, 24h Holter recordings (1st, 6th, 12th months), and ECGs (2nd month and every 6 months) were performed.
**Results** There were no significant differences in clinical profile, left atrial dimensions, left ventricular ejection fraction, and late atrial potentials between both groups. During 26±13 months, 10 P (18%) had AFL recurrence and 14 P (25%) had episodes of AF (31% in group I and 23% in group II; p=NS). After AFL ablation, 69% of the P in group I did not have AF recurrence. In group I, AF occurred in the first month post AFL ablation in 80% of the cases, while in group II, AF appeared >6 months post-ablation.
**Conclusion** During the first 2 years after ablation of AFL: 1) the recurrence rate of AFL is <20%, 2) AF occurs frequently, without relation with previous AF. Nevertheless, it is possible to obtain a significant reduction of AF in P with previous AF. 3) The late appearance of AF in P without previous AF suggests a progression of the arrhythmic substrate.

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## META ANALYSIS OF FIVE INTERNATIONAL MULTI-CENTRE REGISTRIES OF CATHETER ABLATION OF TYPICAL ATRIAL FLUTTER

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**Methodology** Raw data from FRANCE 1, FRANCOR, EASTHER, CENTHER and ENTRY, international multi-centre registries have been processed.
**Results** These registries have been organized in 35 electrophysiology centers in 12 European countries. In total 825 patients have been treated in these registries. (633 men (76%), average age 63.1±12 years). All patients have been treated by radiofrequency catheter ablation (RFA) with the use of an irrigated-tip catheter. The average duration of arrhythmias (typical atrial flutter) prior to ablation was 563 days. 288 (35%) patients had concomitant atrial fibrillation and 324 patients had organic heart disease. A first ablation was performed in 725 patients; a second subsequent RFA was identified in 74, and a third one in 22 patients. The average procedure time was 100±53 minutes, of which 46±34 minutes were required for the radiofrequency ablation period alone; the waiting time after the ablation was 21±20 minutes. The average time of X-ray radiation was 14±12 min. The average number of individual applications of the RF energy per one procedure was 11,42±9,2. After the first 30 seconds the following parameters have been achieved: power output 35±8 W, temperature 40.4±4 oC and impedance 112.3±20 Ù. A bi-directional block was achieved in 764 patients (90%); uni-directional block in 35 cases (4%), and no success (no block) was observed in 54 patients (6%). 9 Adverse events were reported (1 haematoma at the puncture site, 1 acute coronary syndrome requiring a PCI, 1 PM implantation was required due to AVB, 3 cases of AT occurred, 2 cases of an atypical flutter, 1 SSS) which represent 1% of all treated patients.
**Conclusion** The meta-analysis showed a high efficacy and safety level of radiofrequency catheter ablation of typical atrial flutter and confirmed the indication of catheter ablation as a safe first line treatment of typical atrial flutter.

## DOES SURFACE EKG DISCRIMINATE BETWEEN TYPICAL AND ATYPICAL ATRIAL FLUTTER? RESULTS OF 401 CONSECUTIVE PATIENTS

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**Introduction** Ablation of isthmus dependent atrial flutter (IDFL) is simple, safe and very successful. On the contrary in case of non-IDFL the procedure could be difficult and risky especially if the flutter circuit is the left atrium. In order to verify if the EKG can be a reliable tool to identify the flutter substrate we examined 401 consecutive patients ablated for atrial flutter.
**Patients and Methods** We reviewed the ECG of 401 pts that underwent catheter ablation because of atrial flutter between January 2001 and January 2007 (78% male, mean age 69±10 years). We considered IDFL ECG pattern the presence of negative sawtooth waves in the inferior leads with positive waves in V1 (counterclockwise flutter) or positive deflections in the inferior leads and negative in V1 (clockwise flutter). 332 of these patients had an IDFL (group 1) while 69 patients had non-IDFL (group 2).
**Results** In the group 1 we found an IDFL ECG in 276 (78%) patients while 56 pts (22%) we found a non-IDFL ECG. In the group 2 we found 46 (67%) pts with a NIDFL ECG, and 23 (33%) had an IDFL ECG. The pts with non-IDFL were ablated in the right atrium in 47 pts (60%) while the flutter circuit was in the left atrium in 27 cases (40%).
**Comments and conclusions** Our data show 1) that even if the typical IDFL ECG has a good predictive value (83%) of isthmus dependent arrhythmia before performing isthmus flutter ablation we have to clearly prove the electrophysiological tachycardia mechanism because in 17% pts the substrate is not isthmus depended. 2) 41% of atypical ECG present at the electrophysiological study an IDFL, then in case of atypical ECG it is not possible to identify the arrhythmia mechanism.

## INCREMENTAL PACING FOR THE DIAGNOSIS OF COMPLETE AND FUNCTIONAL BLOCK OF THE CAVOTRICUSPID ISTHMUS

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**Purpose** Typical atrial flutter (AF) recurrences after ablative therapy are related to reconduction over the cavotricuspid isthmus (CTI). We hypothesized that the assessment of complete and not functional bidirectional CTI block is useful to reduce AF recurrences.
**Materials and methods** Thirty-two consecutive patients (mean age 67±9 years, 6 female) undergoing CTI ablation for typical atrial flutter were prospectively included in the analysis (group 1), and compared to a previous cohort of 106 consecutive patients undergoing 125 flutter ablation procedures with confirmation of CTI block by previously established criteria (group 2,67±11 years, 22 female). The incremental atrial pacing protocol was performed from both the coronary sinus (CS) and right lateral atrium (RA) at cycle lengths of 600-500-400-300-250 ms. "Functional" CTI block was suspected and further radiofrequency applications deemed necessary when the distance between double potentials (DP) along the isthmus ablation line increased >20 ms during incremental pacing. Otherwise, "complete" CTI block was determined.
**Results** Complete CTI block was achieved in 31/32 patients from group 1. During functional block, the DP significantly increased during incremental pacing from 69±25 to 118±23 ms from the CS and from 78±36 to 124±28 from the RA ($p<0.001$). Inversely, during complete block the DP did not increase significantly, 113±20 to 121±19 ms and 124±28 to 127±36, respectively, p=NS.
The CTI was considered blocked in 102/125 procedures in group 2 (p=0.1 vs group 1). Of the 21 patients with complete CTI block (group 1) there were no flutter recurrences in a mean follow-up of 8±2 months. In contrast, among the 102 efficacious procedures from group 2 there were 12 recurrences (p=0.045 as compared to group 1).
**Conclusions** The incremental pacing is useful for the assessment of complete CTI block to reduce atrial flutter recurrences after ablation.

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## USEFULNESS OF TISSUE DOPPLER IMAGING TECHNIQUE IN WOLFF-PARKINSON-WHITE SYNDROME

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**Objective** To evaluate the feasibility of tissue doppler imaging (TDI) for locating the early ventricular contraction sites associated with accessory atrioventricular pathways in Wolff-Parkinson-White (WPW) syndrome.
**Methods** Twenty-two patients admitted for WPW ablation were consecutively included in the study. A TDI (Vivid 3; General Electric Medical System, Milwaukee, WI, USA) was performend before, after, and at three months after radiofrequency ablation of the accessory pathways.
The pre-excitation site was represented as a time interval between the delta wave or before the onset of the QRS complex and the S wave at TDI, and confirmed by electrophysiological studies.
**Result** Of 12 patients with left-sided accessory pathways, the early ventricular contractive sites were correctly identified by TDI in 11 patients, while the sites were determined by TDI in 8 out of 10 patients with right-sided accessory pathways. The results were confirmed at the TDI exploration. There was no significant difference between the two groups (P>0.05). Postoperatively, all pts manifested an elongation of the activation time, consistent with an immediate positive result of the procedure. At three months after the RF procedure 21 pts out of the 22 manifested the same post-op results. One patient presented shorter activation time which was consistent with WPW redo.
**Conclusion** In the presence of Wolff-Parkinson-White syndrome, TDI localizes contraction abnormalities associated with early activation of a part of the ventricle. This noninvasive examination, concordant with the available data in literature, seems to be an adjunctive tool for localizing both the left-sided and the right-sided accessory pathways. After the ablation procedure, it also predicts the early and intermediate success of the ablative procedure.

## PREARRHYTHMIC REDUCED CONTRACTILE PERFORMANCE IN PATIENTS WITH VENTRICULAR ARRHYTHMIAS

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**Introduction** Recently we demonstrated significant voltage gradients in the last sinus beat (S-1) preceding ventricular extrasystoles (VE) and/or ventricular tachycardia (VT) compared with earlier sinus beats (S-2 and S-3). The findings were compatible with phase 2 reentry as the responsible mechanism for VE/VT in man.
**Aims of the study** To examine if the prearrhythmic voltage gradients could be detected in the contractile performance of S-1 using Tissue Doppler Echocardi-ography (TDI).
**Methods** Thirteen consecutive patients, 7 females, 6 males, median age 53 years were examined with GE VIVID 7. Six patients had no structural heart disease, 3 patients had arrhythmogenic right ventricular dysplasia, 2 patients ischemic heart disease, one patient aortic stenosis, and one patient suffered from di-lated cardiomyopathy. Patients were examined from the apical four chamber view with a frame rate above 160 Hz. Loops containing at least 3 sinus beats prior to a VE were used. Analyses were performed in end-systole using tissue tracking analysis for evaluation of systolic displacement at the base of the lateral wall and interventricular septum.
**Results** A highly statistically significant decrease in systolic displacement was observed in all 13 patients comparing S-1 with S-2 (interventricular septum 5.1 versus 9.2 mm, p<0.001; Lateral wall 4.8 versus 9.0 mm p<0.001).
**Conclusion** Ventricular ectopy is preceded by a significant decrease in contrac-tility in the last sinus beat preceding the arrhythmia. This new phenomenon was observed in all 13 patients studied irrespective of the etiology of the heart disease pointing to a common arrhythmogenesis.

## USING PHENOMENON OF MECHANICAL RESTITUTION AND POTENTIATION TO ACCURATELY ASSESS LV FUNCTION FROM SINGLE BEATS DURING ATRIAL FIBRILLATION

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Irregular rhythm in AF makes it difficult to assess LV function. Echo parameters are generally averaged over 3-5 beats which is unreliable. A mean of 13 to 17 beats are needed to accurately estimate cardiac output during AF. LV function is also dependent on the ratio of preceding (RR1) and pre-preceding (RR2) cycle lengths.
**Methods** 30 patients with AF (mean age 72±12 years; 21 men) underwent 2D echo & Doppler analysis (GE Vivid 7) to assess LV systolic function (aortic time-velocity integrals (TVI), end-diastolic (EDV) and systolic volumes (ESV) and ejection fraction (EF) using biplane method) & diastolic function (mitral E wave velocity, deceleration time (DT), pulmonary venous flow velocities). Minimum of 17 consecutive cycles were recorded for each parameter. Beats with equal RR1 and RR2 intervals (index beats) were identified (maximum difference <60 msec) and labelled as IB1 & IB2 (longest & shortest equal R-R cycles respectively). Average values measured over 17 consecutive cardiac cycles were compared with single values obtained from IB1 and IB2.
**Results** Strong correlation was seen between values of all parameters of LV systolic and diastolic function obtained over index beats (IB1 & IB2), and the average of values from 17 consecutive cycles (coefficient of correlation in range of 94-99% for all parameters of systolic function, p<0.0001; 95-96% for mitral E velocity, p<0.0001; 80-85% for mitral DT, p<0.0001; 90-95% for pulmonary venous velocities, p<0.0001). Mean relative error for EF from index and averaged beats was <1%. Measurements were not affected by short or long cycle lengths and provided values with similar accuracy between IB1 and IB2.
**Conclusion** Single beats with RR1=RR2 allow accurate assessment of LV systolic and diastolic function in AF. These findings can be explained by the phenomenon of mechanical restitution and potentiation and remove the time-consuming need to measure over multiple cycles.

## IMPLANTATION OF THE RIGHT ATRIAL LEAD IN THE BACHMANN'S BUNDLE REGION HAS NO INFLUENCE ON CARDIAC HEMODYNAMICS IN PATIENTS WITH MULTISITE ATRIAL PACING

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In patients treated with multisite atrial pacing the impact of changes in hemodynamics, due to altered atrial activation sequence, on antifibrilatory properties of pacing has not been elucidated yet. Bachmann's

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bundle (BB) area pacing was reported to attenuate AF progression, but data on its hemodynamics is limited. We compared effects of two multisite atrial pacing configurations on cardiac hemodynamics by echo-Doppler. There were 29 patients with right atrial (RA) lead implanted at the BB region, and 28 patients with RA appendage (RAA) pacing. In all patients the second atrial pacing lead was implanted in the coronary sinus (CS). In all patients cardiac output (VTI_Ao), MPI, right and left ventricular filling, interval from pacing spike to the peak of mitral (PAm) and tricuspid (PAt) A-wave, right-left atrial contraction sequence [PA(m-t)], and the difference in A-wave duration [Adiff(m-p)] at the level of the mitral valve (Am) and pulmonary veins (Ap) were examined.

**Results** There were no significant differences between two groups other than pacing duration: 2.8±1.3 years in the RAA vs 1.3±0.5 years in the BB group (p<0.01). Comparing RAA+CS and BB+CS pacing configurations: PAm 170±21 ms vs 154±24 ms (<0.01), PAt 163±22 ms vs 164±27 ms (0.97), PA (m-t) 8±20 ms vs -9±27 ms (<0.05), absolute values of PA (m-t) 17±13 ms vs 21±18 ms (0.4), Am 167±22 ms vs 163±22 ms (0.6), Ap 140±24 ms vs 143±19 ms (0.6), Adiff (m-p) 27±36 ms vs 21±24 ms (0.5), VTI_Am 8.3±2.5 cm vs 8.0±1.9 cm (0.8), VTI_At 5.5±1.4 cm vs 6.0±1.8 cm (0.2), VTI_Ao 30.2±6.8 cm vs 29.9±5.9 cm (0.9), MPI 42±13 vs 48±12 (0.06).

**Conclusions** Implantation of the right atrial lead at the BB region accelerates left atrial contraction, and reverses the usual right-to-left atrial contraction sequence, when compared to conventional RAA location. The right atrial lead implantation site has no influence on cardiac hemodynamics.

## NO DIFFERENCE OF ACUTE DELETERIOUS EFFECTS ON THE NORMAL LEFT VENTRICULAR FUNCTION BETWEEN RIGHT VENTRICULAR APICAL AND OUTFLOW PACING

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**Background** A depressed LV function is sometimes observed after long-term right ventricular apical (RVA) pacing. Whether acute right ventricular outflow (RVOT) pacing causes less deterioration in wall motion score (WMS), LV-strain and tissue Doppler imaging (TDI) than acute RVA pacing, is unknown.

Objectives: To compare the acute effects of right ventricular outflow (RVOT) or apical (RVA) pacing on the normal left ventricular (LV) function measured by wall motion score (WMS), LV strain and tissue Doppler velocity imaging (TDI) in patients with normal LV function.

**Methods** Fourteen patients with a DDD-pacemaker inserted for brady-tachycardia syndrome (7 RVA, 7 RVOT) and normal LVF without other cardiac abnormalities were studied. Pacemaker dependency was absent in all, allowing acute programming changes. Echocardiography including WMS, LV-strain and TDI for electromechanical delay was performed both during normal intra-ventricular conduction (AAI mode) and abnormal intra-ventricular conduction (DDD mode), and at a higher pacing rate of 20 ppm above the initial rate.

**Results** Mean WMS worsened from normal 16 (AAI pacing) to 19.2 in RVA and to 18.1 with RVOT pacing. Mean longitudinal LV strain was 20.8% during AAI pacing and decreased to 18.8% and 19.7% for RVA and RVOT pacing respectively. No difference was observed in the electromechanical delay between RVA and RVOT pacing. Pacing at higher rates resulted in a further worsening of all assessed parameters.

**Conclusion** Both acute RVA and RVOT pacing negatively affect the normal LV function shown with WMS, LV-strain and mechanical activation times compared to normal intraventricular conduction, without clear differences between both RV pacing sites. Higher pacing rates enhanced these unfavorable effects of RVA and RVOT pacing. These findings suggest that echocardiographic examination of the LV function during the implantation procedure cannot support selection of the most favorable right ventricular pacing site.

## DOES MECHANICAL DYSSYNCHRONY INDICATE AN HIGHER SUSCEPTIBILITY TO ARRHYTHMIC EVENTS IN PATIENTS WITH DILATED CARDIOMYOPATHY? RESULTS OF A PILOT ITALIAN EXPERIENCE

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**Purpose** Mechanical dyssynchrony is supposed to be the consequence of anomalous electrical activation of the left ventricle; we hypothesized that the presence of dyssynchrony at echocardiography might be a marker of a higher susceptibility to arrhythmias in pts with dilated cardiomyopathy. Aim of this pilot analysis was to assess whether the echocardiographic evaluation of dyssynchrony is related to the number of arrhythmic events in pts with idiopathic dilated cardiomyopathy.

**Materials and methods** We studied 19 pts with idiopathic dilated cardiomyopathy (EF<40%) implanted with a Medtronic single chamber ICD; the reason for implantation was primary prevention in 11 pts (58%) and secondary prevention in 8 pts (42%). None of the patients had bundle branch blocks.

The echocardiographic evaluation was performed with GE VIVID 7 equipments; data were stored on CD ROMs for off-line analysis in a core laboratory. The following dyssynchrony indices were considered: interventricular mechanical delay (IVMD) >40 ms, difference in time to peak systolic velocity between lateral wall and septum >65 ms, 12-segment standard deviation in time to peak velocity >33 and filling time duration <40%. Device interrogations were performed to record the number of ventricular arrhythmias (VA) occurred during a 12 months period.

The incidence of both overall life-threatening VA (VF, FVT and VT) and of VF were compared in pts with and without dyssynchrony.

**Results** Atrio-ventricular dyssynchrony and intraventricular dyssynchrony were not related to the the number of ventricular arrhythmias. Interventricular dyssynchrony seemed to be related to VA (p=0.07) and VF incidence (p=0.08).

**Conclusions** Our results suggest that mechanical dyssynchrony could be related to arrhythmic events in pts with idiopathic dilated cardiomyopathy. Datas need to be confirmed by further evaluations in larger populations.

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## ICD THERAPY IN PATIENTS WITH SEVERELY DEPRESSED LEFT VENTRICULAR FUNCTION

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**Introduction** With accumulation of the clinical evidence the implantable cardioverter device has become a standard treatment for either primary or secondary prevention of sudden death. However, the value of this treatment option is variable according to the indication of implantation. MADIT has well outlined the criteria of those patients with ischemic heart disease that would get benefit from ICD implantation. We aim at detecting the value of ICD implantation in patients with severely reduced left ventricular function.

**Patients and methods** We followed up 67 patients with severely reduced left ventricular function (<30%). 46 patients were with previous history of myocardial infarction and proved by coronary angiography to have coronary heart disease (group A), and the rest were diagnosed to have idiopathic form of cardiomyopathy (group B). All patients had ICD as a primary prophylaxis against ventricular tachycardia.

**Results** Group A consisted from 46 patients (36 males, 78.3%), while group B consisted from 21 patients (15 males, 71.4%), p value 0.4. The mean age was comparable in both groups (64±10 years). The mean follow-up duration for group A was 38±15 months versus 41±17 months, p value 0.5. 20 patients of group A (43%) versus 11 patients of group B (52%) were found to have at least one sustained ventricular tachycardia that necessitated either ATP (anti-tachycardia pacing) or shock therapy, P value 0.5.

**Conclusion** (1) ICD therapy is really an effective therapy for patients with coronary heart disease and reduced left ventricular function with documented life saving capability. (2) Nearly half of our patients with severely reduced LV function who had ICD implanted received at least one appropriate ICD therapy within 3 years follow-up. (3) Patients with severely depressed LV function are the most to get benefit from such therapeutic approach.

## IMPACT OF RENAL DYSFUNCTION ON SURVIVAL OF DEFIBRILLATOR RECIPIENTS IMPLANTED FOR PRIMARY PREVENTION

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**Purpose** We aimed to evaluate the impact of renal dysfunction (RD) on survival in defibrillator recipients implanted for primary prevention.

**Methods** We studied 102 patients (mean age 66.4±10.4 years, male 84%), submitted to ICD implant since January 2003 to December 2005. All the patients were in maximal and optimal therapy for heart failure (56% in NYHA class III; mean ejection fraction: 26.9±7.4%). An ischemic etiology was found in 61.5% of the patients. The primary end-point was all-cause mortality; the secondary end-point was the correct therapy delivery for ventricular arrhythmias (VA). RD was defined as a creatinine clearance (CrCl) less than 60 ml/Kg/min.

**Results** We found a RD in 34 patients (33.3% of the population). During the follow-up (mean 21.3±10 months) 17 patients died. Ten out of 34 patients died in RD group, while 7 out of 68 patients died in the control group (29.4% vs 10.3%, p=0.02). The survival after the follow-up period was 63.9% in the RD group and 85.6% in the control group. At the multivariate analysis the presence of RD (p=0.04), as well as NYHA class IV (p=0.002) and pulmonary hypertension (p=0.02), were associated with increased all cause mortality. A progressive increase in mortality rate was observed in relation to the worsening of RD (2 out of 17 patients in 45<CrCl<60, 4 out of 10 patients in 30<CrCl<45, 4 out of 7 patients in CrCl<30 ml/Kg/min). We noted a correct therapy delivery for VA in 16 patients (26.5% in the RD group; 11.7% in the control group; p=0.10).

**Conclusions** RD was associated with an increase in all cause mortality in patients submitted to ICD implant for primary prevention. The risk was present even if RD was mild and it raised proportionally to the worsening of RD.

## LONG-TERM CLINICAL RESULTS OF ICD IMPLANTATION

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**Purpose** The analysis of complications after the implantation of single-chamber and multi-chamber implantable cardioverters-defibrillators (ICD).

**Material** In 1990-2007, in the Bakoulev SCCVS 281 ICD have been implanted (156 - single-chamber, 125 - multi-chamber). Primary implantation of ICD was performed in 197 patients, in 84 cases ICD were replaced because of batteries depletion.

**Results** We evaluated long-term results of 281 implantations of the devices in 197 patients with ICD of the 3-4 generations (140 men, aged 14 - 74 years, mean, 48,9±14,8 years), follow-up duration 2 - 137 months (mean, 31,8±30,2 months). During the operation no complications occurred. In the long-term follow-up the following complications were seen:

Surgical - 15 (5,8%) (bed suppuration, decubitus - 3, lead dislocation, damage - 3 single-chamber and 7 dual-chamber, pacing threshold increase - 2); non-motivated discharges - 21 (8,1%) (T-wave detection- 4 single-chamber and 1 dual-chamber, lead damage - 1 single-chamber and 5 dual-chamber, sinus tachycardia, SVT - 6 single-chamber and 3 dual-chamber, external electromagnetic interference - 1); others - 3 (1,2%) (sensitivity disturbances during the attack - 2, device dysfunction - 1); total - 39 (15,1%)

**Conclusion** 1) The percentage of dislocation of active-fixation leads is much lower, than of the passive-fixation leads. 2) Leads damage occurs more frequently in young patients and can be caused by anatomical particularities of clavicle and first rib space. 3) Non-motivated discharges for SVT and sinus tachycardias are twice as frequent with single-chamber devices.

## ICD…THE PROPER THERAPY FOR THE APPROPRIATE PATIENT…LONG TERM STUDY

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**Introduction** ICD has become a standard treatment for prevention of sudden death. However, the value of this treatment option is variable from centre to another according to the studied patient group and follow up duration. We aim to define the variable protective effect of ICD therapy among different patient groups in our centre.

**Patients and methods** We followed up 131 patients with implanted ICD for variable indications including coronary heart disease with impaired LV function, idiopathic cardiomyopathy, syncope or previous resuscitation and suspected Brugada syndrome.

**Results** 64 patients were having CAD with history of AMI and reduced LV function, 33 patients had syncope at least once, 21 patients with idiopathic cardiomyopathy and reduced LV function, 9 patients with Brugada syndrome and the remaining 4 patients with hypertrophic cardiomyopathy. The mean follow up duration was 40±17 months. 46 patients (35.1%) developed at least one sustained ventricular

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tachycardia that necessitated ICD therapy. 52.3% of those with idiopathic cardiomyopathy, 37.5% of CAD patients, 27.2% of those with syncope, 22% among Brugada syndrome and non of those with hypertrophic cardiomyopathy required ICD therapy at least once during the follow-up. Nearly one third of our patients (46 patients, 35.1%) had 472 adequate ICD therapies during the follow up (mean; 10 ICD therapies for each), while the remaining (85 patients, 64.9%) didn't have any. This indicates that there is certain group of patients who get the maximal benefit of ICD implantation in whom the ICD stands as a shield against sudden death.

**Conclusion** ICD therapy is really an effective therapy for many patient groups with good impact on the survival of patients. Patients with severely depressed LV function are the most to get benefit from such therapeutic approach. The indications of ICD implantation should be revised in order to give the proper therapy to the appropriate patient.

## INAPPROPRIATE THERAPY AMONG PRIMARY PROPHYLACTIC ICD PATIENTS IS NOT A CLINICAL PROBLEM

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**Introduction** The rates of ICD implantation for a primary prophylactic indication have increased. The frequency of inappropriate therapy (IT) vs appropriate therapy (ApT) among this population has not been fully characterized.

**Methods** The St. Jude Medical Advancements in ICD Therapy (ACT) Registry is an outcome-oriented registry collecting demographic, device and clinical data in over 5,000 patients (pts) during a two-year follow-up. Case report forms for 2,645 pts undergoing ICD implantation for a primary prevention indication, with 12 months of follow up, were analyzed for the presence of ApT & IT as defined by the individual investigator. Baseline pt demographics included the following: Age (65.6±12.7 years), Gender (76.3% male), & NYHA Class (I – 6.0%, II – 33.8%, III – 36.4%, IV – 1.8%, Unknown – 22.0%). Device type was as follows: 31.6% single chamber, 36.1% dual chamber, & 32.3% CRT-D.

**Results** During the 12 month follow-up period 2016 therapies were noted in 271 pts (i.e. 10.2% of the population). 94% (1894) of the therapies were appropriate & 6% (122) were inappropriate. During the follow-up period 89.6% of the pts (2370) experienced no therapy; 9.6% of the pts (253) experienced only ApT; 0.7% of the pts (18) experienced only IT; & 0.2% of the pts (4) experienced both Apt & IT.

**Conclusions** Among pts, enrolled in a general registry representing a real world situation, undergoing an ICD implantation for primary prophylactic purposes:

1. The frequency of appropriate ICD discharges appears to be consistent with that noted in clinical trials of similar pts during the first 12 months following implantation.
2. The frequency of IT is low, occurring in only 0.9% of the overall population.
3. Concerns that ICD usage for primary prophylactic purposes in a general population might result in an unacceptable incidence of inappropriate therapy appear to be unwarranted.

## REDUCTION OF ANXIETY IN ICD PATIENTS: A MULTICENTER ICD STUDY

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Implantable cardioverter defibrillators (ICDs) can reduce the incidence of sudden cardiac death in selected patients who are at risk for life-threatening ventricular tachyarrhythmias. However, ICD discharges are often painful and delivered at unpredictable times, whether they are appropriate or not. Thus, these devices are sources of anxiety, but are also perceived as offering an opportunity to prolong survival. Consequently, patients are worried about possible device malfunctioning. New generation devices offer features that inform patients of possible device malfunctioning, which might have a benefit in reducing the patients' device-related anxiety.

The PAtient NOtifier feature for Reduction of Anxiety: a Multicenter ICD study (PANORAMIC) is an international, multicenter, prospective, randomized, open, parallel study designed to investigate the benefit of the Patient Notifier™ feature (St. Jude Medical) on the device-related patient anxiety. This study will also be investigating the overall reduction in anxiety, the evolution over time in anxiety for the different types of personality and the sensitivity and specificity of the Patient Notifier™ feature.

Patients will be enrolled 2 to 14 weeks after implantation, on the first ambulatory visit after hospital discharge. At that time, patients will be randomized in a 1:1 fashion to either a control group (Patient Notifier™ OFF) or a treatment group (Patient Notifier™ ON). Patients in this treatment group will receive information on the Patient Notifier™ feature as per standard of care and will have it tested before discharge. All patients will be followed for 12 months, with scheduled visits at 6 and 12 months post-enrollment. During these scheduled visits, all patients will complete both a validated (Hospital Anxiety and Depression Scale (HADS)) and a specially designed device-related anxiety questionnaire and have a standard ICD evaluation performed.

356 patients will be enrolled and enrollment completion is expected by mid 2009.

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## TRANSVENOUS REMOVAL OF PACING AND DEFIBRILLATING LEADS: A SINGLE CENTER RESULTS AND COMPLICATIONS IN OVER 10 YEARS EXPERIENCE

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**Background** Transvenous extraction of Pacing (PL) and Defibrillating Leads (DL) is today a highly effective technique. Device related complications are currently rising the need of Transvenous Lead Removal (TLR). Aim of this report is to analyse the longstanding experience performed in a single Italian Center.
**Materials and methods** Since January 1997 to June 2007, we managed 1193 patients (884 men, mean age 65.7 years, range 6-95) with 2065 leads (mean pacing period 69.23 months, range 1-336). PL were 1828 (1032 ventricular, 724 atrial, 72 coronary sinus leads), DL were 237 (223 ventricular, 2 atrial, 12 superior vena cava leads). Indications to TLR were class I in 33% and class II in 67% of the leads. We performed mechanical dilation using the Cook Vascular (Leechburg PA, USA) extraction kit and, if necessary, other intravascular tools (Catchers and Lassos, Osypka, Grentzig-Whylen, G); a Jugular Approach (JA) through the internal jugular vein was performed in case of free-floating or difficult exposed leads.
**Results** The technique was judged not applicable in 3 PL (0.15%). Removal was attempted in 2062 leads; 2032 leads (1795 PL, all the 237 DL) were completely removed (98.4%), 18 (0.87%) partially removed, 12 (0.58%) not removed. The JA was performed in 57 free-floating and 156 difficult exposed leads, allowing to completely remove 205 (96.24%) and partially remove 6 (2.81%) leads. Major complications occurred in 8 cases (0.67%): cardiac tamponade (7 cases, 2 deaths), hemotorax (1 death).
**Conclusions** Our experience shows that in centers provided with wide experience, TLR using mechanical dilation has a high success rate and a low incidence of serious complications. The use of the JA allows a very high effectiveness and safety in case of free-floating or difficult exposed leads.

## EXTRACTION OF PACEMAKER AND ICD LEADS: A NEW SINGLE CENTRE EXPERIENCE

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**Introduction** Over the last few years, an increasingly widespread use of permanent cardiac stimulation devices for the therapeutic treatment of rhythm disturbances has been closely followed by an increase in the number of device-related complications which due to leads extractions. This study reports our experience in leads extraction.
**Methods** Between May 2003 and June 2007, at our Centre, 101 leads were extracted from 54 patients (37 male, age 26-85, mean 70.9±13.5 years, age of implant range 1 -312 months, mean 48.9±49.4 months, n. of reparative operations before the extraction procedure 1.6±1.5, range 0-5, active fixation 16%, 34 atrial, 45 ventricular, 4 VDD, 12 defibrillator and 6 coronary sinus leads). Clinical indications to extraction were sepsis (25%), pocket infection (26.4%), chronic draining sinus (36.1%), PM/ICD malfunction (6.9%) and interference with other systems (2.8%). Manual traction was used for 52.8% of leads and dilation/countertraction for 47.2%. Success was completely achieved in 97.2% and partially in 1.4%. Only one lead (1.4%) was not extracted. Manual traction alone was effective in 52.8% of leads and dilation in 96.9%, so achieving a total success rate of 97.2% through the sequential use of traction followed by dilation technique. Local anaesthesia was effective in 80.6%, while sedation by an Anaesthesist was necessary only in 19.4%. Acute complications were non sustained ventricular tachycardia (6.9%), asymptomatic (11.1%) and symptomatic hypotension (5.6%), and the perioperative treatments were volume expansion (40.3%), drugs (22.2%) and transfusions (13.9%).
**Conclusions** The results obtained show that lead extraction was rewarded by a high success rate both in terms of a high percentage of successful operations and a limited number of recorded complications.The methods utilized, involving manual traction with the use of a locking stylet and dilation through polypropylene sheaths, were able to treat and resolve even the most complex cases.

## TRANSVENOUS LEAD EXTRACTION IN PATIENTS WITH AN UPGRADE FROM A PACEMAKER SYSTEM TO AN ICD

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Due to possible electrical interference it is preferred, but not mandatory to remove abandoned leads in case of an upgrade of a pacemaker system to an ICD.
**Methods** Lead removal was first attempted from the site of implantation using gentle but progressive manual traction, having a simple guide wire inserted. Intracardiac ECG and fluoroscopy are used for guidance. In patients with unsuccessful or incomplete lead removal the femoral approach was subsequently used to grab and retract the lead through the femoral vein. Standard catheterization equipment was used such as standard angiography catheter, JR4 or AL1, in combination with a long snare to grab the distal lead part or the Needle Eye was used.
**Results** In 18 pts with a mean age of 64±6 years 24 leads were removed. It concerned 2 atrial, 21 right ventricular and 2 left ventricular leads. Leads were implanted 46±41 (range 0,5-181) months before extraction. In 1 pt lead removal failed. Additional tools were used in 3 pts; Needle Eye, in 1 pt a long sheath over the lead; in 3 pts the femoral vein approach was needed also. In 2 pts complications occurred: low blood pressure due to pain and manipulation of the entangled lead in the RV. There were no early or late deaths. Procedure time including new implant and DFT testing were 120±80 minutes; fluoroscopy time was 16±20 minutes.
**Conclusion** Removal of abandoned leads in case of a pacemaker upgrade to an ICD can be handled successfully with manual traction and additional standard tools for lead extraction, such as a snare and Needle eye. In a few cases the dual approach was necessary for complete removal. There were no major complications

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## EXCIMER LASER-ASSISTED EXTRACTION OF CARDIAC LEADS: EXPERIENCE IN 100 CASES

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**Introduction** The laser sheath (Spectranetics) uses optical fibers, delivering pulsed ultraviolet cool excimer laser light, to vaporize fibrotic tissue binding intravenous cardiac leads to the vein or heart wall during lead extraction from the implant vein.
**Methods** During the period from December 2001 to February 2007, in our center 154 pacing and defibrillator leads were treated in 100 patients using traction, LLD Kit, laser sheath and surgery. The indications for lead extraction are sepsis (49%), lead malfunction (38%) and up-grading (13%).
**Results** The results of 154 lead extractions were: 1) Complete removal of 118 leads (76,62%); 2) Partial removal of 6 leads (3,9%); 3) No removal of 30 leads (19,48%).
In 49 cases of sepsis (with 94 leads to remove) the percentages of complete removal and partial removal increased respectively 91,5% (86 leads) and 4,25% (4 leads), while the percentage of non removal leads decreased at 4,2% (4 leads).
**Conclusions** The laser sheath is indispensable to complete lead extraction lead in first and second class indication. This technique has resulted sure with rare incidence of life-threatening complications. The use of laser sheath extraction has almost deleted heart surgery treatment of infectious complications in lead implant, which is burdened from both high mortality and long hospitalization.

## INITIAL EXPERIENCE OF EXIMER LASER-ASSISTED EXTRACTION OF PACEMAKER AND IMPLANTABLE DEFIBRILLATOR LEADS

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**Purpose** To assess effectiveness and safety of excimer laser extraction of chronically implanted transvenous pacing leads using countertraction technique.
**Materials and methods** We operated upon 7 patients (all males), mean age 56.1±11.7 y.o., the mean time of lead placement was 7.7±4.2 yrs. Indications included erosion of device pocket in 3 pts, abscess of pocket in 1 pt, high grade of tricuspid valve insufficiency in 1 pt with 2 ventricular leads, lead related induction of life-threatening ventricular tachycardia in 2 ICD pts. We used xenon-chloride laser with excimer laser sheath 14-16 Fr and locking stylet # 2 LLD KIT (Spectranetics, USA). Endotracheal anesthesia was applied in all cases.
**Results** Leads removal was a success for 1 atrial and 9 ventricular leads. All intracardiac leads were extracted with countertraction after near-the-complete progression of the laser sheath. Postoperative follow-up period was 9.3±5.7 mos. There were no procedure-related complications.
**Conclusion** Laser lead extraction is safe and effective approach to removal of long-term leads including those with active fixation.

## SAFETY AND EFFECTIVENESS OF TRANSVENUOS LEADS EXTRACTION IN PAEDIATRIC PATIENTS. A SINGLE CENTRE EXPERIENCE

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**Purpose** The increasing number of cardiac device implantation is associated with an increase in the rate of leads infection or failure. These device-related complications concern paediatric implantation also. We aimed to evaluate effectiveness and safety of transvenous leads extraction (TLE) using mechanical dilatation (MD) in a population of patients aged less then 18 years.
**Method** Since January 1997 to June 2007, 20 patients (13 male; mean age 12.6±4 years old; range 6-18 years), underwent TLE to remove 26 leads (20 pacing leads; 6 defibrillator leads). Mean implantation time was 60±51 months (range 8-192 months). The indication for extraction was: local infection in 4 patients (20%); sepsis in 3 (15%); lead malfunction in 12 (60%); fractured free-floating leads in 1 (5%). We performed mechanical dilatation using the Cook Vascular (Leechburg PA, USA) extraction kit and, if necessary, other intravascular tools (Catchers and Lassos, Osypka, Grentzing-Whylen G.); jugular approach (JA), through the internal jugular vein, in case of free-floating or difficult exposed leads. All the procedures were performed with cardiac-surgery stand-by. Local anaesthesia was used in 8 (40%; patients aged >12 years), general anaesthesia in 12 (16%). Procedures were performed in the Cath lab (12) or in OR (8).
**Results** All the leads were completely removed. Manual Traction was effective in 4 leads (15%), while MD was effective in 22 leads (85%). The JA approach allowed to removed 2 leads (7%). Major complication occurred in 1 patient (pulmonary embolism complicated with FV, successfully treated).
**Conclusion** Our study suggests that TLE by MD is an effective and safe procedure in young patients, when performed by skilled operators in an experienced Centre. In paediatric patients indication for leads extraction may be extended to all functionless leads.

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## LIFETIME COST-EFFECTIVENESS OF PRIMARY PREVENTION ICD THERAPY FROM A BELGIAN HEALTH CARE PERSPECTIVE

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**Background & Aims** Primary prevention of sudden cardiac death (SCD) by implantable cardiac defibrillators (ICD) has proven superior to medical therapy alone (OMT), as reflected in recent ACC/AHA/ESC guidelines. Our aim was to assess the cost-effectiveness of ICD therapy, for the indicated primary prevention population (excluding inherited disorders), extrapolated to a lifetime horizon, using Belgian health care cost data.
**Methods** We reviewed the literature for relevant randomized controlled trials (RCTs) with direct comparison between ICD and OMT. A meta-analysis of deaths associated with ICD and OMT was conducted across the 6 eligible RCT (MADIT I, MADIT II, AMIOVIRT, CAT, DEFINITE, SCD-HeFT). The impact on life expectancy was modeled using an adaptation of a previously published Markov model by Sanders et al. For the base case, we assumed a population mean age 61 years receiving single chamber ICD, a replacement frequency based upon published longevity curves with maximum of 6.5 years, a mean implant hospitalisation duration of 3.25 days, a 1% infection rate, annual 3%-6% lead failure and actual device costs in Belgium. The economic data were derived from official Belgian sources. Results were discounted at 3% for cost and 1.5% for effect.
**Results** The meta-analysis showed that the relative risk of all cause death was 0.72 (95% CI: 0.64-0.82). The use of an ICD was projected to add 1.88 life years or 1.57 quality adjusted life years (QALY's). The incremental cost-effectiveness ratio (ICER) for the base-case was Euro 29,525 per QALY gained. Sensitivity analysis showed that the ICER is most sensitive to device longevity, patient mortality risk, projected lifetime benefit, and cost associated with implant and screening.
**Conclusion** In patients fulfilling currently accepted primary prevention ICD indications, ICD therapy can be considered a cost-effective use of healthcare resources. Device longevity and patient selection can further improve cost-effectiveness.

## EARLY PROPHYLACTIC USE OF AN IMPLANTABLE CARDIOVERTER-DEFIBRILLATOR AFTER ACUTE MYOCARDIAL INFARCTION: A LONG-TERM FOLLOW UP

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**Background** At a mean follow-up of 30±13 (SD) months, the Defibrillator in Acute Myocardial Infarction Trial (DINAMIT) failed to prove any survival benefit of early primary prophylactic implantation of a cardioverter-defibrillator (ICD) in patients after acute myocardial infarction (IM). Our aim was to analyze: a) the survival of patients randomized for the DINAMIT study in our centre after a longer follow-up; b) the timing of first appropriate ICD interventions.
**Patients and methods** The studied population comprised 32 patients randomized for the DINAMIT study in our centre (16 treated by ICD versus 16 treated conventionally) within 6-40 days after an acute IM and followed-up prospectively. All had a reduced left ventricular ejection fraction (<35%) and impaired cardiac autonomic function (depressed heart-rate variability or elevated average 24 hour heart rate on ECG Holter monitoring).
**Results** During a mean follow-up of 43±24 (SD) months 11 patients died: 4 in the ICD group and 7 in the control group (hazard ratio for death in the ICD group was 0,50; 95% CI 0,15-1,72; P=0,26 ns). During the first 30 months after randomization 8 deaths occurred: 3 in the ICD group and 5 in the control group. Four patients in the ICD group had appropriate ICD interventions, the first occurred 5 to 62 months (median 9 months) after randomization.
**Conclusion** We found a 50 percent reduction of the relative risk for death in the ICD group. However, due to a small patient number, the documented reduction had a large confidence interval and was not statistically significant. Our findings showed a trend for better survival in the ICD group that increased with the time from the index IM. This suggests that a re-evaluation of the DINAMIT results after a longer follow-up might be reasonable and help to unravel optimal timing of primary preventive ICD implantation in high-risk patients after IM.

## SUDDEN CARDIAC DEATH IN PATIENTS WITH IMPLANTABLE CARDIAC DEFIBRILLATOR. ANALYSIS OF PREDICTIVE FACTORS IN A FRENCH COHORT STUDY

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**Purpose** There is very little available data that identify baseline predictive factors for sudden cardiac death in patients with implantable cardiac defibrillator (ICD).
**Methods** Causes of death were analysed in 2396 patients who had required an ICD, and were enrolled in EVADEF, a prospective and multicentric french cohort study (60.4±15 years, 86.1% men, New York Heart Association (NYHA) functional class I 33%, II 50.5%, III 14.7%, IV 1.5%, coronary artery disease 57.3%, mean left ventricular ejection fraction (LVEF) 38±16%, mean QRS duration 120±30 ms, secondary prevention 81.1%). Data concerning sex, age (>68 or < or =68 years), primary or secondary prevention, NYHA functional class, LVEF (< or =35%), QRS duration (> or =120 ms, <120 ms), and heart disease were studied.
**Results** Within 2 years after the implantation, there were 274 deaths, i.e. a mortality rate of 13.0% (95%CI: 12.3-13.7). Circumstances of death were sudden in 29 patients (10.6%). Only low LVEF (< or =35%) was found to be predictive of sudden cardiac death (OR: 2.6; 95% CI: 1.2–6.4, p<0.01). Sex, age, primary or secondary prevention, high NYHA functional class, QRS duration and heart disease were not found to be significantly predictive of sudden cardiac death.
**Conclusion** In patients with ICD, sudden cardiac death risk was only associated with lower LVEF.

## THE HIDDEN LINK BETWEEN VENTRICULAR ARRHYTHMIAS AND SLEEP BREATHING DISORDERS IN ICD PATIENTS: PRELIMINARY RESULTS FROM THE VISION STUDY

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Sleep breathing disorders (SBDs) are common in cardiovascular patients (pts): they are suspected to play a role in the occurrence of

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ventricular tachyarrhythmias (VTA). However, to date there are not many reports about SBDs in ICD pts. SBDs are usually measured by the Apnea-Hypopnea Index (AHI=nb. of episodes/sleep hour). In case of AHI>15, the pt is normally suspected to suffer from Sleep Apnea Syndrome (SAS) and to be at risk for VTA. The aim of the VISION study is to investigate the link between SBDs and VTA in unselected ICD pts.

**Methods** Sixty pts were preliminarly considered (class I/IIa latest ICD guidelines): 52 dual-chamber and 8 biventricular ICDs (Alto2 models, Sorin Group) programmed with PARAD/PARAD+ dual-chamber arrhythmia detection algorithm. To estimate the AHI, about 1 year after implant, all pts underwent an overnight Holter-recording of ECG (2 leads) and Nasal Pressure (NP) signal. The estimated AHI (Holter recordings) and the VTA events (as detected by ICDs during 1 year follow-up (FU)) were correlated. Additionally, the circadian distribution of VTA was assessed.

**Results** 32 pts (53%) showed an AHI>15 (SAS-group: AHI 26,4±8,5) whereas 28 pts (47%) had an AHI<=15 (No-SAS-group: AHI 7,1±4,4). During 1-year FU, the number of VTA events in the SAS-group was higher than in the No-SAS-group (5,9±14 vs 2,9±6,4 respectively), however the difference wasn't statistically significant. We didn't observe significant VTA circadian variation, but a tendency to more VTA episodes at morning vs night was detected (SAS-group: 2,0±3,7 vs 0,7±2,0; No-SAS-group: 0,7±1,7 vs 0,5±1,3).

**Conclusion** 53% of unselected ICD pts suffer from SBDs. A trend for more VTA episodes in the SAS-group was observed (vs No-SAS-group), but this was not statistically significant (limited number of pts to date considered?). VTA events seem to be more concentrated at morning, but no precise circadian variation could be identified.

## SHOULD WE RUSH TO IMPLEMENT COMMUNITY-BASED AED STRATEGIES IN FRENCH-SPEAKING SWITZERLAND? FIRST ANSWERS FROM RACE REGISTRY

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**Background** Every minute of delayed electric countershock, without bystander basic life support (BLS) , reduces survival to hospital discharge by 5 to 10% It was recommended so far that the lay public should be trained in BLS and the use of automated external defibrillators (AED). Assessment of bystander reaction in witnessed cardiac arrests in the French-speaking Switzerland was made using RRACE (Registre Romand d'Arrêts Cardiaques Extrahospitaliers) registry data.

**Methods** Since April 2007 the registry enlisted the help of 1300 General practitioners (GPs), 23 Emergency Medical Services (EMS) and 21 hospitals to prospectively collect the data of every adult (>18 years) who suffered from cardiac arrest outside of the hospital (OHCA) in French-speaking Switzerland.

**Results** One hundred nine OHCA were included, 63 (58%) of them were witnessed. Of them 37 (59%) were known for cardiac disease 44 (70%) of witnesses were family members. Locations were: Home 42 (67%), Public places 12 (19%), Work 9 (14%). Mean call to arrival time was of 11(+/-4) minutes. Eleven bystanders (17%) (7 of them health pèrofessionals) immediately called EMS and practiced BLS; Nine witnessed patients and 1 unwitnessed survived to hospital discharge (overall survival rate 9%)

**Discussion** Community-based AED strategies in French-speaking Switzerland should be preceded by strengthening of the weak links of "the chain of survival". Only after enhancing public awareness about OHCA symptoms and BLS through widespread training (eg at the workplace, in high schools) and repeated media campaigns can we expect community-based AED strategies to be effective in our area. Family members of people known for heart diseases should be trained to recognize symptoms of impending cardiac arrest and to provide BLS since nearly 3/4 of witnesses were family members and more than half of OHCA victims were previously known for cardiac disease.

## FURTHER RESULTS OF THE IMPLEMENTATION OF AUTOMATIC EXTERNAL DEFIBRILLATORS IN A LARGE BOLOGNA CONDOMINIUM

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**Introduction** The highest incidence of cardiac arrest (CA) has been observed at patient's house. AED have been implemented in large malls, airports, schools, but not in condominiums, as suggested by the US, the Nertherlands, the Piacenza Progetto vita experiences, the recent international guidelines on Cardiac emergencies, and a recent law proposal of the Emilia Romagna Region.

**Patients and Methods** In collaboration with Italian Physiocontrol Medtronic we implemented two AEDs (and one with Leardal) in three buildings of a large Bologna condominium, in which 120 families live.

**Results** For two years, we monitored with the AEDs, 5 patients with an acute coronary syndrome (ACS), chest pain or dizziness, while waiting for a 118 Bologna Soccorso ambulance, at the patient's house. In 2006 we monitored 2 patients, one with a stroke and one with a total AV block, while waiting for a 118 Bologna Soccorso ambulance. Recently, in January and may 2006, in both cases, together with one son of the patients we took care of subjects suffering from CA. In the first case, the subject experienced CA due to VF. He was adequately monitored and cardioverted according to AED voice informations. The second case, suffered from recurrent VT. The patient was defribrillated 14 times. Both were later admitted to the hospital and received an ICD implantation. In 2007, we monitored 2 patients with chest pain, before hospital admission.

**Conclusions** A direct telephone connection should be made available with the local 118 Bologna Soccorso, to simultaneously alert the emergency ambulance. Many patients have been successfully monitored for 20 minutes, while waiting for an emergency ambulance. CA can be adequately treated by relatives and family members when AED are available close to the patient's house.

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## IMPACT OF ATRIAL FIBRILLATION OCCURRENCE ON THE CLINICAL RESPONSE TO CRT DURING SHORT-TERM FOLLOW-UP: PRELIMINARY DATA FROM THE PRIMARY PREVENTION ACTION-HF REGISTRY

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**Background** The relationship between atrial fibrillation (AF) occurrence after cardiac resynchronization therapy (CRT) and the clinical response to CRT is unknown.
Purpose of this study was to assess the correlation between AF occurrence and the clinical response to CRT in a group of consecutive patients implanted with a CRT device with defibrillator backup (CRT-D) enrolled in the prospective ACTION-HF registry.
**Patient population and methods** Six months follow-up data were available for 228/416 enrolled patients. Baseline clinical characteristics were: age 69±8, NYHA functional Class I/II/III/IV=2.2/25.2/69.5/3.1%, left ventricular ejection fraction 27±6%, heart failure (HF) symptoms duration 13.5±15 months.
AF occurrence, NYHA functional Class and the number of HF hospitalizations at six months follow-up were analyzed. Patients were considered clinical responders (ClRs) if their NYHA class improved of at least one point or they remained in stable Class II and they were completely free from HF hospitalization during follow-up.
**Results** 34/228 (15%) pts had AF episodes during follow-up. New onset AF was observed in 19/34 (56%) pts whereas the remaining 15 pts had AF history. The ClRs were 70.6% in the overall patient population. There were fewer ClRs among patients with AF occurrences during follow-up than in patients without AF: 47% vs 74.7% (p=0.002).
ClRs were 11/19 (57%) among patients with new onset AF as compared with 5/15 (33.3%) among patients with both AF history and recurrences (p=NS). The absence of AF at 6-months follow-up was predictive of clinical response to CRT (OR 3.3, CI 1.54-7.18).
**Conclusions** These preliminary data suggest that the incidence of AF during the first 6-months follow-up after the implant of a CRT-D device is about 15% and that the development of any AF is associated with a poorer clinical response to CRT.

## MEASUREMENT OF INTERATRIAL CONDUCTION INTERVALS AND THEIR IMPACT ON OPTIMAL AV DELAY IN BIVENTRICULAR HEART FAILURE PACING

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Total duration of the hemodynamically optimal AV delay (AVD) is the net effect of individual interatrial conduction and electromechanical intervals. Using the novel esophageal left-atrial electrogram feature of the Biotronik ICS3000 programmer, implant-related interatrial conduction times (IACTs) can be measured in patients with pacing systems irrespective of make and model.
Therefore, aims were to study the proportion of implant-related IACTs on total duration of the optimal echo AV delay for VDD and DDD operation in heart failure (HF) pacing.
**Methods** AVD was individualized by echo in 78 HF patients during predischarge test. After that, IACTs in VDD and DDD operation were quantified using the esophageal left-atrial electrogram feature of the ICS3000.
**Results** In VDD operation, in 74 of the 78 pts, mean optimal AVD was 94,8±45.4 ms with an IACT proportion of 42,6±26.3 ms (44,9±20,8%). In 78 pts, mean optimal AVD in DDD operation was 181.5±47.7 ms containing a considerable IACT proportion of 129.0±26.3 ms (71,1±25,4%). Generally, in both pacing modes, total duration of the optimal AVD exceeded the individual IACT by 52.9±41.3 ms, at mean.
**Conclusions** In heart failure pacing, duration of optimal AVD will be considerably influenced by an IACT proportion of about 43% and 71% in VDD and DDD operation, resp.. Therefore, if echo optimization is not possible and/or practicable, esophageal left-atrial electrogram recording capability of the ICS3000 can be used to determine the optimal AVDs which are about 50ms longer than the individually measured IACTs.

## INTERRELATION AMONG INTRATHORACIC IMPEDANCE MEASUREMENT, BNP, AND TDI PARAMETERS: A TISSUE DOPPLER ECHO STUDY

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Intrathoracic impedance measurement has been introduced by several biventricular defibrillator devices (InSync Sentry and Concerto, Medtronic, Minneapolis, MS, USA) and has been shown to predict early identification of pulmonary fluid accumulation secondary to left-sided heart failure (HF). Tissue Doppler Imaging (TDI), through the detection of specific parameters such as the transmitral to mitral annular early diastolic velocity ratio (E/E a) is an established method to assess the LV end diastolic pressure (LVEDP). Both TDI and B-type natriuretic peptide (BNP), are predictors of poor cardiac outcome. The aims of this study were: 1) to evaluate the clinical value of the OptiVol alert and its prediction for decompensated HF, 2) to correlate the Optivol alert to the non invasive measurement of LVEDP as assessed with TDI, and BNP values. One hundred six consecutive patients (mean NYHA class 2.6±0.6, mean LVEF 24±6%) who received biventricular defibrillators were included. When presenting with the OptiVol alert, pts were admitted at our outpatient clinic: the current hemodynamic status was evaluated, a BNP determination was placed, and a TDI echo was performed. During follow-up (mean 15±5 months), there were 32 presentations with the OptiVol alert in 21 patients. An increase in E/Ea (>15) was evident in 80% of the pt population (26 out of the 32). BNP samples were positive in 70% of those who had the OptiVol alert. Clinical signs and symptoms of HF were present in only 13 patients. When needed, an increase in diuretic therapy was made. Intrathoracic impedance measurement as assessed through Optivol alert is an useful tool for monitoring pulmonary fluid status. This parameter, may guide the strength of HF therapy, and strictly correlates with an increase in LVED pressures as measured with TDI echo and BNP.

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## COMPARISON BETWEEN ECO VERSUS IEGM-METHOD OF AVD AND VV OPTIMIZATION IN HF-PTS

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**Background** Despite the demonstrated importance of an individual and systematic optimization of AV and VV delay in patients with CRT, programming of these settings does not occur routinely in clinical practice. Limitations to optimization include lack of a standard protocol, cost, time, requirement of a skilled echosonographer, and need for coordination of clinical services. A new intracardiac electrogram (IEGM)-based method was developed to calculate optimal VV delays, which can be performed with a programmer during routine device follow-ups. This study compared this IEGM-based method with the current Doppler echocardiography (ECHO) method using aortic velocity time integral (AVTI) to optimize the VV delay and trans-mitral flow waves to optimize the AV delay.
**Methods** 10 pts (all male, age 67,2±10,79, NYHA 3-4, QRS >130 msec, FE 29,5±6,59) have been studied with both ECHO and IEGM-based methods. The pts were implanted with SJM EPIC-HF or ATLAS-HF ICD. The IEGM VV delays were compared with the optimal VV by echo, at which the maximum aortic VTI (max AVTI) was obtained. The IEGM AV delays were compared with the optimal AV by echo, at which the optimal configuration of A and E waves was obtained. The same protocol has been applied again after a 6 months follow-up.
**Results** The max AVTI obtained with echo (17,43±3,66) and the max AVTI obtained with IEGM-method (15,62±3,58) was equivalent ($R^2$=0,78, a 95% confidence). The difference between the optimal AV and VV delay calculated with the two methods don't differ significantly.
**Conclusions** These preliminary data demonstrate that innovative and quicker IEGM method for estimating optimal AV and VV delays achieve the same results as echocardiographic one. The automated programmer-based IEGM method provides a reliable and simpler alternative to standard techniques for the optimization of AV/PV and VV delay settings in patients with CRT-D devices.

## THE EFFECTS OF THE CARDIAC RESINCRONIZATION THERAPY ON LONG TERM SURVIVAL: 7 YEARS FOLLOW-UP

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Aim of the study was to analyze hospitalization rate and mortality – total mortality (TM), cardiac mortality (CM) and sudden death (SD) – in a wide patient population implanted in our institution in the last six years. Methods: since 1999, 365 pts (270 male) underwent CRT for severe CHF (EF 27%±8.1). In 166 pts a backup ICD was associated. The mean age was 71.2±9 years (range 36-92); 198 pts (54%) had ischemic heart disease (IHD); 67 were in atrial fibrillation at the time of implant; 85 pts were previously paced with right ventricular apical pacing; 18 were candidates for heart transplantation. The follow-up was scheduled every three months for the first year and then twice a year. Results: the implant success rate was 99%. The mean follow-up was 33±23 months (range 1 – 84 months). Compared to the year before CRT, a significant decrease in hospitalization rate was observed during the first year of follow-up (2.55±1.6 vs. 0.81±0.7, p<.001). TM was 11.02%, CM was 8.19%. The "ICD group" compared to the "PM group" shows a reduction of TM: 11.4% vs15.3%; CM: 7,2% vs11,5%; SD:1,1% vs 5,5%.

TM was also evaluated at implant (0,23%), at 6 months and steps of 1 years as follow:

| | | | |
|---|---|---|---|
| 6 months (3.3%) | 1 year (6.1%) | 2 years (11.1%) | 3 years (16.7%) |
| 4 years (21.7%) | 5 years (33.3%) | 6 years (38.9%) | |

In the group of IHD vs not-IHD, TM was 11.6% vs 9.5%, CM was 10.7% vs 4.7%, SD was 7% vs 1,03% respectively. The main causes of death in IHD were heart failure and sudden death.Conclusions: in our experience CRT improves clinical and instrumental features of patients with CHF; the benefit of CRT is similar in IHD and not-IHD; CRT decreases the hospitalization rate and increases survival; IHD seems to have a worse prognosis than not-IHD in term of TM, CM and SD; the association with a back-up ICD strongly reduces SD, CM and TM in this population.

## PHRENIC NERVE STIMULATION CAN BE PREVENTED WITH LONGER LEFT VENTRICULAR PULSE DURATION DURING CARDIAC RESYNCHRONIZATION THERAPY

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Stimulation of the diaphragm via the phrenic nerve (PN) is a common (5-25%) complication of left ventricular (LV) epicardial stimulation during cardiac resynchronization therapy. As the chronaxie values of myocardium and motor nerve differ, our aim was to investigate whether it is possible to avoid PN stimulation with pacing pulse duration (PD) optimization.
A total of 44 patients were enrolled (32 male, age 64.6±9.3 years, indication for biventricular pacing). Unipolar LV leads were implanted with the standard transvenous technique in a sidebranch of coronary sinus. Strength-duration relationships of LV and PN stimulation were calculated based on pacing threshold measurements on the first postoperative day: 6 patients (14%) had diaphragmatic contractions during LV stimulation.
The LV rheobase was 0.84±0.11 V, the PN rheobase was 2.59±0.82 V ($p<0.05$). The LV chronaxie was 333±33 ms, the PN chronaxie was 104±18 ms ($p<0.05$). The ratio of PN and LV pacing thresholds was calculated in each patient with diaphragmatic contractions. The difference between the thresholds was greater at longer PD, so we programmed LV stimulation at twice pacing threshold, 1.5 ms PD. The LV electrode was repositioned in one patient because the PN threshold was equal to or below LV pacing threshold at any PD. There were no signs or complaints of PN stimulation in the other 5 patients during the 3 months of follow-up.
This study confirmed that the strength-duration characteristics of LV and PN stimulation differ and PD optimization is a simple and efficient method to avoid PN stimulation. We recommend using longer pulse duration in patients with phrenic nerve stimulation.

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## AUTOMATIC DETECTION OF RETROGRADE P-WAVES USING NOVEL DIGITAL SIGNAL PROCESSING PACEMAKER TECHNIQUES

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**Purpose** We evaluated the potential ability of novel Digital Signal Processing pacemakers (pm) to differentiate antegrade (APW) from retrograde P-waves (RPW) based on their different morphology. RPWs may occur after isolated ventricular pacing, e.g. during Minimal Ventricular Pacing or false mode switching. Their automatic detection may be used to automatically adapt the pacing mode or timing in an attempt to return to normal AV synchrony.
**Material and methods** 14 pts with documented RPW and an implanted digital dual chamber pm (T-series, Vitatron) were enrolled. Atrial lead position was RAA (n=10), low inter-atrial septum (n=3) or anterial wall (n=1). High resolution uni- and bipolar IEGMs of APW and RPW were recorded in DDD and VVI pacing mode for later off-line analysis.
**Results** Analysis of the first pts revealed that in septal lead position RPW were broader (unipolar 27 vs 20 ms, +35%; bipolar 24 vs 17 ms, +41%), had lower slew rates (0.2 vs 0.4 V/s) and had smaller negative amplitudes (bipolar 2.5 vs 3.3 mV) than APW.
In the RAA lead position RPW were more similar to APW: signal width increased only 14%, slew rates and negative amplitudes were similar. The first positive amplitude was more pronounced in RPW.
**Conclusions** Morphological differences between APW and RPW seem more pronounced in septal lead position as we expected since both wave fronts enter the RAA in a similar way while the septal position is more exposed to the two different conduction pathways.

## AV-INTERVAL OPTIMIZATION USING SURFACE ECG

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**Introduction** The methods for optimizing the AV-delay (AVD) applied so far are time consuming. A simple method is the approximate adjustment of the AVD with the help of a surface-ECG. The purpose of this abstract is the validation of a simple algorithm for using the ECG method. The optimum AVD is given if at the end of left atrial contraction the mitral valve is closed by the ventricular pressure increase (onset of isovolumetric contraction time, ICT). To achieve this with pacemaker patients, the individual atrial and ventricular conduction times must be considered.
**Methods** The total atrial conduction time can be defined from the beginning of the atrial paced or sensed P-wave to the end of the P-wave (EP). The beginning of the ICT corresponds to the peak/nadir of the paced or intrinsic QRS complex. The time from EP to the peak/nadir of the intrinsic QRS was measured in 100 normal individuals. An age-related average value of 100ms was determined, which serve as a physiologic reference. The approximated optimum AVD is given if the delay from EP to the ICT amounts to 100ms. Thus, the optimum AVD for sensed and paced P waves can be calculated by a simple formula: [AVDopt=AVDprog+100-T] AVDopt=optimized AVD; AVDprog=programmed AVD at baseline; T=interval EP to peak/nadir of paced QRS; 100 ms physiologic reference. In order to validate the method 30 DDD-pacemaker patients (74±9y, 16m) with AVB III were evaluated by Doppler echocardiography (Ritter formula).
**Results** Surface ECG optimized AVD compared with echocardiography optimized AVD, showed a statistically significant correlation (P<0,01). Mean: AVD paced ECG 178±19 ms (130–220 ms); Doppler 182±17 ms (142–208 ms). AVD sensed ECG 104±14ms (70-125 ms); Doppler 106±12ms (70-125 ms).
**Conclusion** The approximate AVD adjustment with the surface ECG appears to be a viable technique.

## FEASIBILITY OF CRT DEVICES AUTOMATIC OPTIMIZATION BY PEAK ENDOCARDIAL ACCELERATION SENSOR

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**Background** Recent trials show that the setting of interventricular (VVD) and atrioventricular delays (AVD) in CRT devices could be relevant in the process of hemodynamic efficiency optimization of CRT itself. Previous studies demonstrate that VVD/AVD values determined by Peak Endocardial Acceleration (PEA) signal analysis (accelerometer implemented in a dedicated RV lead) correspond to the highest hemodynamic improvement as indicated by echo and LVdP/dt. We aimed to preliminarly assess the capability of a new automatic algorithm - using PEA - to determine the optimal VVD (OVVD) and AVD (OAVD) values.
**Methods** 33 patients (pts) with CRT indications (21 M, 74±8,2y, NYHA class 3,1±0,3) were implanted with a CRT pacemaker (NewLiving CHF, SORIN Group), connected to an RV lead equipped with PEA sensor. At the inclusion visit, the automatic procedure for CRT optimization was launched, testing 9 VV configurations to find out the OVVD (LV, BiV0ms, L+R 12/24/48 ms, R+L 12/24/48 ms, RV); an AVD scan was then automatically carried out, consisting of 11 steps [20 ms to (PR-30) ms], in sinus driven (VDD) and atrial paced (DDD) conditions, to identify the OAVD. In 10 pts the optimization of VVD was performed 4 times, during two consecutive days after implant.
**Results** In all pts the algorithm found an OVVD (Biv0ms in 50%, L+R in 25%, and R+L in 25% of pts). The reproducibility of OVVD procedure (i.e. same OVVD four-times) was confirmed in 9/10 pts; in the remaining pt we observed two variations of OVVD.
AVD optimization: 66 AVD scan curves were analyzed (2 for each pt), and 48 curves had the expected 'sigmoid shape' in 24 pts. OAVDs values: 95±31 ms in VDD, and 138±39 ms in DDD.
**Conclusions** The promising preliminary results obtained in the OVVD/OAVD identification suggests the applicability of this algorithm (to be clinically validated on a large-scale) to optimize CRT devices with an automatic method, operator-independent and cost-effective.

## OPTIMIZATION OF BIVENTRICULAR PACING USING QUICKOPT ALGORITHM

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**Background** The optimization of atrioventricular (PV) and interventricular (VV) delays in devices for cardiac resynchronisation therapy (CRT) improves cardiovascular hemodynamic performance. The aim of this study was to correlate the optimal PV and VV delays obtained by intracardiac (IEGM) based algorithm QuickOpt(QO) with optimal PV and VV delays obtained by echo.
**Methods** 21 patients (pts) (age: 64±6.3 years, LVEF 30,7±5,3%, LVEDD 66.5±2,5 mm, LA 49,0±5.9 mm, LBBB, 71% ischemic, 4 pts with atri-

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al fibrillation (AF), 2 pts without intrinsic R wave) treated with CRT-D (SJM, Atlas+HF, Epic+HF) were included. All pts underwent pulssed Doppler echo delay optimization to determine the maximum LV outflow track velocity time integral (VTI) for multiple delays. Three pts with atrial fibrillation were tested for VV delays. VV delay was optimized among activations: LV pre-excitation 15, 20, 30, 40 ms, simultaneous, RV pre-excitation 15, 20 ms. For each VV delay was tested PV delay (80,100,120,140 ms).

**Results** The optimal values of VV a and PV delays were individual for VV (range RV10ms to LV 40 ms) and also for PV (80,100,120,140 ms) delay. In 1 AF pt was QO VTI significantly lower (12.7 vs 22.6 cm). QO measurements were not successful in 2 pts without intrinsic R wave. In the group of 19 pts with intrinsic R wave a strong concordance between QO algorithm and echo optimization was observed in 15 pts (78.9%). In 4 pts was QO VTI significantly lower (15.0 vs 17.5 cm, 17.6 vs 22.4 cm, 12.7 vs 22.6 cm, 18.0 vs 19.9 cm).

**Conclusions** 1. Optimal PV and VV delay were obtained in 78,9% of QO measurements. 2. In our group optimal PV and VV delays were individual. 3. QO measurements were limited in pts with AF and in pts without intrinsic R wave. 4. QO algorithm provides quick and seems to be effective way to optimize biventricular pacing.

## FIRST CLINICAL EXPERIENCE WITH A NEW ALGORITHM TO AVOID UNNECESSARY RIGHT VENTRICULAR PACING IN PATIENTS WITH PRESERVED INTRINSIC CONDUCTION

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**Introduction** Frequent unnecessary right ventricular pacing in patients with intrinsic conduction can worsen the patients prognosis. This analysis evaluates the potential of a new algorithm (VIP -Ventricular Intrinsic Preference) to avoid unnecessary ventricular pacing in clinical routine.

**Methods** 39 consecutive patients with intact AV conduction (73±10 years; 25 men; Sinus node disease=31; Carotid Sinus Syndrome=4, Syncope=4) implanted with a Victory DR dual chamber pacemaker were analyzed. VIP is based on the principle of AV search hysteresis. AV delay is extended up to 200 ms (VIP interval). Ventricular stimulation can occur for up to 3 cycles (VIP cycles) before switching to the programmed AV delay. VIP search can be programmed from 30 seconds to 30 minutes to search for intrinsic conduction with the programmed number of VIP cycles. Mean Follow Up time was 5,8±3,1 (1-12) months.

**Results** 24 patients were programmed to DDDR, 14 to DDD and 1 to DDIR (excluded from analysis). Mean paced AV-delay (AVp) was 178±14 ms (160-225) and mean sensed AV-delay (AVs) was 150±6 (130-225) ms. VIP interval was programmed to 166±26 (100-200) ms. This resulted in a total AVp of 343±16 (300-350) ms and a total AVs of 315±22 (250-350) ms. VIP cycles were set to 1 in 4 (10,5%) patients, to 2 in 19 (50%) patients and to 3 in 15 (39,5%) patients. VIP search was programmed to 3,9±1,6 (1-5) minutes. The mean percentage of atrial pacing was 54%±40% (0,5%-99%). The mean percentage of ventricular pacing was 5,5%±7,1% (0,5%-29%; Median 2,8%).

**Conclusions** VIP leads to a low percentage of ventricular pacing in patients with intact intrinsic conduction. The results are comparable to published data of similar functions with the advantage of continuous AV synchronous ventricular activation. No complications related to the VIP algorithm were seen in the reported analysis.

## CLINICAL EVALUATION OF CARDIOGENIC IMPEDANCE SIGNALS IN HEART FAILURE PATIENTS WITH BUNDLE BRANCH BLOCK

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**Purpose** The purpose of this study was to investigate the feasibility of using cardiogenic impedance signals to monitor hemodynamic alterations in heart failure patients with bundle branch block.

**Materials and Methods** Acute impedance signals were recorded with external equipment between lead electrodes during implantation of CRT devices in 12 heart failure patients, NYHA class II-IV. Quadripolar impedance signals were recorded between left ventricle (LV) and right ventricle (RV) (Z1) and between LV and right atrium (RA) (Z2); bipolar impedance was recorded in RV (Z3). Recordings were obtained during intrinsic rhythm, LV pacing with optimized PV delay and pacing with a short PV-delay in LV and RV. The impedance signals were analyzed with respect to amplitude, systolic slope and fractionation of the curve. Calculated parameters were compared to hemodynamic parameters acquired from a non-invasive plethysmographic blood pressure monitor (Finapres™).

**Results** The amplitude and morphology of the impedance signal were significantly changed in all patients when the PV-delay was altered. The amplitude of Z1 correlated to pulse pressure (r=0.43, p=0.007). The fractionation of Z1 (r=-0.39, p=0.014) and Z2 (r=-0.41, p=0.013) decreased with increasing pulse pressure. The slope of Z3 correlated to pulse pressure (r=0.35, p=0.03). The amplitude (r=0.37, p=0.012) and systolic slope (r=0.41, p=0.0043) of Z3 correlated to VV-time. Also the amplitude (r=0.35, p=0.018), systolic slope (r=0.33, p=0.027) and fractionation (r=-0.30, p=0.04) of Z1 correlated to VV-time. The amplitude (r=0.29, p=0.045) and slope (r=0.38, p=0.008) of Z3 correlated to left ventricular ejection fraction (LVEF).

**Conclusions** The cardiogenic impedance signals measured from three areas of the heart contained specific information about the contraction pattern of the heart. The consistent results indicate that new algorithms can be proposed to automatically optimize device therapy for heart failure patients.

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## CATHETER ABLATION OF GANGLIONATED PLEXUSES FOR PAROXYSMAL ATRIAL FIBRILLATION: ANATOMICAL VERSUS SELECTIVE APPROACH

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**Introduction** Selective GP ablation and anatomical GP ablation both may eliminate paroxysmal atrial fibrillation (PAF). The relative efficacy of these 2 techniques has not been directly compared.
**Methods and Results** Eighty patients with symptomatic PAF (age, 53±9 years) were randomized to undergo GP ablation. Selective GP ablation (SGPA; n=40) - Atrial ablation target sites were identified as the places where vagal reflexes evoked by transcatheter high-frequency stimulation (HFS) were obtained. Vagal reflex was defined as prolongation of the R-R interval by >50% during AF. The end point of ablation was defined as the failure to reproduce vagal reflexes with repeated HFS. Anatomical GP ablation (AGPA; n=40) – In this variant of catheter ablation no selective search of GPs was performed, target sites for catheter ablation were defined using the data of their anatomical location. The mean procedure and fluoroscopy times were 186±42 and 52±16 minutes for SGPA and 145±12 and 37±11 minutes for AGPA, respectively. At 9.2 months, 42.5% of patients who underwent SGPA and 82.5% of patients who underwent AGPA were free of symptomatic PAF when not taking antiarrhythmic drug therapy (P=0.02). The only complication was left atrial flutter in a patient who underwent AGPA.
**Conclusion** In comparison of two existing methods of GP ablation the method using the anatomical approach was proven better in long-term period.

## ABLATION OF ATRIAL FIBRILLATION: DOES THE LINEAR LESION APPROACH ACT ON CRITICAL MASS?

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**Purpose** The left atrial critical mass is involved in the maintenance of atrial fibrillation re-entrant wavelets.
Left atrial linear ablation has been proved to be effective in the therapy of atrial fibrillation.
The aim of this study is to determine if the effectiveness of transcatheter linear ablation is due to the reduction of the atrial critcal mass.
**Materials and Methods** Four hundred patients were submitted to atrial fibrillation ablation. Linear lesion were applied to the left atrium using the CARTO system. The extension of the linear lesions was proportional to the left atrial volume evaluated with the CARTO system. Left atrial volume inferior to 150 ml: pulmonary veins encircling, roof line, left isthmus line(group 1); 150-200 ml: addition of a septal line (group 2); 200-250 ml addition of an anterior line (group 3); grater than 250 ml addition of atrial appendage isolation (group 4).
Areas of atrial tissue bordered by the applied lines were measured using the CARTO system in a sample of 100 patients.
**Results** After a follow up of 600±370 days 78% of patients were in sinus rhythm off drugs.
The were no differences among the four groups of different atrial volumes in terms of sinus rhythm maintenance. The initial atrial volume was not predictive of the results
The extension of areas bordered by ablation lines were similar among the different groups.
**Conclusions** Extensive linear ablation is effective in the therapy of atrial fibrillation: one the reasons may be attributable to the critical mass reduction.

## LONG-TERM FOLLOW-UP AFTER CRYBALLOON ABLATION OF THE PULMONARY VEINS WITHOUT ON-TOP-THERAPY IN PATIENTS WITH PAROXYSMAL OR PERSISTENT ATRIAL FIBRILLATION

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**Purpose** Ablation of atrial fibrillation (AF) using the cryoballoon ablation catheter system Arctic Front (CryoCath® Technologies) has proved to be a safe treatment in electrical isolation of the pulmonary veins (PV). Cryoballoon ablation usually is combined with an additional electrogram-guided on-top-therapy. In a pilot study we investigated the effectiveness of Cryoballoon ablation alone on the preservation of sinus rhythm (SR) 6 and 12 months after the procedure.
**Methods** Twenty-one patients with documented highly symptomatic paroxysmal (n=15) or persistent (n=6) AF underwent cryoballoon ablation and have been followed up for at least 6 months. Transseptal PV isolation was performed using the 28 mm balloon catheter after angiographic verification and electrophysiological mapping of the PV by a ring-shaped decapolar (Lasso) catheter. Treatment results were again verified by the Lasso catheter. Patients who showed AF recurrence after 3 months were offered a second treatment with the same technique but smaller balloon size. Primary study endpoint was AF-freedom after >6 months (documentation by 12-lead-ECG, Holter-ECG, event recorder, arrhythmia history).
**Results** Eighty PV were treated by 182 cryoapplications (2.3±0.4 per PV). Isolation was achieved in 78.8% of all PV. Mean follow-up (FU) was 9.5±3.5 months after the first procedure (>12 months: n=8). Six patients underwent a second procedure. After 1.3 procedures per patient, 16 patients (76.2%) showed SR. In the other 5 patients a redo was planned. The rate of AF recurrence was significantly higher in patients without PV isolation than in those with complete isolation (72.7% vs 25%, p=0.04).
**Conclusions** Cryoballoon ablation without on-top-therapy shows a high effectiveness in preservation of SR in long-term FU, but in approximately one half of patients a second procedure is necessary. This suggests that a reduction in material costs by abandoning on-top-therapy may lead to a higher redo rate.

## RECURRENT ARRHYTHMIAS AFTER CATHETER ABLATION OF PAROXYSMAL ATRIAL FIBRILLATION AND RESULTS OF A REPEAT ABLATION

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**Purpose** To describe recurrent arrhythmias following ablation of paroxysmal atrial fibrillation (AF), and the re-ablation results.
**Materials and methods** Re-ablation was performed in 77 patients (pts) (18 F, 54±11 years) in 97 procedures (2 re-ablations in 20 pts), which was 21% out of 362 pts with the first ablation for a paroxysmal AF by the end of the year 2006. The re-ablation end points were re-isolation of the pulmonary veins (PV) and termination of a spontaneous or induced sustained arrhythmia in all pts, and arrhythmia noninducibility in pts with the induced arrhythmia.
**Results** Prior to the 1st or the 2nd re-ablation: clinical left atrial tachycardia (LAT) was present in 10 (13%), resp. 5 (25%) pts; persistent AF in 12, resp. 2 pts; and persistent LAT in 6, resp. 4 pts. Arrhythmia due to the PV-LA reconnection was found in 50 (65%), resp. 7 (35%) pts, and arrhythmias originating in the LA free wall were found in

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26 (34%), respectively 13 (65%) pts during the 1st or the 2nd re-ablation. All PV arrhythmias were terminated by the PV encircling. Substrate-related arrhythmias were terminated by ablation except 2 (3%) and 3 (15%) pts during the 1st and 2nd re-ablation. Persistent AF was mainly terminated via conversion into LAT. In case of primary LAT or AF converting into LAT, ablation sites restoring sinus rhythm were largely located in the LA anterior wall or the coronary sinus. During the 22±13 months follow-up, 69 (90%) pts were free of arrhythmia, 55 (71%) pts off antiarrhythmic drugs.
**Conclusion** AF related to the PV-LA reconnection dominated prior to the 1st re-ablation, thereafter, proportion of the LA free-wall substrate-related arrhythmias increased as a result of unmasking of unrecognized sources or the proarrhythmic effect of previous ablation lesions.

## FEASIBILITY AND SAFETY OF USING AN ESOPHAGEAL PROTECTIVE SYSTEM: IMPLICATIONS OF CIRCULATING FLUID TEMPERATURES ON RF CONDUCTIVE HEATING

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AF ablation may result in LA-Esophageal fistula. Conductive heating (CH) is the main culprit for RF lesion growth and collateral damages.
**Purpose** To assess the feasibility and safety of using an esophageal system to modulate CH, thus controlling lesion depth, as an attempt to protect the Eso from thermal injury during RF ablation.
**Methods and Results** An "in vitro" lamb heart-Eso preparation was developed to evaluate such effects on heat propagation. A customized system (EPSac by RossHart Technologies Inc.) included a temperature controlled fluid-circulating system and a probe with a distal expandable compliant sac (up to 3 cm in diameter and 5 cm in length) which was inserted to a segment of Eso and placed in contact to the heart tissue (2-5 mm thick). A sensor was placed between the Eso and the heart for interface temperature monitoring during RF delivery via a 4 mm tip catheter, perpendicular to the heart tissue (15 g contact pressure) at 25, 35 and 45 W, 100±5 U for 30 seconds (immersed in a circulating saline bath at 37°C). All cardiac RF lesions were transmural. There was no Eso damage while circulating fluid at 10 and 5°C, but consistently injured the Eso at 25 and 15°C at all power tested.
In addition, an "in Vivo" canine model was used to test the EPSac effects on CH while delivering 35W for 30 seconds to the LA directly opposite to the Eso. Gross and microscopic exam identified Eso thermal injury while circulating the EPSac at 25°C, but no Eso injury at 5°C.
**Conclusions** The study system (EPSac) promoted esophageal protection likely by absorbing RF conductive heating. Full protection, irrespective of power up to 45 W, required circulating fluid temperature between 5-10°C. The feasibility and safety of using such a system to avoid esophageal thermal injury in patients undergoing AF ablation remains to be demonstrated.

## ESOPHAGEAL CAPSULE ENDOSCOPY: DIFFERENT FINDINGS BASED ON THE ANESTHESIA PROTOCOL

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**Introduction** Left atrioesophageal fistula is a rare but devastating complication that can occur following catheter ablation of atrial fibrillation.
**Methods** Fifty patients undergoing AF ablation for paroxysmal and persistent/permanent symptomatic atrial fibrillation refractory to AAD have been enrolled and randomized into 2 groups: those undergoing the procedure under conscious sedation with fentanil or midazolam (25 patients, group 1) and those receiving general anesthesia (25 patients, group 2). All patients underwent esophageal temperature monitoring during the procedure. Radiofrequency energy was discontinued when the luminal temperature reached 39°C. After ablation all patients had capsule endoscopy to assess the presence for endoluminal tissue damage of the esophagus.
**Results** The results are shown in the table below

| | Group 1 General Anestesia n=25 | Group 2 Conscious sedation n=25 | P value |
|---|---|---|---|
| Max Esophageal temp | 40.6°C±1°C | 39.6±0.8°C | P <0.003 |
| Time to Baseline temperature recovery | 29±3 sec | 18±2 sec | P <0.001 |
| time to peak Temperature | 9±7 sec | 21±9 sec | P <0.001 |
| Positive Endoscopy findings | 12 pts (48%) | 1 pt (4%) | P <0.001 |

**Conclusion** The use of general anesthesia increases the risk of positive esophageal findings by capsule endoscopy.

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## INFLUENCE OF HEAD-UP TILT TEST PROTOCOL ON ITS RESULTS IN PATIENTS WITH SYNCOPE IN RELATION TO THE GENDER

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The aim of study was evaluation of results of head-up tilt test (HUTT) in patients with syncope in relation to their gender and used protocol of HUTT.
We observed 354 pts (142 men, 212 women) aged 18-58 yrs (x 38,2 yrs) with syncope referred to HUTT.
All pts underwent standard HUTT acc. to Westminster (HUTT-s) – 300 pts or Italian protocols (HUTT-Italian) – 54 pts. Additional tilt tests with isoproterenol infusion or sublingual nitroglycerine administration were preformed in pts with negative HUTT-s (acc. Westminster protocol). HUTT was assessed as positive if reproduced symptoms referred by patients.
**Results** The prevalence of women with syncope was observed, but waso-wagal syncope was induced with comparable frequency between men and women in studied group (83,1 vs 82,2%).
Positive HUTT-s was in 129 pts (43,0%). Among 171 pts with negative HUTT-s 80 pts (26,6%) underwent HUTT with isoproterenol infusion (HUTT-I) and 89 (29,6%) pts with NTG administration(HUTT-NTG). HUTT-I was positive in 46 pts (57,5%), whereas HUTT-NTG was positive in 55 pts (61,2%). HUTT-Italian was positive in 34 pts – 62,9%. At least positive HUTT was in 74,6% pts.
Mixed type of vaso-vagal response (VVR) to HUTT was the most frequent during HUTT-I whereas cardioinhibitory type of VVR was the most frequent during HUTT-NTG. There were no significant differences in the frequency of VVR between men and women in all types of HUTT.
**Conclusions** 1. Vaso-vagal syncope induced by head-up tilt test did not more frequently occurs in women that in men; 2. The method of induction of syncope during HUTT not a gender of patient has influence on the type of vaso-vagal response to tilt.

## BEHAVIOR OF CENTRAL AND PERIPHERAL TEMPERATURE DURING HEAD UP-TILT TEST IN PATIENTS WITH SYNCOPE

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Since pre-syncopal symptoms frequently include hot flashes and sweating, it was the purpose of this study to evaluate core and skin temperature (T) in patients with history of syncope, during head-up tilt test (HUT). Twenty-three Pts of both sexes (78% females), with previous history of syncope were included. Of these, 13 had positive (+) HUT and 10, negative. The mean age for positive HUT was 45.7 vs 53.8 for those with negative HUT (P=0.433). Core and skin Ts were measured with calibrated fast-response thermistors connected to a custom-built amplifier and analog/digital converter (Exxer SRL, Buenos Aires). Core T (Tc) was measured with the probe within the ear canal and peripheral T (Tp) in the middle of anterior forearm. Recordings were obtained continuously and simultaneously with surface ECG and non-invasive, beat-by-beat blood pressure (Colin, USA). The area under the temperature curves of both Tc and Tp were obtained and averaged in periods of 3 minutes, at baseline (B), initial, (I, immediately after head-up tilt), preceding syncope (S) in Pts with HUT+ or the end of the test (End) in Pts with HUT-.
**Results** Pts with HUT+ showed a significant drop in Tc at I (-0.43%, p<0.001) and S (-0.56%, p=0.013) and drop of Tp at I (-1.22%, p=0.031) and at S (-1.59%, p=0.007). Pts with HUT- had a significant Tc drop at I (-0.36%, p=0.019), but non-significant at 10 min (0.14%) and End (-0.14%). The area under the curve of Tp decreases significantly during the test only in patients with HUT +. Conclusions: This pilot study suggests that syncope is preceded by changes in both central and peripheral thermal balance indicating the need for further investigation in this area.

## USE OF DIFFERENT SUBLINGUAL NITROGLYCERIN DOSAGES DURING HEAD-UP TILT TESTING IN ELDERLY PATIENTS WITH UNEXPLAINED SYNCOPE

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The importance of head-up tilt testing (HUT) has been demonstrated in the evaluation of elderly patients (pts) with unexplained syncope. Protocols using sublingual (SL) nitrates are increasingly used. Nevertheless, exaggerated responses to nitrates have been frequently described in elderly pts.
**Objective** To evaluate if the impact of nitroglycerin (NTG) in the diagnosis accuracy of HUT is dose-dependent in elderly pts with unexplained syncope.
**Methods** We studied 102 pts with >65 years submitted to HUT using NTG after an asymptomatic drug-free phase. Pts were divided into 3 groups according to the NTG dosage used: 500 mcg (73±6 years; n=37), 375 mcg (77±5 years; n=18) and 250 mcg (72±8 years; n=37). The protocol included a stabilization phase, a passive phase of 20 minutes (70º) and a provocative phase of 20 minutes after SL NTG. Continuous monitorization of the ECG and blood pressure was obtained (Task Force; CNSystems). The test was considered positive when there was reproduction of symptoms with bradycardia and/or arterial hypotension (cardioinhibitory, vasodepressive or mixed). A progressive and parallel decrease in blood pressure after NTG administration, with development of symptoms, was considered an exaggerated response to nitrates.
**Results** There were no differences in age and gender distribution between the groups or in the type of responses obtained (table).
**Conclusions** In a population of elderly pts with unexplained syncope, HUT potentiated by SL NTG: 1. is safe and provides a significant contribution for the etiological diagnosis of syncope; 2. the response to SL NTG is not dose-dependent, with no significant differences in the rates of exaggerated responses to nitrates.

| | 500 mcg | 375 mcg | 250 mcg |
|---|---|---|---|
| Female gender (%) | 57 | 39 | 26 |
| Negative test (%) | 32 | 50 | 34 |
| Positive test (%) | 51 | 33 | 51 |
| Vasodepressive (%) | 63 | 33 | 46 |
| Mixed (%) | 26 | 33 | 50 |
| Cardioinhibitory (%) | 11 | 33 | 4 |
| Exaggerated response (%) | 16 | 17 | 15 |

p=NS for all comparisons.

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## RELATIONSHIP BETWEEN INADEQUATE SINUS NODE CHRONOTROPIC RESPONSE AND CARDIOINHIBITORY VASO-VAGAL SYNCOPE

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The aim of study: evaluation of exercise induced chronotropic response of sinus node in patients with cardioinhibitory vaso-vagal syncope. Study population: we observed 41 pts (20 women, 21 men) aged 18-52 yrs, with cardioinhibitory vaso-vagal syncope (CI VVS). Other, than CI VVS, were previously excluded in all pts.

**Methods** All pts underwent exercise treadmill test (ETT) acc. to modified Bruce protocol. Duration of exercise, achieved peak HR expressed as % of maximal age-predicted HR (calculated from formula 220-age) and maximal metabolic workload (METS). Presence of chronotropic incompetence - defined as failure to reach 85% of maximum predicted heart rate - was also evaluated.

**Results** Stress test was well tolerated by all pts. Mean duration of ETT was 10.9 min (5.2-18.35 s). Mean reached metabolic workload was 10.1 METS (4.4-19). During exercise 60-103% of age-predicted maximal HR was achieved (mean – 85.5%). Chronotropic incompetence was diagnosed in 9 pts (21.9%) – they reached 60-76% of predicted max HR (mean value 70.2%)

**Conclusions** 1. Chronotropic incompetence was present in only 20% of patients with cardioinhibitory vaso-vagal syncope; 2. The role of chronotropic incompetence in pathogenesis of this kind of vaso-vagal is uncertain.

## STUDY OF THE HEMODYNAMIC PATTERN OF THE CLINICAL SYNDROME OF POSTURAL ORTHOSTATIC HYPOTENSION

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Postural Orhtostatic Hypotension (POH) is commonly seen in the elderly because of complex age-related impairment in hemodynamic regulation mechanisms.

**Purpose** To describe the hemodynamic pattern of the POH and to evaluate the effect of elastic compression treatment as previously described.

**Methods** 8 patients (6 female), mean age 65±15 years, affected by symptomatic POH underwent 2 tilt-test procedures, with and without elastic bandage of the legs (compression pressure 40 to 60 mm Hg) and of the abdomen (compression pressure 20 to 30 mm Hg) in a randomized crossover fashion. Leg bandage was administered for 10 min and was followed by an additional abdominal bandage for a further 10 min. Non invasive beat to beat recording (Task Force Monitor, Graz, At) of systolic blood pressure (SBP), stroke volume (SV), cardiac output (CO) and total peripheral resistance (TPR) was used.

**Results** Active treatment was able to counteract the decrease in TPR. Indeed, TPR were 1768±474 dyn*sec*$m^2$/cm5 baseline and 1623±321 dyn*sec*$m^2$/cm5 after 20 min of treatment. SV (57.1±3 ml baseline and 54±5 ml after 20 min) and CO (4.7±1 l/min baseline and 4.3±1 l/min after 20 min) remained unchanged. As consequence SBP decrease was of less entity, being SBP 134±15 mm Hg baseline and 107±35 mm Hg after 20 min.

**Conclusions** Progressive SBP decrease observed in patients affected by POH is characterized by concomitant progressive decrease in TPR (by 37% in this study) while SV and CO have slight changes. Elastic compression bandage is able to counteract this hemodynamic pattern by avoiding the decrease in TPR.

## A NEW THERAPEUTIC APPROACH TO NEUROCARDIOGENIC SYNCOPE. SHORT&LONG TERM FOLLOW-UP

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Multiple mechanisms, central and peripheral, have been implicated in the pathophysiology of neurocardiogenic syncope (NCS). We tested the efficacy of a therapeutic strategy that could block both central and peripheral factors in patients (pts) with NCS.

**Methods** Thirty-four pts (mean age 37.0±14.6 years, 21 women) with NCS were included and randomly (1:1) received the combination of a serotonin reuptake antagonist (SSIR-fluoxetine 20 mg/day) and a beta-blocker (atenonol 12.5-25 mg/day) or placebo. Pts had a positive head-up tilt-test (HUT) and >5 total syncopal spells or 2 in the previous 6-months.

**Results** Eighteen pts received the combination of fluoxetine-atenolol and 16 placebo. There were 3 withdrawals after inclusion. We followed-up our pts for a period of 11.9±6.1 months (1 to 24). Pts received therapy for 6 to 12 months. Syncopal episodes 6 months prior to study inclusion were 2.8±2.6 in the fluoxetine-atenolol group and 2.1±1.4 in the placebo group (p: non significant). Total syncopal episodes at 6 month follow-up decreased significantly in both groups when compared to baseline 6-months (fluoxetine-atenolol: 0.2±0.6, placebo: 1.3±1.3, $p<0.05$). Thirteen (81.3%) pts remained free of syncope with fluoxetine-atenolol and 6 (40%) with placebo. Kaplan-Meier analysis with respect to the first recurrence of syncope revealed that fluoxetine-atenolol was significantly more effective than placebo (Cox's test $p=0.03$). One pt from each group had syncope with severe trauma and had a pacemaker implanted. During long-term follow-up pts' symptoms in both groups improved significantly. 10 of 11 pts (90.9%) and 12 of 13 pts (92.3%) in the placebo and treatment groups respectively with a long follow-up, remained free of syncope during the second 6-month period.

**Conclusions** Preliminary results show that a combined therapeutic strategy that blocks both central and peripheral mechanisms of NCS improves short term symptoms. The long-term follow-up showed that symptoms improve significantly irrelevantly to the type of medication pts receive.

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## DO "REAL LIFE" PATIENTS IMPLANTED WITH CRT-D MATCH THE POPULATION CHARACTERISTICS OF CLINICAL TRIALS? DATA FROM THE ACTION-HF REGISTRY

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**Introduction** Patients implanted with CRT-D device for primary prevention in current practice may show different clinical characteristics with respect to large trials population and may be exposed to a different risk.
**Methods** Aim of the analysis is to see if, in patients indicated for CRT-D for primary prevention enrolled in the ACTION-HF registry, clinical characteristics match those from COMPANION study.
**Results** Data from 404 patients enrolled in ACTION-HF are compared with the 595 COMPANION patients implanted with CRT-D. Clinical characteristics do not substantially differ as to: QRS (160 vs 160), LBBB (76 vs 73) and heart rate (70 vs 72). Conversely, patients from ACTION-HF are moderately older (70 vs 66) and represent a less compromised population with respect to COMPANION study (NYHA class>II: 72% vs 100%; HF duration: 1 vs 3.5 yrs; LVEF: 26% vs 22%; diabetes 27% vs 41%).
**Conclusion** Clinical characteristics of patients currently implanted with CRT-D are representative of a different population with respect to COMPANION trial. "Real life" registries are useful in clinical practice as the enrolled population often show different characteristics with respect to their reference trials. Follow up data will show if these patients are exposed to different risk.

## ATRIAL FIBRILLATION PREVALENCE AND PATIENT CHARACTERISTICS IN CRT-D DEVICE RECIPIENTS. DATA FROM THE ACTION-HF REGISTRY

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**Introduction** Evidence suggest that among patients implanted with CRT-D devices those with atrial fibrillation (AF) have a worse prognosis than patients with no AF, and that AF is a marker of increased mortality in patients with underlying cardiac disease.
**Methods** Aim of the analysis is to see if, in patients indicated for CRT-D for primary prevention enrolled in the ACTION-HF registry, clinical characteristics in patients with AF differ from those without AF.
**Results** Among 303 patients enrolled in ACTION-HF 80 patients (26%) showed AF either at baseline ECG or in patient files (28 paroxysmal, 11 persistent, 41 permanent). Patients with AF differed from the others for the following characteristics: severe mitral regurgitation (32% vs 21%; p<0.02); left bundle branch block (86% vs 73%; p<0.02); primitive dilated aetiology (77% vs 62%, p<0.02); valvular disease (20% vs 5% p<0.01); systolic blood pressure (126 vs 115 mm Hg; p<0.01) and QRS duration (165 vs 153 ms; P<0.05).
**Conclusion** Clinical characteristics of patients with AF implanted with CRT-D show a higher prevalence of structural diseases with respect to those without AF. Follow up data will show if these patients are exposed to different risk.

## ELECTROCARDIOGRAPHIC PATTERNS DURING BIVENTRICULAR PACING WITH VARIATIONS IN THE VENTRICLE TO VENTRICLE TIMING INTERVALS

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**Purpose** Cardiac Resynchronization Therapy (CRT) is an approved therapy for patients with symptomatic heart failure (HF) and interventricular conduction delay. Recent pacing systems incorporate programmable functions that allow adjustments to the stimulation interval (V-V) between the two ventricles. The ECG manifestations with modifications of V-V timing features have not been evaluated and the purpose of this study is to describe ECG patterns associated with variations in V-V timing intervals.
**Materials and Methods** Patients who received CRT for standard indications were included in the study. Twelve-lead ECGs were recorded before implantation, during right ventricular (RV) pacing alone, left ventricular (LV) pacing alone and Biventricular (Bi-V) pacing with V-V intervals of -40 ms (LV to RV), 0 ms and +40 ms (RV to LV). Leads positions were confirmed fluoroscopically. QRS morphologies were analyzed by two independent observers.
**Results** Twenty four patients, 17 men and 7 women whose mean age was 71±11, were included. During Bi-V pacing at 0 ms the frontal plane axis was directed superiorly, similar to RV pacing; and negative complexes in Lead I and RBBB pattern appeared in V1, similar to LV pacing.
During Bi-V pacing at -40 ms, Lead I and precordial morphologies strongly resembled LV pacing; however the frontal plane axis was directed superiorly for infero apical positions and was variable for posterior and lateral positions.
Bi-V pacing at +40 ms generated a superior frontal plane axis as RV pacing; however Lead I showed positive or negative complexes and Lead V1 demonstrated RBBB or LBBB patterns.
**Conclusion** Biventricular pacing with variations in the V-V timing intervals produce specific patterns for each timing. Recognition of specific ECG manifestations with variations in V-V intervals may be clinical relevant in identifying responders and nonresponders to CRT, lead malfunction and the need for further AV and V-V optimization.

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## VENTRICULAR ARRHYTHMIAS IN PATIENTS WITH CRT-D DEVICE WITH OR WITHOUT PERMANENT ATRIAL FIBRILLATION

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**Purpose** It has been reported that patients with chronic atrial fibrillation (CAF) and CRT-D therapy show improvement in clinical and echo parameters similar to patients in sinus rhythm (SR). Aim of this study is to analyze the ventricular tachyarrhythmias burden in patients of the Italian InSync ICD Registry, according to the presence of SR or CAF.
**Methods** We studied 421 patients (364 SR, 57 CAF). The baseline characteristics were comparable in the two groups, except for the older age (69 vs 66 years) and the higher ejection fraction (29% vs 25%) of the CAF patients (both p<0.05).
**Results** During a mean period of follow-up of 19 months, ventricular tachyarrhythmias were detected in 93/364 (26%) SR patients, and in 17/57 (30%) CAF patients (NS). Episodes were 1632 (4.48/pt) in SR group, and 206 (3.61/pt) in CAF Group (NS). Ventricular tachycardia (VT) was detected in 70/364 (19%) SR patients and in 13/57 (23%) CAF patients (NS). Number of VT episodes was 1243 (3.4/pt) in SR patients, and 139 (2.4/pt) in CAF group (NS). VT cycle length was (median) 358 ms in SR and 332 ms in CAF (p<0.05). Ventricular fibrillation (VF) episodes were detected in 51/364 SR patients (14%), and in 11/57 CAF patients (19%) (NS). Number of VF episodes was 1.1/pt in SR, 1.2/pt in CAF patients. VF cycle length was 280 ms in SR group, 272 ms in CAF group (NS).
**Conclusions** Patients with CAF and CRT-D devices do not show a worse ventricular tachyarrhythmias burden comparing with patients in stable SR; they only have faster ventricular tachycardia episodes.

## EFFECTIVENESS OF CARDIAC RESYNCHRONIZATION THERAPY IN THE ELDERLY

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**Background** It is currently unclear whether elderly patients respond less favourably or not to cardiac resynchronization therapy (CRT) compared with younger patients. This is an important issue, because most patients with heart failure are old.
Purpose: To compare the beneficial effects of CRT between patients under and over 70 years old.
**Material and Methods** A total of 58 consecutive patients with heart failure (12 aged >or= 70) who underwent CRT were studied prospectively (Nov 2005-Mar 2007). Before CRT and 3 months after, demographic, echocardiographic and clinical evaluation was performed. Patients with reduction in LV end-systolic volume >or= 15% after CRT were classified as responders.
**Results** Before CRT, mean NYHA class was 3.2±0.6 and mean duration of the QRS was 156±28 ms; 36% of patients had ischemic cardiomyopathy and 21% were aged >or= 70 years. Patients aged <70 years were more likely to have severe dilatation of LV (LVEDV= 291.0±118.6 vs 232.1±98.7 ml in patients aged >or= 70 years, p<0.05). No other significant differences in baseline characteristics were observed between these groups. The 2 patient groups showed a significant improvement in clinical symptoms, LV ejection fraction and LV end-systolic volume after CRT. Furthermore, the magnitude of improvement in the LV ejection fraction and extent of LV remodelling were not significantly different between groups. The number of nonresponders was comparable between patients aged <70 (42%) and those aged >or= 70 years old (58%). Besides that, we found no differences between groups in unplanned cardiac hospitalizations or in mortality at 6 months.
**Conclusions** Patients aged >or= 70 years demonstrated comparable benefit from CRT as those aged <70 years. The number of nonresponders to CRT was similar in the 2 groups. These results suggest that age should not be considered in the CRT's patient selection.

## MORTALITY AFTER CRT: A SYNERGETIC EFFECT BETWEEN VENTRICULAR REMODELING AND REDUCED FREQUENCY OF VENTRICULAR ARRHYTHMIAS. THE INSYNC ICD ITALIAN REGISTRY

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**Background** It is currently debated whether cardiac resynchronization therapy (CRT) has an effect on the burden of ventricular arrhythmias (VA). We investigated whether the reverse remodeling after CRT may reduce the occurrence of VA.
**Methods** The study included 398 patients enrolled in the InSync ICD Italian Registry, treated with CRT-D and with a follow-up of at least 12 months. Spontaneous VA detected by the device were reviewed and validated.
**Results** After 6 months of follow-up VA episodes persisted in 79 patients (group 1), while no VA episodes occurred in the remaining 319 patients (group 2). At baseline, clinical and echocardiographic characteristics of the two groups were comparable: NYHA class (3.0±0.7 vs 2.9±0.6), QRS width (163±34 ms vs 166±31 ms), ejection fraction (26±6% vs 26±7%), LVEDV (226±45 ml vs 251±98 ml), LVESV (158±38 ml vs 182±84 ml) (All p=NS). At 6 month visit, ventricular remodeling was apparent only in group 2 pts: LVEDV (200±83 ml, p=0.042 vs Baseline), LVESV (133±65 ml, p=0.002 vs Baseline). No changes were evident in group 1 pts: LVEDV (216±69 ml, p=0.769 vs Baseline), LVESV (160±59 ml, p=0.521 vs Baseline). The long-term survival from all-cause death resulted higher in group 2 pts (Log-rank test: p=0.032).
**Conclusions** In patients treated with CRT, a reduction of ventricular arrhythmic events occurs during the initial 12 months following implant and it correlates with the degree of ventricular remodeling. Patients demonstrating a remission of arrhythmic episodes have a better survival and more pronounced long term improvements.

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## ACTIF: A REAL WORLD EXPERIENCE OF RADIOFREQUENCY ABLATION OF ATRIAL FIBRILLATION IN FRANCE

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**Purpose** This multi-centre, prospective registry intends to report efficacy and safety data from 8 centres in France, with a varying range of experience.
**Materials and methods** Data from 498 radiofrequency ablation procedures performed in patients with atrial fibrillation (AF) were recorded between March 2005 and December 2006. Primary endpoints were acute procedural success and freedom of AF recurrences at 6 months.
**Results** An interim analysis of 248 patients (79% male; age 57±10 y; AF history 62±52 months) shows that 67% of patients treated with catheter ablation have paroxysmal AF. Hypertension, heart failure, previous stroke and atrial flutter was seen in 31%, 9%, 5% and 27%. Procedure time and fluoroscopy time were 146±47 min. and 33±16 min. Ninety percent of patients had their first ablation and 11% needed a redo ablation in the first 6 months. An electro-anatomical approach (CARTO® EP Navigation system, Biosense Webster Inc.) or segmental approach (LASSO® Circular Mapping Catheter, Biosense Webster Inc.) was used in 41% and 43% of the patients. In addition to pulmonary vein isolation, additional lesions in the left atrium and a right atrial isthmus line were created in 65% and 37%. In 96% of the cases ablations were performed using an irrigated tip catheter (THERMOCOOL® catheter). Acute procedural success was achieved in 90.6%. Twenty-four hour Holter recordings detected paroxysmal AF episodes and chronic AF in 32% and 31% at screening vs 24% and 15% at 6 months. Patients reported no more AF recurrences at 6 months in 63% and stopped taking anti arrhythmic drugs and anticoagulation in 29% and 42%. A total of 18 procedure related adverse events (4.6%) were reported. No death or stroke was seen.
**Conclusions** Radiofrequency ablation of atrial fibrillation performed at centres with varying experiences is effective and safe.
Key words: atrial fibrillation, radiofrequency ablation, irrigated tip.

## ELECTROPHYSIOLOGICAL CHARACTERISTICS AND CATHETER ABLATION IN PATIENTS WITH PAROXYSMAL SUPRAVENTRICULAR TACHYCARDIA AND PAROXYSMAL ATRIAL FIBRILLATION

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**Introduction** Paroxysmal supraventricular tachycardia (PSVT) is often associated with paroxysmal atrial fibrillation (AF) and can act as a trigger. The aim of this study was to investigate the clinical and electrophysiological characteristics in patients with PSVT and AF, and to demonstrate the origin of the AF before the radiofrequency (RF) ablation of AF.
**Methods and Results** 402 consecutive patients with paroxysmal AF (338 had a pure PV foci and 64 had a non-PV foci) that underwent RF ablation were included. Twenty-one patients (10 females; mean age 47±18 years) with both PSVT and AF was divided into 2 groups. Group 1 consisted of 14 patients with inducible atrioventricular nodal reentrant tachycardia (AVNRT) and AF. Group 2 consisted of 7 patients with Wolff-Parkinson-White (WPW) syndrome and AF. Patients with non-PV foci of AF had a higher incidence of AVNRT than those with PV foci (11% vs 2%, P=0.003). Patients with the atypical form of AVNRT had a higher incidence of AF ectopy from the SVC than those with the typical form (86% vs 14%, P=0.03). The patients in group 2 had a larger LA diameter than those in Group 1 (41±3 vs 36±3 mm, P=0.004). The patients in group 1 had a higher incidence of an SVC origin of AF than did those in Group 2 (50% vs 0%, P=0.047).
**Conclusion** The SVC AF has a close relationship with AVNRT, especially in atypical AVNRT. The effect of the atrial vulnerability and remodeling may differ between AVNRT and WPW syndrome.

## SAFETY AND EFFICACY OF QUADRANT ABLATION USING A NOVEL EXPANDABLE MESH CATHETER

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**Introduction** We've reported using an expandable MESH catheter to create LA/PV antrum lesions. However, partial ostial/atrial ablation may be preferable to minimize risk or to close gaps in previously ablated tissue. The aim of this study was to test the feasibility and safety of quadrant (arc) ablation in vivo. Methods: Six dogs (31.5±2.1 kg) were acutely studied. Three dogs underwent quadrant ablation where a portion of the circumference of the MESH catheter was energized and three underwent ablation where a combination of all electrodes and quadrants were energized ('quadrant plus circumferential'). Radiofrequency ablation at 25, 30 and 35 watts, 62°C was used for quadrant ablation; 100 watts and 62°C were applied for circumferential alablation. The heart was excised and examined grossly and histologically.
**Results** Twelve PVs were targeted. Quadrant lesions had the same histological appearance as standard RFA with edema, necrotic cells, and loss of nuclei. Lesions created by energizing a quadrant (28%-33%) of MESH circumference correlated with the intended targeted area, the corresponding histo-pathologic lesions measuring 10 to 95% of the circumference. Due to vein size, some vein ostia overlapped with a quadrant, resulting in lesion lengths up to 95% of the circumference. The circumferential applications created lesions that were less than the full circumference of the PV. Histologic analysis demonstrated that 82±35% transmurality. The quadrant plus circumferential RFA created curvilinear lesions that isolated the targeted PVs (4 out of 6) veins. No thrombotic complications or MESH-related collateral tissue damage was observed. The additional segmental applications superimposed on the circumferential lesions did not result in tissue perforation or charring.
**Conclusions** Targeted quadrant plus circumferential MESH ablation safely creates lesions around targeted PVs. This technique may prove useful for treating gaps in intended circumferential lesions or in applying a minimalist approach to PV isolation.

## THERE IS A MARKED INCREASE IN BIOCHEMICAL MARKERS OF MYOCARDIAL INJURY AFTER RADIOFREQUENCY ABLATION FOR ATRIAL FIBRILLATION

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Application of radiofrequency ablation (RFA) in the heart causes myocardial injury. It is unknown whether the release of biochemical markers is related to the different locations of RFA in the atrium. We

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sought to investigate the changes in myocardial enzyme levels after pulmonary vein (PV) isolation for atrial fibrillation.
**Methods and results** 82 consecutive patients (17 women, mean age 57±7) referred for PV isolation were included in this study. All patients underwent segmental PV isolation, and some patients had additional left atrial lines (n=28), cavotricuspid isthmus lines (n=7) or both (n=5). Troponin-T (TnT), creatin kinase (CK), CK-MB and C-reactive protein (CRP) levels were assessed before and 24 hours after ablation. All PVs were isolated in all patients by using an irrigated RFA catheter. All baseline measurements were within the normal range (TnT <0.03 µg/L, CK 122±58 U/L, CK-MB 3.4±1.2 µg/L and CRP 3.42±1.2 mg/L), and showed a significant increase (p<0.001) in all four markers after ablation (TnT 1.36±0.76 µg/L, CK 162±100 U/L, CK-MB 9.0±3.7 µg/L and CRP 12.3±10.6 mg/L). Statistical analysis revealed a linear relationship between the numbers of RFA applications and post-ablation TnT concentration ($r^2$=0.328, p<0.001). Similar relationships were demonstrated for CK and CK-MB ($r^2$=0.449 and 0.409 respectively, p<0.001). An increase in serum CRP levels was observed in most patients after RFA, but no relation to the number of RFA application points was found. There was a tendency towards more myocardial injury of RFA applications around the PV than in the other parts of the atria (mean TnT release per RFA application 0.030 vs 0.027 µg/L, p<0.001).
**Conclusions** Serum levels of TnT, CK, CK-MB and CRP increase after PVI. There seems to be a linear relationship between the number of applications and the post-ablation serum levels of TnT, CK and CK-MB. RFA may have a larger impact at the PV antrum than in the other parts of the atria.

## STRUCTURAL LEFT ATRIAL DIFFERENCES BETWEEN PATIENTS UNDERGOING CATHETER ABLATION FOR PAROXYSMAL OR PERMANENT ATRIAL FIBRILLATION

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**Purpose** To compare the left atrial (LA) volume and voltage characteristics between patients (pts) undergoing catheter ablation of permanent and paroxysmal atrial fibrillation (AF).
**Materials and methods** Electroanatomical maps obtained before ablation during the first ablation procedure were compared between 107 pts (24 F, 55±10 years) with permanent AF (lasting without SR 7-140, median 18 months, resistant to amiodarone and cardioversion) (group 1) and 107 patients (30 F, 56±11 years) with paroxysmal AF (group 2). Patients with serious primary structural heart diseases were excluded. Both groups did not differ in hypertension (64 vs 59 pts), LV EF was lower in group 1 (53±8 vs 60±5, P<0.001). LA electroanatomical maps were created from 132±27 and 116±21 points in groups 1 and 2. LA volume (ml) calculated by the CARTO software, LA volume/BSA (ml/m2), proportion of points <0,2 mV and points >1 mV (%) were compared.
**Results** LA volume and LA volume/BSA were higher in the group 1 (157±35 vs 120±30; P<0.001, resp. 76±15 vs 59±15; P<0.001). Proportion of points <0,2 mV was higher in group 1 (30±20, median 22 vs 16±18, median 9; P<0.001) and proportion of points >1 mV was lower in group 1 (15±12, median 12 vs 44±25, median 47; P<0.001).
**Results** Among patients without major primary structural heart disease, permanent AF is associated with significantly higher LA volume and proportion of points <0,2 mV, and lower proportion of points >1 mV indicating either more advanced structural remodeling due to arrhythmia itself or more severe idiopathic scar reconstruction or amyloid deposition within the LA wall.

## NON-INCISIONAL ATRIAL TACHYCARDIA: ACUTE AND LONG-TERM EFFECTS OF TRANS-CATHETER RADIOFREQUENCY ABLATION.

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**Background** Radiofrequency catheter ablation (RFCA) has been proposed as a curative treatment in patients (pts) with atrial tachycardia (AT) unresponsive to antiarrhythmic drugs. However, the long term clinical effects are not well known.
**Aim** To evaluate the clinical characteristics, the acute and long term results of RFCA in pts with drug refractory nonincisional AT.
**Methods and Results** the study population consisted of 70 consecutive pts (32 men, mean age 58±18 yrs) who underwent RFCA of AT refractory to 2.3 antiarrhythmic drugs. Paroxysmal AT was present in 54 (77%), persistent in 15 (21.4%), iterative in 2 (2.9%). Organic heart disease was detected in 20 pts (38.6%), tachycardiomiopathy in 5 (7.1%). AT arose from the right atrium in 63 (90%), from the left atrium in 7 (10%). Acute success of RFCA, defined as AT interruption and noninducibility after RFCA, was obtained in 60 pts (86%). The AT origin was close to the crista terminalis in 18 pts (25.7%), tricuspid annulus in 10 (14.3%), apex of Koch triangle in 10 (14.3%), in the right atrial free wall in 12 (17.1%), right atrial septum in 14 (20%), pulmonary vein ostium in 4 (5.7%) and other sites in 3 (4.3%). Other tachycardias including AV nodal tachycardia, atrial fibrillation and flutter were induced in 20 pts, successfully treated by RFCA in 15. During a mean follow up of 43 months only 2 pts (2.9%) had recurrences of a slower and nonsustained AT, that was successfully treated by a second RFCA.
**Conclusion** 1. AT arises in well define sites of right atrium and left atrium. 2. RFCA is effective and safe in the acute therapy and during longterm followup. 3. TA is frequently associated with others tachyarrhythmias treatable in the same session with RFCA.

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## PACEMAKER LEAD PROLAPSE THROUGH THE PULMONARY VALVE IN CHILDREN

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**Background** Transvenous pacemaker leads in children may be placed with redundant slack to allow for patient growth. This excess lead can rarely prolapse into the pulmonary artery and interfere with valve function. We sought to determine the response to lead repositioning on valve regurgitation.
**Methods** This is a retrospective review of demographics, pacemaker lead type, implant duration, radiography and echocardiography.
**Results** Nine pediatric patients (age at implant 8±4 yrs; revision 13±4 yrs, 7 female) at seven centers identified with pulmonary valve lead prolapse, accounting for <0.1% of pediatric patients with transvenous pacing leads. Diagnoses were congenital AV block (6) or sinus node dysfunction in complex congenital heart disease (3). All nine patients underwent procedures to retract and reposition the lead. All leads were fixated in the RV apex (6 active and 3 passive fixation leads). Implant duration prior to revision was 4±3 yrs. Two leads required radiofrequency-powered extraction sheaths, two were pulled using a catheter snare from below, and five were retracted and repositioned. The degree of tricuspid regurgitation was none/trivial (3), mild (4), or moderate (2), and only two improved with repositioning. Pulmonary regurgitation preoperatively was mild (5) or moderate (4) versus trivial (4), mild (3) and moderate (2) after repositioning or replacement. Patients with longer-term implanted leads did not have improvement in pulmonary regurgitation. Two patients had mild pulmonary stenosis from lead-related obstruction.
**Conclusion** Prolapse of transvenous RV apical pacing leads into the pulmonary artery can rarely occur when a generous amount of slack is left for future growth. The leads can be repositioned, but may require extraction and replacement, particularly if chronically implanted and adherent to valve apparatus. Lead revision does not always resolve pulmonary regurgitation, and lead prolapse may result in permanent valve damage.

## RISK OF SUDDEN DEATH IN CHILDREN AND ADOLESCENTS WITH WOLFF-PARKINSON-WHITE SYNDROME

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Wolff-Parkinson-White syndrome (WPW syndrome) is the main cause of supraventricular tachycardia in children and adolescents. The risk of sudden death is atrial fibrillation (AF) that could degenerate to ventricular fibrillation (VF).
The AIM of this study was to investigate when the children and adolescents with WPW syndrome are at risk of sudden death.
**Method** We investigated 130 children and adolescents with WPW syndome and first tachycardia at 1st day until 21 years. They were divided in four groups: I group with first tachycardia during first year of life, II from 1-5 years, III from 5-12 years and IV from 13-21 years. All of them had ECG during and after tachycardia and an echocardiographic finding. They were followed-up mean 6,3±3,5 years. Electrophysiological investigation (EPI) and treatment with RFCA have been done in 51.
**Results** Only type of tachycardia in 40 children in I and II group was ortodromic reciprocating tachycardia (ORT), in III group ORT had 36 (93%) children and antidromic tachycardia 3 (7%), in IV group the first tachycardia was ORT in 41 (80%), ART in 4 (7%) and AF in 6 (11%). In 2 with AF,at 18 and 21 years, AF degenerated to VF. The youngest child with AF was 15 years old. By EPI, 11 of 16 children with AF had effective refractory period (ERP) of accessory pathway less then 220 seconds (p<0,01vs ORT and ART), 8 of 16 with multiple pathways (p<0,01 vs ORT) and 10 of 16 had left lateral and left posteroseptal pathway (p<0,01 vs ORT and ART).
**Conclusion** In high risk of sudden death are the children with WPW syndrome from 15- 21 years. AF could be first manifestation of WPW syndrome and could degenerate to VF. So, an EPI and, if necessary, treatment with RFCA should be done in all children with WPW syndrome before 15 years.

## PROGRAMMED VENTRICULAR STIMULATION IN PATIENTS WITH REPAIRED TETRALOGY OF FALLOT, PULMONARY REGURGITATION AND RIGHT VENTRICLE DILATATION

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**Aim** To analyze the role of electrophysiological study (EPS) in adult patients with repaired tetralogy of Fallot, severe pulmonary regurgitation and dilated right ventricle with systolic dysfunction.
**Methods** Twenty two consecutive adult patients (68% male, 34.5 ¡Ó 12.5 years (range 26 to 57) underwent EPS: 3 with previous ventricular tachycardia (VT). Programmed ventricular stimulation was performed at baseline with 3 extrastimuli. Right bundle branch block was present in all patients (mean QRS duration 164.5 ¡Ó 0.4 ms). MRI showed a mean right ventricular ejection fraction (RVEF) of 27% whereas mean left ventricular EF was 51.7%. Mean right ventricular end-diastolic volume (RVEDV) was 129.75 ml/m2. No patient underwent pulmonary valve replacement prior to EPS.
**Results** Baseline intracavitary intervals were normal in 19 out of 22 patients (HV interval: 52.4b16 ms). Sustained monomorphic VT was induced in 22.7% (n=5) of patients, 1 with previous documented VT and 4 without previous VT; ventricular fibrillation was induced in 4.5% (n=1), without previous VT. Patients with inducible VT had a mean QRS duration of 178 ms, a mean RVEDV of 149.33 ml/$m^2$ and a mean RVEF of 25%. Patients with noninducible VT had a mean QRS duration of 160.6 ms. Mean RVEDV was 126 ml/$m^2$. and mean RVEF was 27%.
An ICD was implanted in the three patients with previous VT. At follow-up (mean of 28,9 months (0,7 to 105,7 months), all patients with previous documented VT, had recurrent VT, whereas the remaining patients, irrespective of the inducibility at EPS, did not have clinical VT.
**Conclusions** In contrast with previous studies, in adult patients with repaired tetralogy of Fallot, severe pulmonary regurgitation and dilated right ventricle, the inducibility of sustained VT at EPS did not predict clinical arrythmias with a mean follow up of 28.9 months. Longer follow up is required to confirm these data.

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## CIRCADIAN PATTERN OF ATRIAL PACING THRESHOLD IN YOUNG PATIENTS

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**Purpose** The aim of this study was to evaluate the range of variation of atrial pacing threshold in young patients with endocardial and epicardial pacing leads.

**Material and Methods** Atrial Capture Management Algorithmä (ACM) is a Medtronic EnPulse pacemakers (PM) feature that works in 2 ways: AV conduction (AVC, atrial pacing with spontaneous AVC) and atrial chamber reset (ACR, intrinsic atrial activity with atrioventricular block, AVB). The study is prospective, non-randomized.

**Results** In 2004-2005, 14 consecutive patients, aged 14±13 years (11 males, 79%) received EnPulse E2DR01 PM for AVB (9 patients, 64%) or sinus node dysfunction (SND). New PM and leads were implanted in 8 patients (57%), the others had only PM replacement. Epicardial leads were implanted in 9 patients. ACM was programmed to automatically measure threshold every 4 hours. Follow-up was 11±6 months: 9742 threshold measurements were stored (6328 AVC, 3414 ACR), 3797 (39%) of which were successful (1807 AVC, 29%, 1990 ACR, 58%) in 11 (79%) patients. Measurement success was 42±34% (AVC 27±39%, ACR 41±29%). Main reasons for unsuccessful measurements were high heart rate in infants and, in a patient, AVB associated with SND. All these had epicardial leads. Pacing threshold showed specific circadian patterns: higher thresholds were found between 00.00 and 12.00 a.m., but the variation was low, 0.03±0.02 Volts.

**Conclusion** Young patients show a circadian variability of atrial threshold with higher thresholds after midnight and in the morning.

## TRANSVENOUS LEADS EXTRACTION IN YOUNG ADULTS. A SINGLE CENTRE EXPERIENCE

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**Purpose** The increasing number of implantation of pacemakers and ICDs is associated with an increase in the rate of leads infection or failure. The need of treatment of these device-related complication are particularly important in young patients. We aimed to evaluate effectiveness and safety of transvenous leads extraction (TLE) using mechanical dilatation (MD) in a population of young adults.

**Materials and methods** Since January 1997 to June 2007, 86 patients (47 male), with age ranging 18 to 40 years (mean age 30±6 years old), underwent TLE to remove 133 leads (112 pacing leads, 21 defibrillator leads). Mean implantation time was 86±64 months (range 2-252 months). The indication for extraction was: local infection in 37 patients (43.1%), sepsis in 9 (10.5%), lead malfunction in 33 (38.4%), fractured free-floating leads in 3 (3.4%), life-threatening leads in 3 (3.4%), occlusion of all veins in 1(1.2%). We performed mechanical dilatation using the Cook Vascular (Leechburg PA, USA) extraction kit and, if necessary, other intravascular tools (Catchers and Lassos, Osypka, Grentzing-Whylen G.); a transfemoral (TA) through the femoral vein, or jugular approach (JA), through the internal jugular vein, in case of free-floating or difficult exposed leads.

**Results** TLE was not applicable in 2 leads (1.5%). Among the remaining 131 leads, 124 (94.6%) were completely removed; 5 (3.8%) partially removed and 2 (1.5%) not removed. Manual traction allowed to remove 13 leads (9.9%). TA and JA were necessary in 1 and 22 leads respectively.

**Conclusion** Our study suggest that transvenous leads extraction by mechanic dilatation is an effective and safe procedure in young patients. These results suggest that indication of leads extraction could be extended to most functionless leads in young adults.

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## THE BIRMINGHAM PROTOCOL FOR INVESTIGATING DEFIBRILLATION THRESHOLDS

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**Background** Defibrillation threshold determination is time consuming with often imprecise results. A protocol for fast and precise threshold determination was developed with 5 methodological peculiarities. It was practically tested in the Cardiac Rhythm Management Laboratory, University of Alabama at Birmingham.
Protocol: 1) A test method with a step-up procedure from below threshold was applied. With each fibrillation episode two defibrillation attempts are possible as long as threshold is not yet reached. The first successful shock is regarded as threshold. 2) The logarithmic principle of equal accuracy was applied. Constant relative voltage steps of 10% upwards and 9.1% downwards were used. 3) Evaluating the results, thresholds of the various waveforms were firstly related to a reference waveform and these ratios were, then, averaged for comparison. 4) Leading and trailing edge voltages of all shocks were registered oscilloscopically to determine efficient leading and trailing edge voltages, pulse duration, time constant, stored energy, and tilt. 5) The pulse duration or tilt was adjusted for every shock on the basis of the time constant of the preceding shock.
**Results** In 12 pigs, 203 fibrillation episodes were initiated corresponding to 17 episodes per animal. 109 thresholds were determined. Of these 109 successful trials 59 (54.1%) were reached with the first shock and 50 (45.9%) with the second shock. It proved to be advantages to relate all thresholds to a standard waveform to reduce the standard deviation. This, in combination with voltage increments of only 10% yielded an accuracy in determining thresholds of different waveforms on all levels that is normally not reached.
**Conclusion** We believe the BIRMINGHAM PROTOCOL to be a good test method as being fast, precise, and suited to determine up to 12 different waveform thresholds in one animal experiment.

## STANDARDIZED DEFIBRILLATOR IMPLANT TEST PROTOCOL ENHANCES SHOCK EFFICACY AND REDUCES IMPLANT TEST BURDEN

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**Purpose** is to quantify the influence of the test protocol on the obtained defibrillation threshold (DFT), the percentage of patients meeting implant criterion and predicted Defibrillation Shock Efficacy (DSE).
**Methods** The probability of successful defibrillation is governed by a Dose-Response (DR) curve with shock energy (E), that is mathematically described with a logistic regression formula:

P (success)=DSE=(E/E50)^C/(1+(E/E50)^C) *100%

with parameters E50 as the energy at 50% defibrillation success and C as the steepness of the curve.
Using computer modeling, the parameter distributions (E50, C) of the DR curves were estimated based on DFT data from 654 patients in the Painfree RX II study.
A 10 Joule (J) Safety Margin (SM) was used as an Implant Criterion for a 30J ICD. Simulated DSE curves were subjected to various test protocols. The table shows the % of cases and DSE at 20J (DSE20) with SM>=10J and SM=10J and the number of VF inductions for protocol completion.

**Results**

| Test protocol | SM >=10 Joule | | SM=10 Joule | | Number of VF inductions |
|---|---|---|---|---|---|
| | (%) | DSE20 (%) | (%) | DSE20 (%) | |
| No test | 100 | 96+/-10 | 100 | 96+/-10 | 0+/-0 |
| 1/1 at 16 J | 93 | 98+/-6 | 93 | 98+/-6 | 1+/-0 |
| 2/2 at 20 J (Golden Std) | 94 | 98+/-6 | 94 | 98+/-6 | 2.0+/-.2 |
| +if failed, 1st repeat 2/2 | 97 | 97+/-7 | 3.6 | 86+/-15 | 2.1+/-.3 |
| +if failed, 2nd repeat 2/2 | 98 | 97+/-10 | .9 | 74+/-16 | 2.1+/-.5 |
| Step Down-start at 20 J | 96 | 97+/-7 | 6.2 | 84+/-18 | 4.8+/-1.4 |
| Step Down-start at 14 J | 99 | 97+/-8 | 1.7 | 70+/-22 | 4.5+/-1.5 |
| SD+ 1 confirm (=DFT+) | 98 | 97+/-7 | 2.9 | 75+/-18 | 5.8+/-1.7 |
| SD+ 2 confirm (=DFT++) | 97 | 97+/-6 | 3.9 | 80+/-15 | 7.0+/-1.8 |
| Binary Search-start 12 J | 99 | 97+/-7 | 1.8 | 74+/-18 | 3.2+/-.2 |
| Step Up-start 5 J | 99 | 97+/-8 | 1.3 | 65+/-19 | 1+/-0 |

**Conclusions** *Standardization of ICD implant test protocol is necessary for a standard predicted DSE at 10. *Patients with a DFT at 10 J Safety Margin or with repeated test after initial failure have a lower than average predicted DSE and increased risk of Sudden Cardiac Death. *System modification after a failed test must be aimed at the highest expected DSE increase only.

## SINGLE CENTER EXPERIENCE WITH A NEW STEROID-ELUTING, SINGLE COIL, ACTIVE FIXATION DEFIBRILLATION LEAD

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A single coil active fixation defibrillation lead with a steroid-eluting extendable/retractable screw (Sprint Fidelis 6931, Medtronic Inc., Minneapolis MN, USA) was implanted in 147 patients (113 male, mean age 61±14 years, mean ejection fraction 35±12%) between january 2005 and july 2007. Nine patients had right sided imnplantation, 32 patients were under amiodarone treatment. The purpose of this study was to evaluate if this type of single coil defibrillation lead allows safe ICD implantation. Defibrillation efficacy was tested at implant and during discharge testing (PHD) according a specific test protocol. Induced ventricullar fibrillation had to be terminated by the implanted device at least twice maintaining a 10 Joule safety margin to maximum device output. Additionally, electrical parameters like R-wave amplitude, pacing threshold, pacing impedance and non-invasively determined shock impedance were measured at implant, discharge testing, 1 month and 3 months follow-up.
**Results** Pacing thresholds (msec) determined at 1 Volt output were low and stable over time (Impl.: 0.24±0.11, PHD 0.23±0.14, 1M: 0.24±0.12, 3-M: 0.24±0.12 msec). Also, appropriate R-wave amplitudes (Impl. 9.81±3.7, PHD: 9.07±3.8, 1-M: 10.2±4.2, 3-M: 10.9±4.0 mV) and pacing impedances (Ohm) (Impl.: 697±193, PHD: 531±92, 1-M: 567±103, 3-M: 577±107 Ohm) were recorded. The shock-lead impedance revealed a wide range from 45 to 103 Ohms (Impl.: 69±12, PHD: 62±11, 1-M: 69±12, 3-M: 72±15 Ohm).
A 10 J safety margin could be maintained in 141/147 patients (95,9%) during implant procedure and in 142 patients (96,5%) at discharge testing. The placement of an additional SVC-coil to obtain the 10 J safety margin was necessary only in 5 patients, no placement of a subcutaneous placed array was needed.
**Conclusion** Safe defibrillation, as well as low-pacing thresholds and reliable R-wave amplitudes could be demonstrated with the use of the Sprint Fidelis 6931 single coil defibrillation lead.

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## BACTERIOLOGICAL ASSESSMENT OF INFECTIOUS EXTRACTED PM AND ICD LEADS

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**Introduction** It has been proven that leads infections, when not treated, lead to very serious consequences. We carried out a microbiologic assessment, in order to identify the prevalent strains of bacteria responsible for the leads infections, so as to delineate an effective therapeutic protocol.
**Methods** Between May 2003 and June 2007, at our Centre, 101 leads were extracted from 54 patients of which 87.5% had indication of infection. After extraction, samples of the suspected infected leads were sent to the Microbiology department for an examination.
**Results** Staph. epidermidis was the most frequently isolated bacterial strain (37.7%), followed by Gram+ flora (16.1%), Staph. aureus (14.3%), Candida parapsilosis (5.4%), Staph. schleiferi (5.4%), Corynebacterium species and Staph. hominis (3.6%). Cultures were negative in about 14.3% of samples. Retained sensitivity to antibiotics was the following: teicoplanin/vancomycin 100%; doxicyclin 96%; amikacin 94%; piperacillin-tazobactam 58%; cotrimoxazole 78%; gentamycin 65%; quinolones 47%; rifampicin 44%; cephalosporins 25% and oxacillin 25%. In case of sepsis, sensitivity for glycopeptides and amikacin was retained (about 100%); to a lesser degree, that also applies to doxicyclin (80%). Moreover, we arbitrarily divided the infections in recent (i.e. ¡Ü 3 months) and chronic infections (i.e. >3 months). With the only exception of doxicyclin, an increase in time prior to referral for lead extraction was associated with a significant increase of antibiotic resistance. Staph. hominis and epidermidis showed very high antibiotic resistance.
**Conclusions** Our data point out a poor susceptibility to antibiotics of the bacteria associated with pacemaker-related infections, and show that also local infections not healing with usual antibiotics are often sustained by methicillin-resistent strains. Therefore, systemic antibiotics must not be delayed in such patients, having in mind that, however, the mainstay of the management of relapsing infections is the complete removal of the implanted system.

## BRUGADA SYNDROME. OUTCOME OF PATIENTS AFTER CARDIOVERTER DEFIBRILLATOR IMPLANTATION IN A LATINAMERICAN REGISTRY

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Brugada syndrome (BS) is an arrhythmogenic disease implying increased risk of sudden cardiac death (SD), but the outcome of patients (p) with implanted cardioverter-defibrillator (ICD) indicated for primary prevention (PP) of SD is still subject to investigation. The aim of this study is to analyse long-term follow-up of p with BS after ICD implantation included in the LABOR Registry.
**Materials and Methods** We studied 44p mean age: 44±15 yrs (35 men), 37p were symptomatic (17p: aborted SD; 16p: syncope; 4p: documented ventricular tachycardia) and 7p were asymptomatic. ICD was indicated for PP in 23p and for secondary P (SP) in 21p.Type 1 ECG pattern of BS was spontaneously registered in 42p and unveiled by ajmaline in 2p. Follow-up lasted between 2 and 104 months (29±27 months).
**Results** During surgery defibrillation threshold >21 J was documented in 4p (9%). Twenty one p received electrical therapies (ET), which were appropriate in 9p and inappropriate in 12p (atrial tachyarrhythmias: 9p; T wave oversensing: 2p lead fracture: 1p). Patients with inappropriate ET were usually younger (age 40±16 yrs versus 49±12 yrs, p=NS).An asymptomatic p experienced appropriate ET (Brugada ECG pattern at baseline). Appropriate shocks tended to be more frequent in SP than in PP (33% versus 9%; p= 0.06). Syncopal episodes recurrences were documented in 2p (13.2%): in one during atrial fibrillation while in the other the episode was unrelated to an arrhythmic event. Two p died as a consequence of malignant ventricular arrhythmias.
**Conclusions** In this small cohort of BS p the incidence of arrhythmic events were low, but ET tended to be more frequent in SP p. Better tools to stratify the risk of life- threatening arrhythmic events are necessary to optimize the cost/benefit ratio of ICD for PP of SD.

## SEVENTEEN YEARS EXPERIENCE OF ICD IMPLANTATION

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**Purpose of study** To analyse the effectiveness of ICD during long-term follow-up, estimate survival of patients with ICD, evaluate complication rate in the immediate and late postoperative periods.
**Material** In 1990-2007, 281 ICD (156 single-chamber, 109 dual-camber and 16 triple-chamber) were implanted in the Bakoulev Center for Cardiovascular Surgery. Primary implantations were performed in 197 patients, in 84 cases the ICD were replaced because of battery depletion.
**Results** We evaluated long-term results of 270 implantations of III-IV generation ICD in 197 patients (140 males, age 14-78 years, in average 49.0±14.7 years), follow-up period 1-131 months, in average 31.8±30.2). During this period 118 pts (60.7%) received ICD therapy, the interval between the implantation and the first therapy was 0.5-70 month. Multifactorial analysis revealed that the only variable which influenced rate of ICD therapy was left ventricle ejection fraction (LVEF). LVEF appeared to be the most important factor of survival; in patient with LVEF<40% the survival was only 62%, while in patients with LVEF>40% it rose to 93%(∂=0,0001). Total cumulative proportional survival (Kaplan-Meier) was 79%.
We have noticed that multiple-chamber ICDs can improve not only LV EF and quality of live (LVEF in this group increased from 37.3±10.1% to 45.0±10.9%, NYHA class changed from 2.87±1.01 to 2.12±0.64), but also influence patient survival. Survival of patients with multiple-chamber ICDs reached 94%, while in patient with single-chamber ICDs it was 67% (∂=0.001).
**Conclusions** 1) Most significant factors influencing survival and quality of live are LVEF and multi-chamber devices. 2) There is no statistically significant difference between surgical complication rate for patients with single-chamber and multi-chamber ICDs. 3) The incidence of inappropriate therapy for SVT and sinus tachycardia with single-chamber devices is twofold higher than with multi-chamber devices.

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## ATRIAL PACING SHOULD NOT POSE A FEAR OF DEVELOPING LATE POSTIMPLANT ATRIOVENTRICULAR BLOCK IN PATIENTS WITH SINUS NODE DISEASE

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Atrial pacing for sinus node disease (SND) is less expensive, and compared with ventricular-based pacing it maintains the normal cardiac depolarization sequence, thus negative effects of ventricular pacing can be avoided. However, it is still rarely used, as concern was raised about the risk of developing atrioventricular block (AVB) during follow-up.

The aim of this retrospective study was to analyze the risk of developing AVB requiring additional ventricular pacing in SND patients with recurrent atrial fibrillation (AF) in whom multisite atrial pacing was inserted, and antiarrhythmic drugs were widely used.

A total of 276 patients patients were identified (66±7 years), who were implanted with two atrial leads: one in the right atrial (RA) appendage, high RA or Bachmann's bundle area, and another lead in the coronary sinus. Patients were observed for median of 2.4 years (0.04-9.4) until the end of the study, a change in pacing mode or patient's death occurred.

**Results** During follow-up 20 patients (7.2%) had a ventricular lead implanted because of AVB with a median delay of 2.1 years [QI 0.6; QIII 3.4 years] after primary implantation (annual incidence 2.5%). It was third-degree AVB in 3, second-degree AVB in 18 patients (Wenckebach-type in 12), and symptoms occurred in 5 patients. Antiarrhythmic drugs were administered in 93% of patients at hospital discharge after multisite atrial pacing insertion, and in 99% of patients during follow-up. First-degree AVB and left anterior fascicular block at implantation were not associated with subsequent AVB. As bundle branch block was infrequent an assessment if it indicates patients at risk of late AVB development was not enabled.

**Conclusions** High-degree AVB is infrequent in patients with SND and recurrent AF treated with atrial pacing, even if antiarrhythmic drugs are widely used. AVB requiring upgrading of the pacemaker occurs at a rate of 2.5% per year.

## EFFICACY OF DIFFERENT ATRIAL PACING RATES IN PREVENTING RECURRENCES OF PAROXYSMAL ATRIAL TACHYARRHYTMIAS

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**Introduction** Clinical efficacy and tolerance of selected overdrive parameters and atrial overdrive algorithms to suppress atrial tachyarrhythmias (AT) is still debated. Recent studies have tested different atrial pacing rates, modes, and sites for preventing atrial fibrillation (AF) recurrence. The study objective was to assess the incidence of AF recurrence at three different pacing rates.

**Methods** Thirty-eight consecutive patients suffering from SSS and symptomatic brady-tachy syndrome (BTS) or paroxysmal atrial fibrillation were implanted with a DDDR pacemaker. In 10 patients the lower pacing rate was programmed at 50 bpm, in 15 pts at 60 bpm and in 13 pts at 80 bpm. All patients underwent follow up at 1 week, at 1-3-6 months after pacemaker implantation for evaluation of the recurrences of paroxysmal atrial tachyarrhythmias in absence of antiarrhythmic drugs. Stored EGMs of >4 s duration identified all AT/AF recurrence.

**Results** At 1 month AT/AF recurred in 6/10 (60%) patients of I group (atrial pacing 0-15%), in 7/15 (49%) of II group (atrial pacing 32-55%), in 1/13 (7.6%) patients of III group (Ap >90%). At 6 months AT/AF recurred in 9/10 patients of I group (90%), in 11/15 patients of II group (73%), in 1/13 patients of III group (7.6%). X 2 test was used to compare data of DDD pacing at 50 vs 60 bpm (p=ns), of DDD pacing at 50 vs 80 bpm (p=ns) and of DDD pacing at 60 vs 80 bpm (p=0,0002). In the group with atrial pacing rate of 80 bpm no symptoms neither signs of heart failure were referred by patients.

**Conclusions** These results confirm that higher atrial pacing rates are both significantly effective for preventing recurrences of paroxysmal atrial tachyarrhythmias in SSS and symptomatic BTS or paroxysmal atrial fibrillation patients, and haemodynamically well tolerated.

## POSTEROSEPTAL ATRIAL SITE IN DUAL CHAMBER DEVICES IMPLANTATION: SAME SITE FOR SEPTAL PACING AND VAGAL AV STIMULATION. INSIGHT TO OPTIMAL STIMULATION SITE AND RATE CONTROL IN AF

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**Background** Postero-septal atrial site has been proposed for prevention of paroxysmal AF in sick sinus syndrome. From postero-septal right atrial endocardium, AV node vagal fibers can be selectively stimulated using high frequency stimulation (HFS). Recent studies have shown that HFS of the AV-node vagal ganglionated plexus during AF could produce a significant reduction of ventricular rate response. We hypothesize that postero-septal right atrial site obtained by a standard screw-in catheter could represent both an optimal pacing\sensing site and allow a persistent AV vagal stimulation in the long term.

**Methods** In 10 consecutives pts with an history of PAF, candidates to dual chamber or biventricular ICD implant, a screw-in atrial (52 cm) lead has been implanted in the post-septal area where an advanced AV block was achieved (following an AV ganglial HFS mapping delivered by diagnostic quadripolar electrophysiological catheter).Devices able to perform a fast (50 Hz) in-hospital atrial stimulation (Medtronic EnTrust or Concerto) were used. At 1 month follow-up a 50 hertz-stimulation from ICD has been performed in order to assess persistence of the vagal effect.

**Results** In 10 patients (100%) we achieved a complete AV block during implantation. Standard electrical measurements (threshold test,amplitude,impedence) showed acute and chronic stability at 1 month FU.

**Conclusions** Data emerging from our study add hints about the role of right inferior ganglionated plexus in regulating AV node function. Besides this integrated therapy opens up a wide range of new diagnostic and therapeutic possibilities.

## ADVERSE CARDIAC EVENTS IN SICK SINUS SYNDROME PATIENTS

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**Purpose** To evaluate adverse cardiac events in sick sinus syndrome patients after pacemaker implantation.

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**Materials and Methods** Study was consisted of 143 coronary artery disease pts (female 20), mean age 61.1±11.1 years old. 75 pts had VVI pacing mode, 38 pts - AAI mode and 30 pts -DDD mode. All pts were divided into 2 groups: post-MI group (45 pts) and non-MI group (93 pts). Follow up was 61.1±23.9 mos. Total and cardiac mortality, structure of mortality, total survey, (pacemaker syndrome,), occurrence of chronic atrial fibrillation, stroke, worsening of heart failure symptoms were assessed during follow up.
**Results** Total mortality was 53.3% in post-MI group and 33.9% in non-MI group. The reasons for cardiac mortality were as follows: MI in 14 (40%) pts.
Cardiac mortality in AAI group was 30.0% and 26.32%, respectively. Total and cardiac mortality in DDD group was 33.33% and 30.0%, respectively. Differences in total mortality and cardiac mortality among the groups were statistically significant ($p<0.05$). Tromboembolic events occurred in 15.79% of VVI pts, in 3.57% of AAI pts and were not revealed in DDD pts. Chronic atrial fibrillation was diagnosed in 42.11% in VVI group, in 7.14% in AAI group, in 9.52% in DDD group. Differences in incidences of chronic atrial fibrillation among the groups were statistically significant ($p<0.05$). Worsening of heart failure symptoms was revealed more frequently in VVI group comparing to AAI and DDD groups in 44.6% ($p<0.05$) and 40.9% ($p<0.05$), respectively. Pacemaker-syndrome was not revealed in AAI and DDD groups. Total survey was higher in these groups as well.
**Conclusion** AAI or DDD pacing significantly improves long-term outcomes in sick sinus syndrome pts.

## USEFULNESS OF AJMALINE TEST TO IDENTIFY ADVANCED INFRA HIS CONDUCTION DISTURBANCES IN PATIENTS WITH SYNCOPE, BUNDLE BRANCH BLOCK AND NORMAL H-V INTERVAL

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**Introduction** A normal H-V interval has been considered enough to exclude advanced infra His conduction disturbances in patients (pts) with syncope.
**Objective** To analyze the effect of an Ajmaline test during the electrophysiologic Study (EPS) in pts with syncope, bundle branch block and normal H-V interval.
**Material and Methods** Between March 2003 and February 2007 an EPS was performed in 140 pts (112 male gender, mean age 64,5¡À16 years) with syncope, bundle branch block (BBB) and normal H-V interval. After a pacing protocol, intravenous Ajmaline (1 mg/kg/min) was admistrated to evaluate the His-Purkinje conduction reserve.
Ajmaline test was considered positive when: H-V interval prolongation ¡? 100 msec. or 2nd or 3rd degree Infra His AV block occurred.
**Results** Ajmaline test was positive in 37 pts (26.4%): 21 pts (15%) showed H-V interval between 100 and 120 msec., 7 pts (5%) >120 msec. and 9 pts (6.4%) 2nd or 3rd degree infra His block.
**Conclusions** In this study population, 26% of the pts with syncope, BBB and normal H-V interval, had an abnormal response to the Ajmaline test.
This subgroup of pts. could have a high risk for spontaneous AV block.

## CLINICAL IMPACT OF IMPLANTABLE LOOP RECORDER STRATEGY IN SYNCOPE: EXPERIENCE FROM ISSUE STUDIES

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**Aim** We evaluated the clinical impact of implantable loop recorder (ILR) in patients (pts) with recurrent syncope of uncertain origin from ISSUE and ISSUE2 studies.
**Methods and Results** Among 590 pts implanted with ILR (52% males, mean age 66±14 years, 75% with normal ECG, 75% without structural heart disease and 34% with positive Tilt Table Testing), 211 had at least one syncope recurrence within two years of follow-up. Significant independent predictors of syncope recurrence were the number of syncope episodes in the last two years before ILR implant (HR=1.02, 95% CI=1.01-1.04, p=0.032) and positive Tilt Table Testing (HR=0.70, 95% CI=0.49-1.00, p=0.050). A correct ILR activation allowed a diagnosis due to syncope-rhythm correlation in 161/211 pts (76%). Diagnosis was asystole in 92 pts (44%), bradycardia in 7 pts (3%), sinus rhythm or sinus tachycardia in 52 pts (25%) and ventricular tachycardia in 10 pts (5%). Median time to diagnosis was 77 days (25°-75° percentile=26-191 days). Fifty-two out of 211 pts (25%) were not able to activate the ILR at least once; there were not significant independent predictors of ILR activation incapacity. Two out of 211 pts (1%) had ILR battery exhausted during the syncope episode. 0.3% of pts underwent to sudden death, 0.8% to non-cardiac death, 0.8% to transient ischemic attach, 0.2% to myocardial infarction and 1.4% to ILR explants due to pocket infection.
**Conclusions** A strategy based on ILR application is safe and effective for pts with recurrent syncope of uncertain origin.

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## RISK STRATIFICATION AND CHOICE OF THE METHODS OF TREATMENT

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**Purpose** Evaluation of the degree of life-threatening of the ventricular arrhythmias (VA) in non-ischemic myocardial diseases and development of an algorithmic approach to choose a method of treatment.

**Material and methods** Since1996 we have studied 273 patients with non-ischemic VA; 221 pts undergoing RFA with 92% effectiveness, 8 receiving ICD (122 males and 151 females, aged 29.5 on average). All pts were divided into 4 clinical groups: 1. Syncope and pre-syncope states – 40.5%; 2. Decreased physical tolerance against the background of different variants of VA – 35.9%; 3. Subjective feelings of arrhythmia and stable hemodynamics – 19%; 4. Asymptomatic variants of VA – 4.6%.

**Results** 1. Statistical analysis reveals a high degree of correlation between syncope states and the significant structural changes of the myocardium (arrhythmogenic dysplasia/cardiomyopathy, myocarditis) including the cycle length (CL) of VT, which relates to sympathotonia (SDNN avr – 25.6±9.8 msec and LF/HF avr – 7.3±1.03. VT with CL avr – 304.5±18.7 msec) (groups 1, 2). 2. ICD has proved urgent in 8 patients with stable paroxysms of VT with CL avr – 265.3±5.7 msec and/or VF (group 1). 3. Significant structural changes of the myocardium are not found in groups 3 and 4; and in group 4 characteristics of HRV are typical of parasympathotonia (SDNN avr – 105.2±20.9 msec and LF/HF avr – 2.3±0.5) with VT CL avr – 498.2±25.7 msec.

**Conclusions** 1. The criteria of potential malignance of VA in non-ischemic myocardial diseases are: significant structural changes in the RV and LV myocardium, decrease of HRV indices: SDNN <30 msec and LF/HF >7 in VT CL <310 msec. 2. The application of ICD is determined by the presence of stable paroxysms of VT with cycle length <=270 msec.

## PROGNOSTIC VALUE OF STRUCTURAL AND FUNCTIONAL RELATIONSHIP IN HYPERTROPHIC CARDIOMYOPATHY

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**Background** Sudden cardiac death (SCD) and serious arrhythmic events (SAE) are the most important problems among patients with hypertrophic cardiomyopathy (HCM). The relation between structural abnormality, impaired function of left ventricle and occurrence of SCD or SAE remains unclear.

**Methods** A total of 83 patients with HCM (age 41.5±15.97 years, 57% men) were divided into two groups: group I (n=34) consisting of non-symptomatic patients with HCM and group II (n=49) made up of patients with SCD after successful resuscitation and ICD implantation, with SAE obtained after clinical exam and Holter monitoring (VT and nsVT; SVT, AF; symptoms of HF). Basic echocardiographic data and using TDI annular velocities from septum (M), lateral(L), anterior(A) and inferior (I) walls with evaluation of heterogeneity index (Het) and global function index (GFI= E/Ea/Sa) were analyzed.

**Results** Both groups were similar in terms of age, sex, NYHA class and incidence of outflow tract obstruction. In group II a higher LVMI, HeI and LAA were observed (183.69±61.95 g/m$^2$, 2,12±0,56; 24,52±8,8 cm$^2$) than in group I [(136.88 ±36.83 g/m$^2$; 1.73±0.45 and 18.66±5.59 cm$^2$) p <0.01; p <0.007; p <0.05 respectively). Higher GFI and E/E'ratio were observed in group II (2.99±1.85 vs 1.5±0.86 cm/s; p=0.001 and 15.09±4.97 vs 10.68±5.32; p <0.05 respectively). LVMI and HeI correlated positively with GFI (r=0.55 and 0.44) but negatively with E' (r=-0.43 and -0.41). GFI >1.97 was an independent risk factor for SCD with 80% sensitivity and 89% specificity. Coincidence of GFI>2.0 + HeI>2.0 and Het <1.0 cm/s had a poor prognostic value (Fisher's exact test p=0.04).

**Conclusions** Patients with HCM and greater LV hypertrophy and more diffuse LV impairment have greater risk of symptomatic disease and greater incidence of serious arrhythmic events. TDI is useful in risk stratification of sudden cardiac death.

## BUNDLE BRANCH REENTRANT VENTRICULAR TACHYCARDIA IN THE SETTING OF PRESERVED VENTRICULAR FUNCTION AND NONSPECIFIC CONDUCTION SYSTEM ABNORMALITIES

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**Introduction** Bundle branch reentrant ventricular tachycardia (BBRVT) typically occurs in the setting of ventricular dysfunction and conduction system disease. However, BBRVT have been also reported as the mechanism of ventricular tachycardia in the absence on ventricular dysfunction.

**Aim** To assess clinical and electrocardiographic characteristics of a group of patients presenting BBRVT.

**Methods** Nine patients (7 males, 61,b 15 y) with documented ventricular tachycardia (VT) underwent an EP study which demonstrated BBRVT as the only mechanism of VT. Analysis of the left ventricular end-diastolic diameter (LVEDD), ejection fraction (EF), QRS morphology and PR interval was performed.

**Results** All patients successfully treated by ablation of the right bundle branch. Four patients (44%) exhibited ventricular dilation (LVEDD >55 mm) and mild systolic dysfunction (EF 46, 45, 41 and 35% respectively). However in 5 out of 9 (55%) left ventricular diameter and ejection fraction were normal except for one patient (56, 53, 57, 45 and 35% respectively). During sinus rhythm 4/9 ptes exhibited an abnormal QRS pattern (2 left bundle branch block, 1 left anterior fascicular block (LAFB), 1 right bundle branch block+LAFB). 5/9 patients had a narrow QRS complex and 2/9 exhibited a slightly and transiently nonspecific conduction abnormality. Interestingly, all patients showing a narrow QRS configuration had a long PR interval (HV interval 61, 69 y 84 ms respectively).

**Conclusion** Bundle branch reentry may be the mechanism of VT in patients without ventricular dysfunction. The majority of our patient showed a non nonspecific conduction abnormality at baseline EKG. In this setting recognition of this mechanism may be very important given that BBRVT can be easily eliminated by catheter ablation.

## RADIOFREQUENCY ABLATION OF ISCHEMIC VENTRICULAR TACHYCARDIA IN PATIENTS IMPLANTED WITH ICD. THE ROLE OF NONINDUCIBILITY AT END OF RF PROCEDURE

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**Background** Patients (Pts) with ischemic ventricular tachycardia (VT) are commonly treated by antiarrhythmic medication and ICD implantation in order to reduce incidence of arrhythmic deaths. Aim of this work was to assess feasibility and effectiveness of RF catheter ablation, guided by three-dimensional electroanatomic mapping tech-

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nique, in pts. whose implanted ICD continues to deliver multiple DC shocks due to VT.

**Methods** Fourthy-six implanted pts. (age 63.56±7.74 yrs, male N=38) with previous MI (mean interval 14.72±4.06 months) and showing at least 2 episodes of sustained (SVTs) or non sustained (NSVTs) ventricular tachycardia or DC shocks in the previous 3 months, were treated by RF ablation. RF ablation, performed by inducing linear lesions across the border zone between the necrotic area and surrounding normal tissues, was preceded by electroanatomic mapping during sinus rhythm using an 4 mm irrigated tip ablation catheter. All inducible VTs were targeted for RF ablation. At the end of the procedure non inducibility was considered as a success.

**Results** 2.31±0.91 linear lesions/pt were performed by RF and complete success was achieved in 33 out of 47 pts. (70%). Fourth (12%) of the 33 pts who were completely noninducibile experienced a recurrence of any VTs during the follow-up period (838.1±497.5) compared with 10 (71%) of 14 pts still inducible (p <0.001). The multivariate analysis show that low ejection fraction (-0.135; p=0.033) and noninducibility (3.351; p=0.0027) has predictive factor of VTs relapse.

**Conclusions** Our data show that RF catheter ablation in pts. with coronary artery disease whose implanted ICD continues to deliver multiple DC shocks due to VTs is actually feasible and effective in reducing arrhythmic episodes. Patients who were rendered completely noninducible had significantly lower VT recurrences compared with pts in whom any VT was still inducible at the end of the procedure.

## EFFECTIVENESS OF ANTITACHYCARDIA PACING THERAPY IN FAST VENTRICULAR ARRHYTHMIAS

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**Purpose** Previous randomized trials have shown a high efficacy rate by ATP (antitachycardia pacing therapy) for treating ventricular tachycardia (VT) >188 bpm, with a shock reduction of 70%. Our aim was to analyze the effectiveness of ATP in fast VT (FVT) in our centre.

**Materials and Methods** Prospective analysis of effectiveness of a single regimen of ATP for terminating FVT (200-240 lpm) in 68 consecutive patients (p) who received an ICD between January 2005 and March 2007. ATP was a burst pace 8 pulses at 88% VT cycle length. We excluded those patients who have usually a polymorphic VT (channelopathies, hypertrophic cardiomyopathy or idiopathic ventricular fibrillation).

**Results** Mean age was 67±11 years old. Etiology was ischemic cardiomyopathy in 56 p (82%), idiopathic in 10 (14%), enolic in 1 (2%) and dilated-phase hypertrophic cardiomyopathy in 1 (2%). Mean left ventricular ejection fraction was 35±14%. Indication for ICD implantation was as secondary prophylaxis in 48 p (71%). During 14±8 months follow-up, 166 FVT episodes occurred in 10 p, and 131 of them was accumulated in a single patient. ATP was successful in 152 episodes (92%), avoiding shock delivering. There were 14 episodes of RVT that were accelerated by ATP. If we exclude the patient with 131 episodes (who did not need shock), ATP was successful in 21 of 35 FVT (60%). There were no significant differences regarding cycle length of VT aborted by ATP respect to them which needed shock (286±13 ms vs 279±15 ms, respectively; p=0,1). The appearance of FVT was neither significantly associated with ischemic etiology nor with secondary prophylaxis.

**Conclusions** ATP in VT between 200-240 bpm is effective, avoiding shock delivering in a high rate of episodes. In our study, the effectiveness of ATP was not associated with FVT cycle length.

## COMBINED RESYNCHRONIZATION AND DEFIBRILLATOR THERAPY IN PATIENTS WITH AND WITHOUT VENTRICULAR ARRHYTHMIAS

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Long term cardiac resynchronization therapy decreases the risk of death and complication related to heart failure. Nowadays sudden cardiac death can be partly prevented by ICD implantation and combination of both therapies in a single device is challenging

**Aim** We attempt to assess retrospectively the efficacy of primary and secondary prevention of ICD and combined CRT-ICD in heart failure patients.

**Methods** We valued total mortality and appropriate/non appropriate shocks in patients with ischemic and non-ischemic cardiomyopathy. Atrial fibrillation patients and previous implanted PM were not excluded. Diagnosis of aetiology was made after coronary angiography in all patients.

**Results** From January 2001 to May 2007 we implanted 258 devices. 104 ICDs were indicated, CRT was associated in remaining 154; 134 patients fit criteria for primary prevention (51,9%). Mean age was 69.2% years, 67% was male and in 67% significant CAD was detected. Mean ejection fraction was 28.2%, 25.1% in Primary and 31.4 in secondary prevention. Medical therapy tended to be optimal relatively to current guidelines Amiodarone was used mostly in secondary prevention patients to reduce ICD intervention.

Mean follow up updated to June, 2007 is 25 months (range 6-108). Overall mortality rate was 7.9% and 4.5% per year; ICD appropriate shocks rate was 23.3% and rate of inappropriate was 14.4%. Appropriate ICD intervention was 43.2% in secondary vs 12.4% in primary prevention. In primary prevention, appropriate intervention was 17.4 in ICD vs 10.9 in CRT-ICD.

**Conclusion** In our population, ICD or CRT-D implant showed: low total mortality, incidence of appropriate shocks as expected. Combined devices seems to reduce incidence of appropriate ICD intervention in patients without previous sustained ventricular arrhythmias.

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## DELINEATING SPATIAL RELATION BETWEEN THE PULMONARY VEINS AND LOCATIONS OF COMPLEX FRACTIONATED ELECTROGRAMS BY THREE-DIMENSIONAL MAPPING

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Pulmonary vein (PV) isolation has been employed as a treatment for atrial fibrillation (AF). Complex fractionated electrogram (CFE) mapping has been introduced as another guide to AF ablation. Spatial relation between the PVs and locations of CFEs are not well defined. Methods and results: 21 AF patients (17 men, mean age 57±11, 14 paroxysmal, 2 persistent and 5 permanent) referred for PV isolation were included. The NavX CFE mapping tool (St. Jude Medical) was applied during stable AF (13 induced). Electrograms were sampled for 8 seconds at each site. CFE values were calculated as the mean cycle lengths of all detected time intervals. 'High frequency' was defined as a CFE value of <80 ms and distance to the relevant PV ostium measured. The PV ostia and antra (within 20 mm from the ostia) were demarcated by guidance of fluoroscopy and NavX geometry. A total of 82 PVs were mapped (left common 4, superior 17, inferior 17; right superior 21, inferior 21, middle 2). PV ostia were divided into two parts: the anterior and posterior. High-frequency CFE was located inside, or 5 mm, 10 mm, 20 mm out from the ostium in 43, 19, 9 and 6 PVs anteriorly and in 21, 16, 13 and 12 posteriorly. No high-frequency CFE was observed in 2/60 and 1/20 PVs anteriorly, 7/60 and 11/20 (P<0.001) posteriorly in paroxysmal and permanent AF, respectively. In the PVs with identified high-frequency CFE, the distances to the PV ostia were 2.7±5.1 and 7.4±5.4 mm (P<0.01) anteriorly, 6.5±6.4 and 9.4±8.4 mm posteriorly in paroxysmal and permanent AF, respectively. Conclusions: High-frequency CFEs were more frequently located in the PV ostia in paroxysmal than in permanent AF. During PV isolation expanding ablation lesions up to 10 mm from the PV ostia may cover most of the high-frequency CFEs around the PV antra.

## IMPACT OF PRE-EXISTENT AREAS OF COMPLEX FRACTIONATED ATRIAL ELECTROGRAMS ON OUTCOME AFTER PULMONARY VEIN ISOLATION

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**Objective** To characterize pre-existent areas of complex fractionated atrial electrograms (CFAEs) recorded in right atrium (RA) and in coronary sinus (CS) during catheter-based pulmonary vein (PV) isolation and to assess their relation to outcome.
**Background** Atrial fibrillation (AF) drivers outside PV may account for failure after PV isolation. It is not known whether non-PV CFAEs identified in patients during catheter ablation are predictors of AF recurrence.
**Methods** We analysed 224 consecutive patients with drug-refractory AF who underwent PV isolation and had spontaneous or induced AF lasting more than 5 minutes during the procedure. With a tricuspid annulus and CS mapping, performed with a 20-pole catheter, CFAEs were retrospectively identified and their impact on outcome was assessed.
**Results** Of 224 patients, 161 were found to have CFAEs (81%). No clinical variable was found to be predictive of CFAEs presence By Kaplan-Meier analysis, following a median follow-up of 23.7 months after a single ablation procedure, 62.8% of patients in the CFAEs (+) group and 85.4% of those in the CFAEs (-) group were free from recurrent atrial tachyarrhythmias (p=0.013). Multivariable Cox regression analysis showed that CFAEs evidence (Hazard Ratio 3.32, 95% CI 1.38 to 7.95; P=0.007), and persistent/permanent AF (Hazard Ratio 2.11, 95% CI 1.06 to 4.22; P=0.034) were independent predictors of recurrence.
**Conclusions** Pre-existent CFAEs, that can be easily identified in RA and CS during PV isolation, are a powerful independent predictor for AF recurrence. Additional substrate ablation after PV isolation warrants consideration in this subset of patients.

## WHAT IS THE APPROACH FOR CATHETER ABLATION OF CHRONIC ATRIAL FIBRILLATION: COMPLEX FRACTIONATED ATRIAL ELECTROGRAM (CFAE) GUIDED OR AFFILIATED TO PULMONARY VEIN ISOLATION

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**Background and Objectives** Pulmonary vein isolation(PVI) is the well accept corner stone for catheter ablation(CA) of paroxysmal atrial fibrillation(AF), but it∞fs not effective for chronic AF. Complex fractionated atrial electrogram iCFAE jguided CA has been report to be an important approach for chronic AF. Present study to test if PVI plus CFAE guided CA is the best approach for chronic AF.
**Methods** This prospective study included 66 consecutive patients (M/F=53/13, 57 } 9 years old) who underwent index CA for chronic (persist >1 month) AF, they were randomized into either CFAE guided CA group (group I) (n=33) or PVI+CFAE group (group II) (n=33). All procedures were guided by CARTO-merge system. In group I, radiofrequency energy was deliveryed to the target with local electrogram characterized by low amplitude (0.05 mv~0.25 mv) and highest frequency(cycle <120 ms). The power was set at 25~35 watts, saline irrigated at 17 or 30 ml/min during energy delivery. In the group II, circumferential PV antrum CA was carried out firstly with the endpoint of PVI, then did CFAE guided CA as aforementioned. SVC was slectively isolated, and cavo tricuspid isthmus(CTI) bidirection block was achieved by same ablation setting in pts. with stable sinus rhythm. The procedure endpoint for the 2 groups was AF termination and non inducible of persistent tachycardia by burst stimulation.
**Results** There is no significant difference in fluoro time (25°} 13 min vs 27 } 14 min), procedure time(168∞}21 min vs 188 } 32 min) between the 2 groups. Procedure endpoint achieved in 66.7% (22/33) in group I and 75.8% (25/33) in group II, p=0.415. During the follow up of an average of 6 } 3 months, the AF free rate without antiarythmia drugs is 51.5% (17/33) in group I and 69.7% (23/33) in group II, p=0.131. There was no symptomatic pulmonary vein stenosis in both group.
**Conclusions** Pure CFAE guided CA for chronic AF is effective. But if carried out after PVI, it fs efficiency will get increased even though non significant.

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## A SUBJECTIVE PERCEPTION OF COMPLEX FRACTIONATED ATRIAL ELECTROGRAMS: IMPLICATIONS FOR ELECTROANATOMIC MAPPING OF ATRIAL FIBRILLATION

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**Purpose** During atrial fibrillation, endocardial sites with atrial electrograms of high dominant frequency (complex fractionated atrial electrograms) likely represent the electrophysiological substrate for arrhythmia perpetuation. Currently available electroanatomic mapping systems encode the degree of fractionation as an average interval between discrete atrial complexes. This study investigated whether this index of fractionation correlates with expert rating of atrial electrograms.

**Methods** Representative collection of 1.5s electrograms with different degree of fractionation obtained during left atrial mapping (n=113) were ranked into 4 categories: 1 - organized atrial activity; 2 - mild; 3 - intermediate; 4 - high degree of fractionation. Averaged classification obtained blindly from 3 experts was used for the analysis. Fractionation index for each electrogram was calculated according to an algorithm previously implemented in commercially available electroanatomic mapping system. This algorithm was based on peak-to-peak voltage sensitivity, signal width, and refractory interval criteria. Relationship between expert classification and the results of automated analysis expressed in miliseconds and Hz was examined.

**Results** While relationship between expert categories and fractionation index was clearly non-linear when this index was expressed in miliseconds, almost linear relationship was observed between expert classification and fractionation index expressed in Hz.

**Conclusions** Color-coded fractionation maps based on fractionation index expressed in miliseconds have unfavourably lower resolution for highly fractionated electrograms at the expense of excessive discriminative power for more organized electrograms. In newly proposed electroanatomic mapping systems, priority should be given to fractionation index expressed in Hz (instead of miliseconds) in order to construct maps that more tightly match the subjective perception of atrial electrogram complexity.

## A RANDOMIZED COMPARISON OF A PURE CIRCULAR MAPPING CATHETER BASED VERSUS A COMBINED CIRCULAR CATHETER AND NAVX SYSTEM BASED ABLATION STRATEGY IN ATRIAL FIBRILLATION

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A pure electroanatomical approach without the aid of a circular mapping catheter (CC) may lead to incomplete isolation of the pulmonary veins (PVs) during atrial fibrillation (AF) ablation.

In this study we compared a PVs CC-based mapping approach (CCM) vs a combined CCM and electroanatomical mapping approach (CCEM) guided by Ensite NavX in performing PVs isolation.

Seventy-four patients (53±15 years, 50 men) with AF (paroxysmal 40; persistent 34) were randomized to a CCM (36) or a CCEM (38) ablation strategy. In CCM a CC was used as unique tool to guide ablation. In CCEM an anatomical reconstruction of the left atrium and the PVs was first obtained, then the CC was positioned at PVs ostium by the combined aid of fluoroscopy and NavX.

The endpoints were: electrical isolation of PVs documented by CC in CCM group and the association of both electrical isolation of PVs documented by CC and complete electroanatomical circular lesion around each PV ostium in CCEM group.

Isolation of all PVs was reached in 38/38 (100%) patients in CCEM group and in 30/36 (83%) patients in CCM group (p=ns). Compared to CCM group, in CCEM a significant reduction in fluoroscopy time (32±11 vs 62±15 minutes, p=0.001) and procedural time (167±33 vs 208±45 minutes, p=0.03) was reported. During a mean follow-up of 12±4 months without antiarrhythmic medication, 31/38 (81%) of CCEM patients were free from arrhythmia recurrence compared with 22/36 (61%) of CCM (p=ns). Two non-fatal pericardial tamponade were reported, 1 in CCM and 1 in CCEM.

An AF ablation strategy based on the combined use of CC and NavX is safe and significantly reduces fluoroscopy and procedural time compared with a pure CC based strategy, and is associated to an higher successful PVs isolation rate and to a lower incidence of AF recurrence, although not significant.

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## RAPID ACCESS BLACKOUTS TRIAGE CLINIC (RABTC) - EARLY EXPERIENCE

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**Introduction** T-LOC/blackouts present to A&E with a 'Collapse?cause'. Resources may be wasted by unnecessary admission and investigation. Lack of diagnosis and misdiagnosis (as epilepsy) are common. Patients often get stuck in the wrong care-pathway.
**Methods** In response to the UK NSF for Arrhythmias, specialist-nurse lead RABTC was started in May 2007, in cooperation with A&E, Falls and Epilepsy teams, to provide patients with blackouts triage within 2 wks to the right care pathway. Patients were interviewed using a computerised questionnaire with embedded video clips. All underwent ECG and lying/standing BP. CSM, echo and 24 hr ECG were done where indicated. All patients were reviewed by a cardiologist. Patients were risk stratified using Red Flag=high risk and Green Flag=low risk.
**Results** During slower nurse-familiarisation phase, 13 patients (5 males, age: 60.5±26.4, range: 18-91 yrs) were evaluated in 7 clinics. Most patients were referred by physicians: 8/13 (61.5%). Time from referral to evaluation: 7.3±3.5 weeks. Previous admissions: 1.3±0.8, range: 0-3. Duration of symptoms: 22.1±22.3, range: 1-72 months. Frequency of blackouts/year: 0-5. ECG findings: normal 4/13 (30.8%). Abnormal findings: atrial fibrillation, sinus bradycardia, BBB/IVCD, abnormal Q waves, LVH, and RVOT ectopics. Echo was abnormal in 6/13 (46.2%). CSM positive in 1/13 (7.7%). Diagnosis at the end of the clinic: Reflex Syncope: 5/13 (38.5%), bradyarrhythmic syncope: 1/13 (7.7%) and psychogenic blackout: 1/13 (7.7%). Further evaluation to elucidate a cause needed in 5/13 (38.5%). Multiple causes of blackouts present in 3/13 (23.1%). Treatment offered: Permanent pacemakers: 2/13 (15.4%), ILR's: 4/13 (30.8%), Reassurance: 3/13 (23.1%) and further evaluation: 4/13 (30.8%). Cardiac Red flags found in 70%, no neuro Red flags, no diagnoses of epilepsy.
**Conclusion** Majority of patients achieved a diagnosis at the end of the clinic. Rest were triaged to the appropriate care pathway. Two were offered definitive therapy. Waiting times were long during the initial nurse training period which are likely to improve. Outcome data will be collected.

## EVALUATION OF SINUS NODE AUTOMATISM IN PATIENTS WITH CARDIOINHIBITORY VASO-VAGAL SYNCOPE

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**The aim of study** Evaluation of sinus node function in patients with cardioinhibitory vaso-vagal syncope.
Study population: we observed 41 pts (20 women, 21 men) aged 18-52 yrs, with cardioinhibitory vaso-vagal syncope (CI VVS). Other, than CI VVS, were previously excluded in all pts.
**Methods** All pts underwent transoesophageal rapid atrial stimulation (RAS) for evaluation of extrinsic and intrinsic sinus node recovery times (SNRT) and corrected sinus node recovery times (CNRT), sino-atrial conduction time (SACT) and Wenckenbach point (WP). Pharmacological blockade (PHB) of sinus node was done with iv propranolol and atropine administration. SNRT >1500 ms and CNRT >525 ms were assumed as abnormal. All pts underwent also carotid sinus massage. Pause >3 s was considered as abnormal.
**Results** Mild prolongation of extrinsic SNRT and/or CNRT with normalization after pharmacological blockade (functional SND) was observed in 8 pts (19.5%). Mild organic sinus node dysfunction (with max CNRT 760 ms) was detected in 1 pts. (2.4%). The rest of patients presented normal values of sinus node recovery times. Decreased intrinsic heart rate was observed in 7 pts (17.1%). Mild to moderate decrease of WP was observed in 7 pts (17.1%). Carotid sinus hypersensitivity was observed in 4 pts (9.8%).

Mean values of measured parameters.

| | HR | SNR | CNRT | WP |
|---|---|---|---|---|
| extrinsic | 69.3 bpm | 1302.7 ms | 513.1 ms | 139.3 bpm |
| intrinsic | 84.6 bpm | 1105.9 ms | 386.2 ms | 142.0 bpm |

**Conclusions** Mild sinus node dysfunction as well as carotid sinus hypersensitivity were observed in about 10-20% of patients with cardioinhibitory vaso-vagal syncope – they seems not to be important factors in pathogenesis of this kind of vaso-vagal reaction.

## CLINICAL AND GENETIC STUDY OF FAMILIAL WITH VASOVAGAL SYNCOPE

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**Background** Vasovagal syncope (VVS) is a common clinical problem characterized by transient episodes of loss of consciousness with or without bradycardia. The existence of families with more than one affected member with syncope is well known. Abnormal autonomic activity is implicated in its pathophysiology, the polymorphisms of adrenergic receptors (AR) are associated with the autonomic regulation of cardiovascular system. Previous research has implicated the Gly389 allele of the β1-AR gene in the susceptibility to faint in VVS. This work describes the Arg389Gly β1-adrenergic receptor gene polymorphism in three families with VVS.
**Methods** Two generations of three families were studied. Vasovagal syncope were confirmed with conventional head-up tilt test (HUT) protocol of two phases (passive and isosorbide challenge). A peripheral blood venous sample of all participants was obtained to isolate genomic DNA. Polymorphism of β1-AR at position 389 (Arg389Gly) was determined by PCR-RFLP. RESULTS: 16 subjects were studied, 11 with VVS. Genetic analysis reveled that all subjects with VVS had the Gly389 allele of the Arg389Gly β1-adrenergic receptor gene. Two out four subjects without VVS had the Gly389 allele.
**Conclusion** These results suggest that the inherited tendency to faint due to VVS may be related to the Arg389Gly β1-adrenergic receptor gene polymorphism.

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## BRUGADA SYNDROME AND AUTONOMIC NERVOUS DYSFUNCTION

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**Purpose** The purpose of this study was to evaluate autonomic function in patients (pts) with Brugada syndrome with a head-up tilt-test (HUT) and sympathetic innervation of the heart assessed by I-123 metaiodobenzylguanidine (MIBG) single photon emission tomography (SPECT).
**Methods** The study included 15 pts with the Brugada syndrome, mean age 40±7.7 years. Thirteen pts had syncopal and/or presyncopal episodes (5 pts had 1.4±2.4 syncopal episodes and 8 reported presyncope) and 2 pts were totally asymptomatic. Eleven pts had inducible ventricular tachycardia/fibrillation and had a defibrillator implanted at a VVI 30 bpm mode. All pts underwent a HUT with clomipramine challenge whereas the I-123 MIBG test was performed in 13. The myocardium uptake was studied in 6 segments (anterior, posterior, inferior, septum, lateral from the short axis and apex from long vertical axes) using a 5-point scale (0=normal, 1=moderately diminished, 2=intermediately diminished, 3=severely diminished and 4=no uptake).
**Results** Ten pts (66.67%) had a positive HUT during the 8.6±4.3 min of the test. Eight of the 13 pts with syncope/presyncope and the two asymptomatic pts had a positive HUT. The response of the test was mixed in 7, cardioinhibitory in 1 and vasodepressive in 2. All pts with a positive HUT had an abnormal uptake of I-123 MIBG with a mean score of 6.3±2.5. Reduced uptake was noted mainly in the inferior, posterior wall and apex. Five pts (33.3%) had a negative HUT and their MIBG score was 1.8±2.9 (ANOVA p=0.015 when compared with the positive HUT group).
**Conclusions** Autonomic abnormalities expressed as abnormal responses to head-up tilt testing and areas of sympathetic denervation in the left ventricle are present in a subgroup of pts with the Brugada syndrome. It is therefore possible, that many syncopal episodes in pts with Brugada syndrome could be pathophysiologically related to abnormalities of autonomic nervous function.

## EMOTIONAL ANTICIPATION IN PATIENTS WITH VASOVAGAL SYNCOPE

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**Introduction** Recurrent vasovagal syncope may occur in otherwise healthy individuals in response to a variety of physical challenges (e.g. hot environments, prolonged standing), but psychological determinants (e.g. emotional distress, intense fear, sudden and severe pain, the sight of blood) have also been recognised as potential triggers. Hence, vasovagal syncope is often referred to as "emotional fainting". It has been proposed that psychological antecedents of fainting might include enhanced anticipation and processing of emotionally-laden events. The present study was aimed at investigating emotional anticipation in 15 fainters and 15 healthy controls, matched for sex and age.
**Methods** A S1-S2 paradigm was employed, where a word (S1) signalled the content of a subsequent picture (S2). Picture contents included erotica, sport, neutral people and objects, threat and mutilations. Stimulus preceding negativity (SPN) amplitude and heart rate (HR) changes during the S1-S2 were computed as measures of affective anticipation. The event-related potentials to S1 and S2 were measured to access the processing of affective stimuli.
**Results** Relative to controls, fainters showed larger later positive potential (LPP) amplitude to word cues, irrespective of their content. On the other hand, fainters showed smaller SPN amplitude and less HR deceleration during anticipation, as well as smaller LPP amplitude to pictures as compared with controls.
**Conclusion** These results suggest that, in fainters, enhanced processing of warning stimuli is followed by attenuated anticipation and processing of emotional cues.

## COMPARISON OF IMPLANTABLE LOOP RECORDER-GUIDED SPECIFIC THERAPY IN OLD VERSUS YOUNG PATIENTS WITH SUSPECTED NEURALLY-MEDIATED SYNCOPE. AN ISSUE2 SUBSTUDY

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**Aim** This ISSUE2 sub-study compared the efficacy of specific therapy based on implantable loop recorder (ILR) in young and old patients (pts) with recurrent suspected neurally-mediated syncope.
**Methods and results** Among 392 pts implanted with ILR, 103 had at least one documented syncopal episode within two year of follow-up (Phase I). Pts were divided in two groups according to median age: 51 pts were <70 (Group A) while 52 pts were ≥70 years old (Group B). The 1-year recurrence rate of syncope during Phase I was 31% in Group A and 34% in Group B. In Group A, 23 pts received specific therapy (22 a pacemaker due to asystole and one an implantable defibrillator due to sustained VT) and the remaining 28 pts did not received specific therapy. In Group B, 30 pts received specific therapy (25 a pacemaker due to asystole, one a antiarrhythmic drug and four a catheter ablation due to supraventricular tachycardia) and the remaining 22 pts did not received specific therapy. The 1-year recurrence rate of syncope in pts treated with pacemaker was 8% in Group A and 4% in Group B.
**Conclusions** A strategy based on early diagnostic ILR application, with therapy delayed until documentation of syncope allows a safe, specific and effective therapy both in young and old pts.

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## STIMULATION RATE AND THE OPTIMAL INTERVENTRICULAR INTERVAL DURING CARDIAC RESYNCHRONIZATION THERAPY

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**Background** Optimization of CRT with respect to the V-V interval is mainly limited to pacing at a resting heart rate. We studied the effect of higher stimulation rates with biventricular (BiV) pacing including optimization of the V-V interval and compared this with the response in single chamber pacing modes.
**Methods** In 36 patients with NYHA class III or IV, chronic atrial fibrillation, and optimal medical therapy, the effect of right ventricular (RV), left ventricular (LV), simultaneous biventricular (BiV), and optimized sequential BiV (BiVopt) pacing was measured. The hemodynamic effect of the pacing mode and the optimal V-V interval was determined at stimulation rates of 70, 90 and 110 ppm. Invasive measurement of LV dP/dtmax was used as hemodynamic parameter for evaluation of left ventricular function.
**Results** The average LVdP/dt max increased for all pacing modalities at increasing stimulation rates from 70, 90 and 110 ppm respectively to 893±178, 942±186 and 981±194 mm Hg/s for LV pacing; 904±179, 973±187 and 1052±206 mm Hg/s for simultaneous BiV pacing and 941±186, 1010±198 and 1079±206 mm Hg/s for sequential BiV pacing with an optimized V-V interval. The corresponding optimal V-V interval decreased from 34±29, 28±28 to 21±27 ms at stimulation rates of 70, 90 and 110 ppm respectively. In 2 individuals LVdP/dt max decreased when the pacing rate was increased from 90 to 110 ppm. In 1 patient LV pacing was superior to optimized BiV pacing for all pacing rates.
**Conclusion** In patients with atrial fibrillation, heart failure and low ejection fraction, LV dP/dt increases for all pacing modalities at increasing stimulation rates. The rise in LVdP/dt with increasing stimulation rates is higher in BiV (+19%) and optimized BiV pacing (+18%) than in LV (+12%) and RV (+13%). The optimal V-V interval at sequential biventricular pacing decreases from 34±29 to 21±27 ms at increasing stimulation rate.

## USE OF ECG MORPHOLOGY TO OPTIMIZE SINGLE-SITE LEFT VENTRICULAR PACING IN PATIENTS WITH HEART FAILURE, SINUS RHYTHM AND LEFT BUNDLE BRANCH BLOCK

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In patients with left ventricular conduction delay and sinus rhythm, left ventricular pacing (LVP) alone significantly increases LV systolic function. Electrical fusion between LVP and spontaneous right ventricular activation is considered the key to resynchronization in sinus rhythm patients treated with single-site LVP.
**Aim** Use of QRS morphology to optimize device programming in patients with heart failure (HF), sinus rhythm (SR) and left bundle branch block (LBBB) treated with single-site left ventricular pacing.
**Methods and Results** We defined fusion band (FB) the range of AV intervals within which surface ECG showed an intermediate morphology between the native LBBB and the fully paced right bundle branch block pattern.
Twenty-four patients were enrolled. Echo-derived parameters were collected in the FB and compared with the basal LBBB condition. Velocity time integral and ejection time did not improve significantly. Diastolic filling time, ejection fraction and myocardial performance index showed a statistically significant improvement in the FB. Interventricular delay and mitral regurgitation progressively and significantly decreased as AV delay shortened in the FB. The tissue Doppler asynchrony index (Ts-SD-12-ejection) showed a non significant decreasing trend in the FB. The "best" values of each tested parameter were measured in that part of the FB corresponding to the shortest AV intervals.
**Conclusions** Using surface ECG criteria based on the fusion band detection may be an attractive option for a safe, simple and fast optimization of resynchronization therapy in patients with HF, SR and LBBB.

## RESPONSE TO CRT IN NARROW QRS PATIENTS: ROLE OF STANDARD ECHO PARAMETERS OF DYSSYNCHRONY

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**Aim** of the DESIRE study was to evaluate in HF patients (pts) with narrow QRS the role of echo parameters and ECG in predicting favourable response to CRT. Pts with HF and QRS < 150 ms were included, classified in dyssynchronized (D) or non-D (ND), according to 3 echo criteria, then implanted with a biventricular pacemaker and followed-up for 1 year. Six months after implant, pts were classified as CRT-responders or not, according to a clinical composite criterion (CCC) considering mortality, HF hospitalizations, and NYHA class.
**Methods** Sixty-four HF pts were included (27 with ischemic etiology), in NYHA class III/IV under optimal medical therapy (54 males; 64.2±12.5 y), with EF 27±8% and LVEDD 69±9 mm. Mean QRS was 121±19 ms (axis 2±59°). Sixty/64 pts were successfully implanted with a CRT-P system (Talent 3 MSP, Sorin Group). Echocardiographic parameters of dyssynchrony were: 1) LV filling time <40% of cardiac cycle; 2) Inter-V delay >40 ms; 3) Left Pre-Ejection Period >140 ms and/or 'diastolic contraction', i.e. overlap of LV lateral wall still conctracting 50 ms after the onset of the next filling phase.
**Results** 45% of pts (27/60) were in the D group (at least one of the D criteria fulfilled). The CCC score improved in 55% of all pts (33/60). Pts in group D improved significantly more than pts in group ND (70% vs 40%; p<0.04).
**Conclusions** 55% of all pts had a positive clinical outcome from CRT. The ECG (pre- and post-CRT) was unable to predict a positive clinical response to CRT. The presence of at least one of the D criteria in baseline echo was predictive of a clinical improvement with CRT. In HF pts with narrow QRS, the above standard echo D criteria should be considered in pts selection for CRT.

## CARDIAC RESYNCHRONIZATION THERAPY IMPACTS ON RIGHT VENTRICLE REMODELLING

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Cardiac resynchronization therapy (CRT) can improve symptoms and left ventricular (LV) function in patients with end- stage heart failure and LV dyssynchrony. It has been reported that CRT also causes reverse remodelling of the LV.It is still unclear if CRT also leads in reverse remodelling of the right ventricle (RV).
The aim of this study was to evaluate RV remodelling after 11 months of CRT.
**Methods** We included 32 consecutive patients with end-stage heart failure, 24 male, mean age 63¡?15 with cardiomyopathy underwent first-time ICD implantation based on the classical criteria. 19 with coronary artery disease (CAD) and 13 with dilated cardiomyopathy

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(DC) EF ¡Â30%,left bundle branch block with QRS duration >130 ms and dyssynchrony: LV Volumes and RV chamber size were assessed at baseline and after 11 months of CRT. Simpson ¢¥s technique was used for LV volumes calculating.: Mean End Diastolic LV Volume: 267¡?98 ml Mean End-Systolic LV volume: 218¡?91 ml For assessing RV chamber size we measured the following parameters in the apical four chamber view: 1) RV long axis: RVLA, 2) RV short axis, RVSA and 3) tricuspid annulus diameter TVAN.
**Results** CRT led to significant remodelling of the LV after 11 months.End-diastolic LV volume from 267¡?98 ml to 240¡?76 ml , p<0.001 and End-systolic LV volume from 218¡?91 to 167¡?81 ml, p<0.001.RV chamber size also presented a significant decrease at 11 months of therapy. RVLA from 93 to 88 mm p<0.001 RVSA from 31 to 29 mm, p<0.01 and TVAN from 39 to 35 mm, p<0.01. Patients with end-stage heart failure due to DC presented the highest level of RV remodelling.
**Conclusions** CRT can cause significant reverse remodelling of the LV and of the RV after 11 months of therapy. For RV remodelling most benefit was observed in patients with heart failure due to dilated cardiomyopathy.

## THE MAGNITUDE OF REVERSE REMODELING IRRESPECTIVE OF ETIOLOGY PREDICTS OUTCOME OF HEART FAILURE PATIENTS TREATED WITH CARDIAC RESYNCHRONIZATION THERAPY

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**Objective** We assessed the relationship between CRT-induced reverse remodelling and mortality during a long-term follow-up in a prospective observational study.
Background: CRT has shown to improve symptoms, left ventricular function and mortality.
**Methods** A prospective registry including 325 consecutive patients who underwent CRT between September 1998 and January 2007 were analyzed. Left ventricular ejection fraction (LVEF) was assessed before CRT and in the period between 3 and 6 months following implant. All-cause mortality, urgent transplantation and implantation of left ventricular assist device were all considered relevant events.
**Results** A total of 325 (136 nonischemic and 189 ischemic) patients were analyzed. Overall, the increase of LVEF was statistically significant and was computed to 7.4 points (95% CI 6.1-8.8, p<0.001). Nonischemic patients had a larger increase [4.9 points (95% CI 2.1-7.6), p<0.001] of their EF from baseline, when compared to the ischemic group. The median duration of follow-up was 4.2 years. The cumulative incidence of all events at the end of the 99 months period of follow-up was 57% and it was 38% (95% CI 31 to 45) at 5 years. At the multivariable analysis of the event-free survival, etiology lost its predictive value (HR 0.85, p=0.53), while a change in LVEF >6 points still significantly decreased the risk of event during the follow-up (HR 0.37, p=0.001).
**Conclusion** Reverse remodeling measured by LVEF after 3 months is a good predictor of long term outcome. Patients with an increase in LVEF >6 points have an excellent event-free survival approaching 62% at 5 years follow-up.

## THE IMPROVEMENT OF RENAL FUNCTION EARLY AFTER CARDIAC RESYNCHRONIZATION THERAPY PREDICTS VENTRICULAR REVERSE REMODELING

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**Background** The aim of the study was to evaluate how the CRT produces an improvement of renal function, expressed by the creatinine clearance (ClCr) parameter, and if the percentage change in plasma ClCr levels from baseline to one week after implant was a possible predictor of ventricular reverse remodelling.
**Materials and Methods** The study group included 16 patients (age 69±9 years) with CHF (90% NYHA III/IV class) and dilated cardiomyopathy (70% non-ischemic), severe sistolic disfunction (LVEF% 25,9±4,7), prolonged QRS duration (185±29 ms), who underwent successful implant of a CRT device. Pharmacotherapy remained stable during the follow-up (FU) period. Plasma levels of ClCr were evaluated before, one week and 4 months after implant. Clinical, echocardiographic and exercise parameters (NYHA functional class, 6mwt, LVEF, LVESV) were evaluated in basal and at 4 months FU.
**Results** At 4 months FU we observe near to an important clinical (6MWT 234,3±97,2 vs 294,9±116,2 p<0,008) and instrumental improvement (LVEF% 25.9±4,7 vs 30.1±5.2 p<0,001; LVESV (ml) 200.8±127.2 vs 171.0±83.9 p<0.001) also a gradual improvement of renal function. The ClCr levels (ml/min) evaluated in basal, one week and 4 months after implant, were 49.6±21.4; 60.3±30.6 and 79±23, respectively, with an important variation between basal ClCr levels and 4 months ClCr levels (p<0.0002). 86% of patients (12/14) which have had an improvement of at least 10% at one week (Var%ClCr >10%), presented an improvement of at least 10% of LVEF (Var%EF >10%) at 4 months FU (p<0.05). Any patients without significant variation of ClCr (Var%ClCr <10%) did not have sensible improvement (Var%EF <10%).
**Conclusions** Cardiac resynchronization therapy near to a clinical and instrumental improvement produces also an important improvement of renal function. Percentage change in plasma creatinine clearance levels from baseline to one week after implant was the strongest predictor of ventricular reverse remodeling.

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## DECREASES IN THORACIC FLUID IMPEDANCE ARE ASSOCIATED WITH INCREASED TACHYARRHYTHMIAS, DECREASED ACTIVITY, HEART RATE AND HEART RATE VARIABILITY

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**Purpose** Acute decreases in thoracic impedance measured with an implantable device have been shown to be sensitive to heart failure (HF) hospitalization. However, worsening HF is often associated with changes in other device recorded diagnostic parameters. We determined the association between thoracic impedance and various device-determined diagnostic indices in patients with HF.
**Methods** Clinical and device diagnostic data, including thoracic impedance, were collected from 265 HF patients (EF=26±6%) indicated for CRT-D therapy (InSync Sentry, Medtronic) from 33 centers of the Italian Clinical Service network, encompassing 246±154 days of follow-up. Device-recorded mean activity counts, atrial tachyarrhythmia burden, night heart rate and heart rate variability (HRV) were compared within patients to the thoracic impedance fluid index using non-parametric statistical tests.
**Results** Patient activity was lower on days with thoracic impedance fluid index >20ohm-days compared to other days (p=0.031). Atrial tachyarrhythmia burden was higher just prior to and during thoracic impedance fluid index threshold crossings than during other time periods (p=0.037). Low device classified HRV (standard deviation <80 ms) and night time heart rates >90 bpm were both associated with higher likelihood of thoracic impedance fluid index threshold crossings (p=0.016 and p=0.047, respectively).
**Conclusions** The strong association of multiple device classified parameters including activity, tachyarrhythmia burden, heart rate and HRV with thoracic impedance further validates the clinical utility of this parameter. The combination of multiple device classified diagnostics may increase the sensitivity, specificity and clinical utility of device-initiated audible and silent alerts.

## CLINICAL USEFULNESS OF AN IMPLANTABLE THORACIC IMPEDANCE MONITORING AND ALERT SYSTEM

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**Purpose** Some CRT-D devices monitor acute decreases in thoracic impedance (Z event) to predict clinically relevant events (CRE) associated with worsening heart failure (HF). We examined the usefulness of an alarm-generating implantable Z monitor to detect and manage CRE.
**Methods** Clinical and device diagnostic data were collected from 407 HF patients (pts) (EF=27±6%) implanted with CRT-D from 30 centers of the Italian Clinical Service network, encompassing 270±180 days of follow-up. The device is able to reveal Z events, via an audible alarm, and it records patient activity (ACT) and heart rate variability (HRV). The alarm was programmed on in 61 pts (Group ON) and OFF in 13 pts (Group OFF). ACT and HRV trends were compared between the two groups.
**Results** A total of 92 Z events in 74 pts were associated with CRE within 2 weeks. 29 hospitalizations were appropriately detected in advance (median 11 days). 44 Z events resulted in increased diuretic dosage in 35 pts without overt symptoms. 18 hospitalizations were not associated with a Z event. The rate of unexplained or untreated Z events was 0.2 per patient-year. HRV and ACT significantly decreased one week after Z events (baseline) in both Group ON and OFF (HRV: -6.5±1.9 ms Group ON, -7.8±1.5 ms Group OFF; p <0.001; ACT: -12.3±4.7 min Group ON, -7.4±3.2 min Group OFF, p <0.001). After 3 weeks, HRV and ACT were higher in Group ON compared to Group OFF (HRV:-5.4±1.8 ms vs -7.8±1.7 ms, p<0.0001 and ACT: -8.2±3.4 min vs -18.8±5.1 min; p <0.05).
**Conclusion** An alarm-generating implantable Z monitor is able to reliably detect CRE with low rates of unexplained events and it could be clinically useful to manage HF pts. In fact diagnostic data recover more quickly in pts seeking care in response to an audible alert than in those with the alarm off.

## REMOTE MONITORING OF CRT-D PATIENTS: THE MULTICENTER ITALIAN CARELINK NETWORK EVALUATION

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**Purpose** With expanding indications for ICD and CRT, the burden of post-implant follow-up is growing. A study was carried out in 5 Italian centers to assess the feasibility of remote follow-up using the Medtronic CareLink Network.
**Methods** The CareLink Network is a system that uses the telephone line for patient data transmission and a password protected website where clinicians view and analyze data. Patients implanted with CRT-D from more than 6 months received the CareLink monitor and were trained to perform device interrogation and transmission at 2 weeks, 1 month and 2 months after the training. A final in-office visit was scheduled after 3 months.
**Results** 67 patients (58 males; 64±9 years; NYHA Class II/III: 32/35) performed 264 data transmissions without technical issues. Overall, the centers received only 3 requests of technical support at the time of the first transmission. The mean time for data review and analysis on the website was 5±2 min. Overall, 23 unscheduled data transmissions were requested by the centers after patient contact.
Remote review of diagnostic data permitted to review arrhythmic episodes in 9 patients (preventing ER admission or unscheduled in-office visit), to confirm the need to optimize pacing parameters in 6 patients (all changes were judged non urgent and no extra visits were generated) and to evaluate 18 episodes of possible fluid accumulation, as detected by the device algorithm of thoracic impedance measurement. Of these, 13 episodes (72%) were successfully managed remotely by assessing the symptom status and the therapy compliance by phone.
**Conclusions** The use of CareLink network in clinical practice appears to be technically feasible. Our analysis seems to show that remote monitoring is an efficient method of surveillance of CRT-D patients. The early detection and review of device and clinical events suggest the potential impact of remote monitoring on overall patient care.

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## CLINICAL AND ARRHYTHMIC OUTCOMES OF PATIENTS WITH POST-MYOCARDIAL INFARCTION CARDIOMYOPATHY TREATED WITH IMPLANTABLE DEFIBRILLATORS FOR PRIMARY PREVENTION OF SUDDEN DEATH: THE SEARCH-MI REGISTRY

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**Purpose** Clinical trials demonstrated that implantable defibrillators (ICD) reduce total mortality in patients with previous myocardial infarction (MI) and depressed left ventricular ejection fraction (LVEF). After MADIT II publication, a debate ensued as to implement its results in clinical practice. In order to improve patient selection and clarify potential differences between trials and clinical practice, SEARCH-MI registry was created.
**Matherials and Methods** SEARCH-MI registry is a European/Mediterranean multicentre, prospective, observational study enrolling patients with previous MI, depressed LVEF and implanted ICD for primary prevention of sudden death. Clinical and arrhythmic data were collected. A comparison was performed with the treatment arm of MADIT II.
**Results** data on 556 patients with at least one recorded follow-up are presented. Mean follow-up was 17 months. SEARCH-MI patients were sicker than those enrolled in MADIT II with higher NYHA class and LBBB more represented. Total mortality was 10.4%. Close to one third (30%) of patients experienced episodes of sustained ventricular arrhythmia. The 23% received at least one appropriate therapy and 10% an inappropriate therapy. Gender (25% males vs 5% females, p=0.0009) and history of non-sustained ventricular tachycardia (24% with vs 18% without NSVT, p=0.037) were predictive of appropriate ventricular therapy.
**Conclusions** SEARCH-MI demonstrates that "real clinical world" positively replicates the results of clinical trials on primary prevention of sudden death after MI. Even though strong predictors of appropriate ICD intervention are still lacking SEARCH-MI did not substantiate the fear of over-indication to defibrillator therapy so frequently evoked after the publication of MADIT II.

## PROGNOSTIC ROLE OF ELECTROPHYSIOLOGICAL TESTING IN POST MI PATIENTS CANDIDATE TO PRIMARY PREVENTION OF SUDDEN CARDIAC DEATH

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**Purpose** Survey to Evaluate Arrhythmia Rate in High-Risk MI (SEARCH-MI) is an European registry on the application of MADIT II results in clinical practice. An Italian sub-study evaluated the correlation of electrophysiological (EP) inducibility with spontaneous ventricular tachyarrhythmia (VTa) and all cause mortality.
**Materials and methods** EP testing was recommended in an Italian sub-study and a standard protocol was suggested: 600 msec and 400 msec drive trains followed by maximum 3 extrastimuli. The spontaneous VTa were classified as monomorphic VT, polymorphic VT and VF.
**Results** A total of 104/416 Italian patients performed EP testing, 54% of them were inducible. The mean follow up period was 16 months. Baseline characteristics of inducible and non inducible patients were similar with the exception of Spironolactone intake (higher in non inducible patients, p=0.04). 26 patients experienced at least one VTa episode. VF was recorded only once (non inducible patient). VTa and monomorphic VT were more frequent in patients without inducibility at enrollment but the difference was not significant (p=0.112 for VTa and p=0.069 for monomorphic VT). The yearly episode rate of VTa was 1.92 in non inducible patients versus a 2.23 in the inducible ones (p=0.29, n.s.).
Total mortality was significantly greater in non inducible patients (p=0.04); the combined end-point of total mortality and VTa was again more significant in non inducible patients (p=0.008).
**Conclusions** In the subgroup of Italian patients enrolled in SEARCH-MI and undergone to EP testing the non inducibility was predictive of higher mortality rate but inducibility was unable to stratify arrhythmic episodes in the subsequent follow-up. It is possible that non inducibility is due to more severe contractile disease, thus justifying the observed higher mortality. Further analyses are required to confirm this finding and to investigate the possible underlying mechanisms.

## IMPACT OF AF IN POST MI PATIENTS WITH HIGHLY DEPRESSED VENTRICULAR FUNCTION

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**Purpose** Survey to Evaluate Arrhythmia Rate in High-risk MI (SEARCH-MI) is a European registry on the application of MADIT II results in clinical practice. An Italian sub-study evaluated the clinical course in terms of mortality, arrhythmic events, and CHF hospitalization, of patients with AF at enrollment as well as those who developed AF during follow-up.
**Methods** The sub-study enrolled 502 patients who had at least one myocardial infarction over one month prior to enrollment and an ejection fraction lower or equal 30%. At time of analysis 373 patients performed at least a follow-up visit (mean 14.1 +/- 8.6 months).
**Results** At enrolment, 103/373 (27.6%) presented with AF or reported history of AF.
Differences between baseline characteristics of 103 patients with AF and 270 with no history of AF were analyzed: AF patients were older, they were treated by PTCA less often and had less frequently history of diabetes.
The probability of ICD therapy for Ventricular Tachyarrhythmia (VTa) was similar in patients with AF vs non AF (p=0.33 n.s.). 32% of AF patients reported inappropriate detection of VTa versus 21%

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in non AF patients (p=0.026). No significant differences were observed concerning mortality and CHF hospitalization (p=0.77 and p=0.11). Fifty-four (52%) of the AF patients had recurrence of AF at follow-up and 38 (14%) of non AF patients reported at least a new episode of AF during the study.

When the model were rerun combining AF patients at enrolment and patients who developed AF at follow-up (total 141), comparing this "AF total" population with patients with no AF (232), the previous results on VTa and mortality are confirmed. CHF hospitalization looks slightly higher in AF patients (p=0.056).

**Conclusions** Arrhythmogenic risk seems to be similar in post infarction patients with severe left ventricular dysfunction regardless the presence of AF. AF patients had more frequently episodes of inappropriate detection of Ventricular Tachyarrhythmia and Heart Failure hospitalization.

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## CARDIAC RESYNCHRONIZATION THERAPY IN PATIENTS CANDIDATE TO OPEN-CHEST CARDIAC SURGERY

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**Purpose** Little data are available on Cardiac Resynchronization Therapy (CRT) in candidates to Cardiac Surgery. Our purpose is the evaluation of percentage of patients maintaining indication to CRT after surgery and efficacy of CRT.
**Materials and Methods** We enrolled 49 patients candidate to cardiac surgery (Bypass 18, Valve Surgery 13, multiple procedures 18) indicated to CRT at enrollment (QRS 148±23 ms; EF 30±8%; NYHA 3.1±0.3). During surgery, an epicardial LV lead was implanted: after surgery, patients were periodically reevaluated to confirm indication to CRT.
**Results** Indication to CRT was confirmed in 11 patients within one month from surgery (group A), in 22 from 1 to 6 months (group B), while in 16 indication wasn't confirmed (group C). Baseline EF was similar, respectively 32±11% (group A), 28±6% (group B) and 30±8% (group C); in group B, EF before CRT was 31±6% (p=NS vs enrollment); at 12 months, EF was respectively 36±12% (group A, p=NS vs enrollment), 36±9% (group B, p <0.05 vs enrollment, vs before CRT) and 46±14% (group C, p <0.01). After surgery, one lead was removed due to infection, three patients experienced adverse events correlated to surgery. Five patients died within 6 months from surgery due to the progressing disease, one already implanted with ICD. The epicardial lead threshold (at 0.5 ms) was 1.3±1.2 V at baseline and 0.8±0.3 V at last follow-up (p=NS).
**Conclusion** Our data show that, after surgery, indication to CRT is maintained in 67% of patients. In the remaining 33%, the lack of indication is confirmed by a higher EF at last follow-up. While in patients implanted during follow-up the adjunctive benefit of CRT is statistically significant, the small number of patients implanted soon after surgery didn't show significant improvements, despite a positive trend. The suggested method is simple, without significant adjunctive risks and allows an easier CRT implant and stable LV thresholds.

## BIVENTRICULAR EPICARDIAL PACING CONCOMITANT WITH ON-PUMP CARDIAC SURGERY

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**Introduction** Biventricular pacing can be carried out by epicardial approach when it is not possible to obtain it through coronary sinus. We try to evaluate left ventricular epicardial lead positioning as first-choice procedure, in heart failure patients undergoing concomitant urgent cardiac surgery.
**Methods** 13 consecutive epicardial PM were implanted by first intention in patients with NYHA IV and EF <35%. These patients underwent urgent surgery for CABGs, mitral valve reconstruction, mitral valve replacement and combined operations. Pacing thresholds, sensing parameters and lead impedances were assessed during surgery (IntraOperative assessment, IO), within 48 hours and during follow up (control visits C1: mean time from implant 35 days; C2: 116 days; and C3: 186 days).
**Results** IO electrical check often show not optimal values, both for LV, RV and atrial leads, but these parameters strongly and significantly improve at 48 hours and 30 days and remain stable at follow-up (p=0.000). QRS shortens from 192±31 to 150±18 msecs (p=0.000). Ejection fraction increases form 21±6 to 21.6±7.5% (n.s.). LVESD decreases from 71±13 to 61±8 mm (p=0.044) and NYHA Class improves (p=0.000). Mortality at follow-up is very high, approaching 70%, and many deaths are sudden.
**Conclusions** LV epicardial lead positioning is reliable, during heart surgery procedures performed for other indications. While QRS, echocardiographic and functional parameters significantly improves, a precise evaluation of the effects of biventricular pacing alone is precluded because of the interfering effect of surgery. Because of the high mortality rate of our population, a less extensive implantation seems appropriate through a better pre-operative patient selection. Perhaps, only LV lead positioning concomitant with surgery seems useful, deferring the implantation of the right leads in patients without clinical improvement. In this case, considering the high rate of sudden deaths observed, the implantation with ICDs seems more appropriate.

## THE BEST RIGHT VENTRICLE SITE POSITIONING FOR BIVENTRICULAR OPEN CHEST PACING

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**Purpose** Cardiac resynchronisation therapy (CRT) is a well recognised procedure to treat patients with low ejection fraction (EF) and left bundle-branch block (LBB). Clinical results are showing improvement in symptoms, exercise capacity, and systolic left ventricular function, accompanied by a reduction in hospitalisation and a superior survivor as compared with optimised medical therapy alone. However, 20% to 30% of patients do not response to treatment despite optimal left ventricle site selection. Thus, we have studied whether the site positioning on right ventricle could further improve left ventricular function.
**Methods** Nineteen patients with low EF and LBB were studied during leads placement for CRT at the end of surgical procedures. We tested the haemodynamic response changing the stimulation site positioning on Right Ventricle (RV). We supposed the anterior wall of RV as a compass-rose (North being interventricular septum, South: atrioventricular junction, East: acute margin, West: pulmonary trunk). During monitoring of cardiac output (C.O.), cardiac index (C.I.), systemic and pulmonary vascular resistance(SVR; PVR), continuous monitoring of aortic wave pressure, central venous pressure, transoesophageal echocardiography recording of LV function, we tested the compass-card.
**Results** At the end of the surgical procedure, bi-ventricular stimulation resulted in several degree of improvement in LV function depending on RV stimulation sites if compared with stimulation off. One-way Anova analysis showed a significantly improvement of LV function when the lead for RV was positioned at North (EF: from 23±3% to 29±3%), CI (2.64±0.08 l/min/m$^2$ to 2.83±0.10 l/min/m$^2$) with reduction of central venous pressure (from 14±4 mm Hg to 9±3 mm Hg), arise in aortic pressure (from 79±9 mm Hg to 103±10 mm Hg); Transesophageal Ecocardiography (TEE) showed a more coordinated ventricular contraction by a better later-septal wall synchronization compared with other stimulation sites.
**Conclusion** Cardiac resynchronisation improves the haemodynamic performance in patients with LBB and severely impaired LV function. Both left and right positioning are important to optimise the effect of CRT.

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## TEMPORARY BIVENTRICULAR STIMULATION IN PATIENTS WITH LOW EJECTION FRACTION

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**Purpose of study** To assess the efficacy of biventricular stimulation in the patients with low ejection fraction (EF) early after open heart surgery

**Materials and Methods** In our study were included 18 patients with initially low EF (38±6.4%), mitral regurgitation (MR) 3+, and the signs of intraventricular dissynchrony. All patients underwent open heart surgery (with cardiopulmonary bypass, cardioplegia and topical cooling). Intraoperatively we fixed temporary epicardial electrodes in the right atrium, left (LV) and right ventricules. 3 types of stimulation (RV stimulation, LV stimulatin and biventricular). Cardiac hemodynamic parameters were evaluated by Swan-Ganz catheter and TEE, TDI in 1; 6 and 24 hours after surgery.

**Results** Biventricular stimulation was effective in 78% of patients. Mean cardiac output (CO) in this group of patients initially was 4,5±1,3 l/min, during biventricular stimulation rose up to 5,15±1,5 l/min, while during RV stimulation was 4,27±1,4 l/min and during LV stimulation - 4,92±1,5 l/min. This effect was stable for 24 hours after biventricular stimulation. Within 24 hours CO increased to 6,69±1,6 l/min, cardiac index from 2,84 to 3.18 l/min per $m^2$. There was observed increase of LV EF and decrease of intraventricular dissynchrony during biventricular stimulation.

**Conclusion** Biventricular stimulation in patients with low EF after open heart surgery is hemodynamicaly more effective in comparison with other types of stimulation. There was observed increase of cardiac output (CO), intracardiac hemodynamics and LV EF, which allowed to reduce the inotropic support and showed recovery of clinical symptoms of heart failure.

## EVALUATION OF A GUIDE WIRE THAT STIMULATES THE LEFT VENTRICLE WITHOUT REQUIRING A CORONARY SINUS CATHETER

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**Introduction** For cardiac resynchronization therapy, the position of ventricular stimulation is of fundamental importance. In contrast to the necessity to find the best pacing site stands the difficulty to positioning the catheter on the LV via the CS.

**Objective** The purpose of this study was to evaluate the possibility to stimulate the LV with an innovative wire (VisionWire BIOTRONIK) and to compare electrical properties of the wire to those obtained with leads or EP catheters.

**Material and Methods** The wire was placed via the CS and positioned on the LV. Then a multipolar diagnostic catheter or a Corox OTW-S "over the wire" catheter was positioned in the same place and stimulation was given to compare it against the stimulation achieved with the wire.

The wire is covered with a Teflon over the entire length, except the proximal and distal floppy part. The Proximal part is connected to an external stimulator. Diameter 0.014´´,1.75 m.

**Results** Five patients were analysed. In 4 cases, correct stimulation of the LV was obtained, from different points, although with thresholds of 10 volts or above. In one case, with stimulations of less than 8 volts, stimulation of the LA was observed. In all cases and with the stimulation from either the diagnostic catheter or Corox, left ventricular stimulation was obtained with thresholds of less than 1 volt.

**Conclusions** The use of a wire to stimulate the LV is feasible and makes it possible to test quickly the best place and position for stimulation. The thresholds between LV catheter and guide wire varied significantly. Further studies need to evaluate the ability of the wire to reliably identify areas of phrenic nerve stimulation.

## SIMPLIFIED PERMANENT PARAHISIAN PACING GUIDED ONLY BY SURFACE ECG. A COMPARISON OF PACED 12-LEAD ECG WITH ADJACENT SEPTAL AND APICAL PACING

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Electrical synchronism can be assured by hisian(H)/parahisian (PH) pacing (Pc); it is feasible, due to recent technical advancement, in >90% of pts. Right ventricular (RV) high septum (HS) Pc with the shortest pace-mapped QRS is also useful. Aim: To assess the capability of surface ECG to guide H/PH or HS Pc implant.

**Methods** 30 pts underwent permanent H/PH or HS Pc for bradycardia indication (suprahisian AVB 15- AF with low ventricular response 7, AVN ablation 2, intrahisian TAVB 1, infrahisian AVB 5) with a back-up RVA sensing/pacing lead. Pace-mapping was performed using a 4.1 F screw-in endocardial lead (Medtronic, Select Secure). ECG during selective site Pc were compared in the same pts. PH Pc was defined after narrowing of wide paced QRS at higher output in the perihisian area with short retrograde atrial conduction.

**Results** Permanent H/PH or HS Pc were obtained in all 30 pts. QRS width was 113±14, 127±11, 145±16, 169±19 ms during PH, adjacent inflow HS, RV outflow S and RVA Pc respectively. QRS axis was +39±21°, +44±17°, +41±19° and -65±17° respectively. QS pattern in V1/V2 (delta wave-like) and V2-V3 transitional zone were observed in 93 and 100%, 13% and 86, 13 and 90% and 0 and 5% of pts respectively. Monophasic R wave in lead I and negative QRS in lead aVL were observed in 100 and 0%, 90 and 5%, 60 and 46%, 93 and 0% of pts respectively. Narrowing of QRS at high energy was observed at different output levels only in PH Pc sites.

**Conclusion** Simplified 12-ECG-guided PH/HS pacing is feasible in identifying the adequate positioning of pacing leads.

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## CARDIAC RESYNCHRONIZATION THERAPY: HOW TO DEFINE A RESPONDER?

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**Background** The definition of responder to cardiac resynchronization therapy (CRT) remains controversial. Different studies have used different criteria to define positive response to CRT. A consensus definition of responder is needed to better identify potential candidates for CRT and assess the outcome in various clinical trials.
**Purpose** To compare different definitions of response to CRT, trying to identify the best definition of responder.
**Methods** 43 consecutive patients (59±11 years, 58% male) who underwent CRT. Before CRT and 3 months after, echocardiographic and clinical evaluation (including quality-of-life) was performed.
**Results** Before CRT, mean NYHA class was 3.1±0.6 and duration of QRS was 143±35 ms. There were 42% responders according to reverse remodelling (defined as a reduction in left ventricular (LV) end-systolic volume by >15%); 65% responders to NYHA definition (reduction of functional class > or=1); 50% responders to LV dP/dt definition (improvement >25% in LV dP/dt) and 62.8% responders according to ejection fraction (EF) definition (improvement of more than 10% in LVEF). Using the NYHA class definition, there was a significant improvement in LV end-systolic volume, LVEF and LV dP/dt in responders. However, nonresponders showed significant improvements of these parameters as well. Responders according to NYHA functional class showed a significant improvement of quality of life score, however, this benefit was greater in the psychological domain, consistent with some degree of placebo effect. Reverse remodelling definition of response had the best agreement with other definitions. In the responder group according to reverse remodelling there were 89% responders by LV dP/dt definition, 83% responders according to LVEF and 60% responders by NYHA functional class.
**Conclusions** The NYHA classification is a weak and unspecific test and definition of response to CRT based on this parameter is not reliable. Reverse remodelling definition seems to be a good choice to assess response to CRT.

## INTER-OBSERVER VARIABILITY OF PREDICTION NON-RESPONDER TO CARDIAC RESYNCHRONIZATION THERAPY BY VECTOR-CARDIOGRAPHY

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**Introduction** Cardiac resynchronization therapy (CRT) is a proven treatment for congestive heart failure, but a substantial number of patients show no response to therapy. Using vectorcardiography analysis (VCG) the time interval between maximum vector and the end of the QRS area (TI) is a new index to predict response to CRT. There are no data about reproducibility and validity of this new parameter.
**Methods** In a series of 65 patients (47 male, 65.38 years, QRS width 157 ms ±22.9, EF 22.7%, LVEDD 72.2 mm) VCG data were prospectively recorded prior to CRT implantation. The TI was independently calculated offline by two different blinded investigators. Positive response to CRT was predicted, if TI was >65 ms. At values near 65 ms an additional AV-Block I had to be considered, because these patients often profit from CRT. The results were correlated with hemodynamic measured response of CRT. Invasive hemodynamic parameters, contractility (dp/dt), pulse pressure (PP) were obtained after CRT implantation. Positive response to CRT was defined as an increase in dp/dt >10% and PP >5%.
**Results** 14 patients (21%) were non-responders measured by invasive hemodynamic parameters. Each of both investigators predicted slight different 12 patients (85%) correctly by TI. To determine the inter-observer variability the quality criteria of the TI as a diagnostic test were calculated for complete conformity of both observers: sensitivity 79% (each observer 85%), specifity 90% (observer1 96%, observer2 92%), positive predictive value 69% (observer1 85%, observer2 75%), negative predictive value 94% (each observer alone 96%).
**Conclusion** The TI seems to be a valid and reproducible predictor of CRT response. The conformity of the independent blinded calculated TI was high at 88% for both investigators, although there was a series of vector ECG from different days for some patients and different ECG were used. So the TI is widely independent from observer.

## PREDICTION OF RESPONDER FOR CARDIAC RESYNCHRONIZING THERAPY USING STRAIN DOPPLER IMAGE

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**Background** It is well established that the cardiac resynchronization therapy (CRT) is effective in patients with severe congestive heart failure. However there are some non-responding patients. There are many methods to assess the dyssynchrony of cardiac wall motion.
**Purpose** In this study, LV wall motion of CRT responding and non-responding patients, and not presenting conventional indications for a pacemaker at baseline, were compared, to predict the efficacy of biventricular pacing therapy.
**Patients and methods** Seven patients (69.5+/-8.9 y/o, mean left ventricular ejection fraction (LVEF): 26.3%) with severe congestive heart failure without indication of conventional indication of pacing were assessed before and after CRT with strain Doppler imaging. Two dimensional strain Doppler imaging of the left ventricle were obtained from the apical four-chamber view. Wall motion was assessed by strain of the myocardium and interval between Q-wave of surface ECG and peak of strain (QPSI) was measured in the three septal and lateral segments. The intraventricular contraction delay was determined as the difference between the minimum and maximum QPSI of whole segment. Non-responders were defined as the patients who had not improved their symptom or their LVEF after CRT.
**Results** Intraventricular contraction delay of non-responder was significantly shorter than that of responder (313+/-115 vs 108+/-25 ms, p<0.0005). When the cut off value of intraventricular contraction delay is set at 140 ms, we are able to distinguish between responder and non-responder.
**Conclusion** Strain Doppler imaging may be useful for predicting the efficacy of biventricular pacing.

## NON-RESPONDER TO CARDIAC RESYNCHRONIZATIONS THERAPY PREDICTED BY VECTOR-CARDIOGRAPHY

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**Introduction** Cardiac resynchronization therapy (CRT) is an accepted treatment for congestive heart failure, but one troubling issue is the lack of a favorable response in a substantial number of patients. LBB, QRS width and echocardiographic measurements are indica-

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tion parameters for CRT, but they are not valid to predict hemodynamic response. A new method based on vector ECG (VCG) analysis may help to identify responders and non-responders.
**Methods** In a series of 65 patients (47 male, 65.4 years, QRS 157 ms ±22.9, EF 22.7%, LVEDD 72.2 mm) vectorcardiography data were prospectively recorded prior to CRT implantation. The VCG analysis were performed offline and blinded. QRS area was calculated from VCG and the time interval (TI) between maximal vector and the end of the QRS area measured. Patients with TI <65 ms were classified as non responder. At values in the range of 65 ms ,the presence of an AV-Block I has to be taken into consideration because these patients often profit from CRT. This time interval value was correlated with the results of hemodynamic measured response of CRT. Invasive hemodynamic parameters, contractility (dp/dt) and pulse pressure (PP) were obtained after CRT implantation. Positive response to CRT was defined as an increase in dp/dt >10% and PP >5%.
**Results** 14 patients (21%) were non-responders measured by invasive hemodynamic parameters. The quality criteria of TI as a diagnostic test to predict non-response were: sensitivity 79%, specifity 96%, positive predictive value 85%, negative predictive value 94%.
**Conclusion** The TI is a new method based on vector ECG analysis. It is a useful diagnostic test to estimate the response or non-response of CRT. With a negativeTI test result, the likelihood of non-response can be calculated to be 85%. This leads to the hypothesis that availability of great areas of late electrical excitation and/or slow depolarisation speed will predict better response to CRT.

## SCAR AS DETECTED BY MAGNETIC RESONANCE IS ASSOCIATED WITH WORSE PROGNOSIS AFTER CARDIAC RESYNCHRONIZATION THERAPY

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**Background** Cardiac resynchronization therapy (CRT) has demonstrated to improve the prognosis in patients with width QRS and left ventricular systolic dysfunction. However, a non negligible number of patients fail to obtain this benefit during the follow-up and the predictors of long-term response to cardiac resynchronization therapy) are not well understood and defined.
**Objective** Aim of the study was to analize if late gadolinium enhancement cardiac magnetic resonance (LGE-CMR) predicts long term clinical response (events) in patients treated with CRT.
Methods: 60 consecutive patients with implanted TRC devices were included. Before device implantation LGE- CMR was performed, to identify the presence, location and pattern of scar. Total scar burden was assessed using a 17-segment model with a 3 point hyperenhancement scale (0=no enhancenment; 1=hyperenhancement less 50%; 2=hyperenhancement >50%). Echocardiographic parameters and clinical events (cardiac death or readmission due to heart failure) were evaluated after 499 days follow up (246-733).
**Results** Twenty two patients (36.7%) did not have LGE, 7 (11.6%) had septal fibrosis whereas 31 (51.6%) had septal or inferolateral necrosis pattern. There were significant differences among patients in the 3 groups for the composite endpoint of cardiac death and readmission for heart failure (non LGE 9.1%, fibrosis 28.6%, necrosis 45.2% p=0.012) Patients without LGE showed better systolic function (p=0.009) and less end-diastolic diameters (p=0,04) at follow-up compared to patients with LGE . In addition, multivariate analysis identifies scar as the most powerful predictor of lack of response to CRT (HR 10.57, CI 1.2-5.8; p=0.012) together with the absence of left bundle branch block and LGE score (total scar burden).
**Conclusion** The presence and severity of LGE CMR predicts clinical events in patients treated with CRT.

## PREDICTORS OF LONG-TERM BENEFITS OF CARDIAC RESYNCHRONIZATION THERAPY

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**Background** Cardiac Resynchronization Therapy (CRT) is the last frontier of non-pharmacologic treatment of heart failure. However, in many experiences, almost a third of patients (pts) enrolled did not experienced any benefit; the reasons are still not completely understood.
**Objective** Aim of our study is to identify the features of responders pts Vs non-responders in the entire population of pts implanted in S. Filippo Neri Hospital.
**Methods** From February 1999, 320 pts have been treated with CRT according to International Guidelines. We performed a retrospective analysis, dividing our population in responders and non-responders, according to the NYHA Functional Class (at least Class II or improvement after the implant) (Par. 1) and to the hospitalization number (<1 in the year after the implant or in the year before the follow-up) (Par. 2a and 2b, respectively), evaluating each criterion alone or in combination. Then, we evaluated the differences between the two subpopulations in relation to the clinical and surgical variables.
**Results** The median follow-up was 25 months; between the 320 pts implanted (mean age 71±9 years, 210 men), 53 (17%) were lost at the follow-up. Only the 267 pts evaluated at the follow-up were considered for statistical analysis. The NYHA functional class was III in 75.2% of pts; the mean Ejection Fraction was 28±8%; the mean duration of QRS interval was 150±25 msec. and the device implanted was a pacemaker in 19.5% of the pts, while in the others a device with defibrillation back-up was implanted. Dilated cardiomyopaty of ischemic origin was observed in 44.9% of subjects, an idiopathic genesis in 39.6% and in the others the origin was ipertensive, valvular or ipertrophyc. At the end of follow-up 42 pts (13%) had died. The percentage of pts who died was significantly increased in tobacco users (20.0 Vs 9.1%), in pts with ischemic cardiomyopaty (62.5 vs 45.5%), in case of NYHA class IV (12.8 vs 5.8%), in pts with worst Ejection Fraction, in pts followed after a substitution or an upgrade (45.2 Vs 29.8%) and finally in case of stimulation in a not target vein (45.2 vs 19.4%). Vice versa, a major percentage of alive pts has been observed in those in sinus rhythm (87.6 vs 69%), in ischemic pts with a previous PTCA (27.0 Vs 8.3%) and in pts with the lead for left ventricular stimulation in a target vein. According to Par. 1, 127 pts (50%) were classified as responders, while 103 (42%) and 98 pts (40%) according to par. 1 + 2a and Par. 1 + 2b respectively. An univariate and multivariate analysis have been performed between the last 98 responder pts and the 169 non-responders. The univariate analysis has recognised diabetes mellitus (p<0.015), NYHA class (p<0.007) and the target position of left ventricular lead (p<0.024) as independent predictive parameters; the multivariate analysis demonstrated that the pts with diabetes have 50% probability of getting benefit from CRT (p<0.038).
**Conclusions** After a long-term follow-up, 87% of pts are still alive. 50% and 40% of those can be classified as responders, according to NYHA class, and to the combination of NYHA class and hospitalizations in the last year, respectively. The only independent predictive factor of CRT success is diabetes mellitus.

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## ANATOMIC VARIANTS OF PULMONARY VEINS: DEFINITION BY 64-SLICE COMPUTED TOMOGRAPHY INTEGRATED WITH ELECTROANATOMIC MAPPING

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Accurate imaging of left atrial-pulmonary vein (LA-PV) anatomy is necessary for successfull and safe atrial fibrillation (AF) ablation.
**Aim** to analyze anatomic patterns of LA-PV junctions in 3D imaging in AF pts submitted to PV electrical isolation (EI).
**Methods** 55 consecutive AF pts (41 M; age 57+9 yrs) were submitted to contrast-enhanced 64-slice CT prior to electroanatomic mapping (EAM) using CartoMerge. Before ablation, after selective PV angiography, 3D CT image and EAM of LA-PV anatomy were superimposed. Extreme care was taken to precisely characterize each LA-PV junction using a combination of endo-/epicardial CT image, EAM and conventional signals recorded by the multipolar circular catheter: the anatomy of the LA–PV junction was defined as a distinct ostium (DO) or a common ostium (CO). Only PVs with LA entry independent from DO or CO of the 4 veins were defined as adjunctive PVs.
**Results** 227 PVs were examined. DO were observed in 179/227 (79%) PVs in 32/55 (58%) pts. In 23/55 (42%) pts a CO was observed: left in 20/23 (87%) pts, right in 2/23 (9%) pts and a CO of the inferior left and right PVs in 1 pt (4%). In 7 pts an adjunctive PV was evident: in 3, it was between the right PVDO, in 1, between the left PVDO, while in 3 it drained in the medial LA roof. EI was achieved in all the targeted PVs at the DO or, if present, at the CO without complications.
**Conclusions** In almost half of the pts a PVCO is present, more frequently observed in the left than the right PVs. In 13% of the pts an adjunctive PV is present and it requires individual treatment. Three-dimensional reconstruction is essential to correctly approach the complex anatomy of the PV, especially in case of CO.

## ELECTROPHYSIOLOGICAL BREAKTHROUGH(S) BETWEEN SUPER VENA CAVA AND RIGHT ATRIUM IN PATIENTS WITH SUPER VENA CAVA-ORIGINATED ATRIAL FIBRILLATION

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**Object** To investigate the distribution of electrophysiological breakthrough (s) between super vena cava (SVC) and right atrium (RA) in patients with SVC-originated atrial fibrillation (AF).
**Methods** Those patients with SVC-originated AF were included in this study. After reconstruction of RA geometry with CARTO system, ablation was targeted at the electrophysiological breakthrough(s) between SVC and RA revealed by circular mapping catheter. Electrophysiological breakthrough between SVC and RA was defined as that local ablation resulted in changes of activation sequence, or abolition or dissociation of SVC potentials. The effective ablation was tagged on the CARTO maps.
**Results** AF was confirmed to be originated from SVC in 16 cases (M/F=12/4 cases, mean age of 53.4±10.6 years old, paroxysmal/persistent AF=11/5 cases), this contributed to 2.9% (16/545) of total procedure volume during the same period. All the AF was found to be driven by fast activations within SVC drive or SVC-right antrum 1 to 1 condunction with the earliest atrial activation registered at the ostium of SVC, and terminated by isolation of SVC. The average electrophysiological breakthroughs between SVC and LA were 2±1, and they were found to be distributed at regular location (s): 16 cases at anterior-septal wall, 14 cases at posterior wall, 14 cases at right free wall. The average applications and procedure time for isolating SVC were 6±2 times and 10±3 minutes respectively.
**Conclusions** Electrophysiological breakthrough (s) between SVC and RA were found to be localized at regular sites, isolation of SVC could be achieved by ablation at those sites without major or minor complications.

## CATHETER ABLATION OF ATRIAL FIBRILLATION NAVIGATED BY 3D MAPPING SYSTEMS: CARTO MERGE OR NAVX?

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**Introduction** Three-dimensional mapping systems are helpful tools for catheter navigation during ablation for atrial fibrillation (AF). We report our experience with two 3D mapping systems: CARTO Merge (Biosense-Webster, Inc.) and NavX (Endocardial Solutions, Inc.) employed in pulmonary vein antrum isolation (PVAI).
**Methods** A total of 66 patients (49 male, mean age 58±5 years) scheduled for PVAI were enrolled in the study. All pts underwent PVAI using the mapping Lasso catheter, navigation by intracardiac ultrasound (Acuson, Mountain View, USA) and by one of the 3D mapping systems: CARTO Merge (Group I) or NavX (Group II). Group I consisted of 43 subjects (32 male, mean age 58±5 years). In Group II we enrolled 23 pts (17 male, mean age 59±4 years). We compared ablation and procedural parameters and efficacy and safety in both groups.
**Results** There was no significant difference between the two groups in total procedural time (254±51 min. vs 246±47 min., p=ns) in Group I vs Group II, respectively. Fluroscopy time was only slightly shorter using CARTO system vs. NavX system (27±9 min. vs 32±14 min., p=ns). The total ablation time and number of ablation points were also comparable in Group I vs Group II (2515±762 sec. vs 2594±1110 sec.; 89±31 points vs 92±51 points, p=ns). After 8 months follow-up, 70% of cases (30/43) in Group I are free of AF. The mean follow-up in Group II is 7±3 months with the results of 65% of patients (15/23) without AF recurrence. The number of complications did not differ in both groups.
**Conclusion** Using CARTO merge and NavX system, there was no significant difference in total procedural time, fluoroscopy time and also between the time and number of radiofrequency applications. The success rate was slightly higher using CARTO merge system. However, both 3D mapping system are comparable and effective in PVAI.

## TRIDIMENSIONAL ELECTROANATOMIC MAPPING USING A REAL TIME MULTI-CATHETER NAVIGATION SYSTEM: FACILITATING EXECUTION OF COMPLEX AF ABLATION STRATEGIES

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Pulmonary vein (PV) isolation has been modified to encompass the left atrial (LA) myocardium surrounding the PV ostia namely PV Antrum Isolation (PVAI). Our intracardiac echo (ICE)-guided PVAI approach has improved ablation outcome. This comprehensive ablation strategy may be technically challenging even for experienced operators.

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**Objectives** To evaluate the feasibility of using a 3-D mapping system (EnSite-NaviX, St. Jude Medical) for LA and PVs reconstruction to facilitate the execution of a complex ablation approach.
**Methods and results** The mapping system was used by ten different operators in 560 pts presenting for ablation of AF (paroxysmal, 224 pts; permanent, 336 pts). Following ICE-guided double transeptal punctures, a circular catheter is advanced in each of the PVs collecting their geometry. During ICE imaging, a still shadow of the circular catheter is placed at each of the PVs ostia. This anatomical demarcation safely guides against inadvertent ablation within the PVs. Subsequently the LA geometry is created by roving the circular catheter. This anatomical reconstruction takes 10-15 minutes. The LA and PVs can be displayed in different views to facilitate navigation of the circular catheter around the PVs antra including the LA posterior wall, while reducing fluoroscopy. All the catheters are displayed in real time within the geometry. EGM-guided PVAI is achieved by targeting RF delivery (4 mm irrigated tip, up to 40 W) at the circular catheter. Additional features include creation of multiple geometries (RA, CS and esophagus); anatomical correlation with a side-by-side segmented cardiac CT; activation and complex fractionated EGMs (CFE) maps.
**Conclusions** The EnSite-NaviX 3-D electroanatomic mapping system allows prompt and accurate LA and PV geometrical reconstruction. It facilitates multi-catheters navigation and allows easy execution of complex ablation strategy irrespective of operator skills. This electroanatomic-guided approach facilitates PVAI while minimizing radiation exposure and collateral damages such as PV stenosis.

## ACTIVATION MAPPING IS SUPERIOR TO CIRCULAR MAPPING IN LOCALIZING RESIDUAL GAP(S) AFTER INITIAL CIRCUMFERENTIAL PULMONARY VEIN ABLATION

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**Background and objectives** Circular mapping is used to localize the residual gap(s) after initial circumferential pulmonary vein ablation (CPVA). However, circular mapping is limited by funnel-shaped and oblique-angled pulmonary vein antrum (PVA).Current study was to test the hypothesis that activation mapping along the circumferential lesions via ablation catheter is superior to circular mapping via circular mapping catheter in localizing residual gap(s).
**Methods** This prospective study included 110 consecutive patients (M/F=68/42, 52.2±5.6 years old) who underwent index catheter ablation for treating paroxysmal AF, they were randomized into either single ablation catheter group (55 patients) or two-catheter group (55 patients, ablation catheter plus circular mapping catheter). All procedures were guided by CARTO-merge system. In single-catheter group, CPVA was carried out without circular mapping catheter. If PVA remained not isolated after initial CPVA, activation mapping along the circular lesions by ablation catheter was carried out to localize the residual gap(s). In two-catheter group, CPVA was performed under the continuous monitor of circular mapping catheter.
**Results** After initial CPVA, PVA isolation rate (P=0.10) and the average residual gaps (P=0.08) were comparable between 2 groups, while the false gaps were documented significantly higher in 2-catheter group (1.9±0.9 vs 0.8±0.1, P=0.01). Less procedure time (P=0.12) and fluoroscopy time (P=0.08) were consumed in single-catheter group but reached no significant difference. Total lesions [163±49 vs 190±78, P=0.03] and total applications [120±56 vs 143±49, P=0.02] were significantly reduced with single-catheter technique. Accumulative success rate of 2 approaches was comparable after a mean of 7 months follow up [75.0% in single-catheter group and 75.4% in 2-catheter group, P=0.15].
**Conclusions** Single ablation catheter is effective both for verifying PV isolation and for localization of the residual gap.

## LARGE ISOLATION AREAS AROUND THE PULMONARY VEINS FOR AF ABLATION USING A 3D NOVEL MESH ELECTRODE CATHETER AND ENSITE NAVX SYSTEM

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PV large area isolation in the left atrium (LA) may be performed using three catheters technique or a circular catheter moved around in the posterior LA.
**Aim** To assess the capability of the combined use of EnSite NavX System and a new steerable diagnostic catheter (Mesh, Bard) in validating the disconnection of the PV-antrum from the posterior LA. Mesh-catheters contain 18 pairs of closely spaced electrodes providing high-resolution recordings of ostial electrograms. EnSite NavX mapping systems allows to visualize nonfluoroscopically both the mesh-catheter circumferential electrodes and the ablation catheter.
**Methods** 5 pts underwent PV antrum disconnection for AF and/or AT-triggered AF ablation after inserting the Mesh-catheter in the superior left or right pulmonary vein ostia. An irrigated-tip ablation catheter was used (max 40 C – 35 W; 10–30 sec.) for applying the lesion.
**Results** 4 pts for AF and 1 pt for AT-triggered AF underwent a successful RF ablation procedure after transeptal approach to the LA. PV disconnection was obtained in 13/13 veins in whom RF ablation was attempted after encircling both the ipsilateral PVs. Disconnection was observed as an "all-or-nothing" phenomenon, obtained also in the adjacent inferior PVs after the disappearance of PV potentials in the superior PV veins where the Mesh catheter was alternatively located. At the end of the procedure, differential pacing confirmed the disconnection between the PV antrum and the LA.
**Conclusion** The combined use of Mesh and EnSite NavX mapping system was useful, in a preliminary experience, in validating the electroanatomical encircling of PVs antra. It could represent a valid alternative to the use of three-catheters setting in the LA (2 double-lasso technique) or of the mapping of the antrum by using an encircling catheter and moving it in different regions around the ostial regions in the posterior LA.

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## PREDICTORS OF COMPLICATONS OF FIRST PACEMAKER IMPLANTATION

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**Aims** The purpose of this study was to determine predictors of in-hospital events and complications after first PM implantation for conventional reasons.
**Methods and results** From fall 2003, data of patients with conventional pacing diagnosis are stored in the Dutch multicenter, longitudinal, PM registry (Followpace study) that prospectively documents patient prognosis, quality of life, and PM events after first implantation. 23 of 104 Dutch PM centers participate in the Followpace study covering about 60% of the annual implantations. From this registry patient characteristics and implantation data of 1198 patients and in hospital complications were analyzed as potential predictors for in-hospital events and complications. In 111 patients 121 (10.1%) in-hospital complications occurred: of the wound complications in 2.8%, lead complications in 2.7%, of traumatic origin 2.3%, fatalities in 0.9%, VT/F in 0.8%, AMI in 0.2% and miscellaneous in 0.4% of patients. The patients characteristics: body mass index, prior heart failure and pacing indication (specifically AV block), and the implantation and pacemaker related characteristics: vena subclavia for venous access, passive atrial lead fixation and dual chamber system implantation were found to be independent predictors of complications during or after first PM implantation. The overall multivariable model yielded an ROC area of 0.65 (95% CI: 0.60-0.70).
**Conclusion** The large prospective multicenter Followpace study shows an incidence on in hospital complications after first PM implantation of 10.1%. Five independent predictors consisting of 2 patient characteristics and 3 implantation and PM related ones can support implanting cardiologists, surgeons and assisting technicians to identify patients at higher risk of events and facilitating a reduction of complications.

## WHICH PATIENT EXPERIENCES MARKED PACING THRESHOLD FLUCTUATIONS AFTER PACEMAKER IMPLANT WITH AUTOMATIC CAPTURE? INSIGHTS FROM THE ITACA STUDY

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**Background** Automatic Capture (AC) is an algorithm designed in permanent pacemakers (PM) (Insignia®, Guidant Corp.) to ensure ventricular pacing with an adequate safety margin. Despite the wide use of this algorithm, in clinical practice it is not known which patients develop threshold rise during follow up requiring maximum energy to ensure safety.
**Aim** Aim of the present analysis is to find, after a PM implant with AC, which patient discharged from hospital with an acceptable ventricular pacing threshold (<1.5 V), required during follow up a safety backup pacing ("Retry" mode).
**Methods and results** Among 597 patients, 43 (7.2%) experienced at least once a Retry due to a temporary threshold rise. In 33 of this patients a high threshold was not detected neither at discharge nor during the next visit. Patient characteristics (gender, atrial disease, AV block, coronary artery disease, atrial fibrillation, PM replacement, PM dependence) lead features (acute/chronic, unipolar/bipolar, active/passive fixation, high/low impedance, steroid eluting, lead site) and threshold measurements (threshold >1V at discharge, maximum measured threshold and maximum threshold variation) were considered to examine the correlation with patients with Retries. Patients with threshold >1V at discharge and with threshold fluctuations over 1V showed a higher incidence of retries (23% vs 8% $p<0.01$; 37% vs 6% $p<0.01$, respectively). Among clinical and lead characteristics only PM dependent patients were associated with a significant lower incidence of retries (2% vs 14% $p<0.01$).
**Conclusion** Up to 7% of patients implanted with PM experience temporary and marked threshold fluctuations over time, most of which cannot be detected at ambulatory follow up or discharge. As clinical variables do not allow to predict completely high threshold rise, Automatic Capture algorithm is an useful tool to avoid programming of maximum output in the first months from PM implant.

## EVALUATION OF VENTRICULAR ARRHYTHMIAS IN PACING PATIENTS (VAPP) BY A NEW GENERATION OF MEMORY FUNCTIONS

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**Background** The new pacemaker (PM) generations featuring extended memory functions (MF) document the occurrence of arrhythmias over long periods. The recordings of atrial episodes and their characteristics are extensively described in the literature. However, ventricular arrhythmia (VA) characteristics and occurrences are less well-known in this population. The goal of this study was to evaluate the pertinence of MF at the ventricular level and to describe the documented VA.
**Methods and results** The VAPP study involved a continuous series of 93 pts (M 66%, F 34%, aged 75±10 yrs) implanted with SC or DC PMs for AVB (41%) SD (55%) who were seen in PM follow-up between Jan 1 and June 30, 2006. 497 visits were analyzed (7 months follow-up average interval) over a period from 2 to 81 months after implantation, and occurrences of VA validated by EGMs, defined by at least 5 QRS complexes >175/mn. The number of episodes and the duration and heart rate during the longest arrhythmia episode were recorded. 24 pts (26%) average age 74±13 yrs of whom 78% males, showed VA in 88 visits (18%). The average number of episodes was 9 per follow-up (1-140), average duration was 4±4 seconds (1-27 sec), and average rate was 214±33 bpm (174-307). The totality of the episodes were classified as non-sustained ventricular tachycardia (NSVT). The ejection fraction was 51±11%. 84% showed cardiopathy: CAD (12), HCM (4) and DCM (4). Statistical analysis showed that age, pacing indication, pacing mode and cumulated percentage of pacing are not relevant factors in NSVT.
**Conclusion** VA are observed in $^1/_4$ of patiens implanted for standard pacing indications. A major determining factor in the occurrence of NSVT is the presence of an associated cardiopathy. FMs featuring EGM recordings are a tool for reliable diagnostic and monitoring of these events. Further studies are required to evaluate the prognostic significance of these arrhythmias.

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## ACUTE EVALUATION (ELECTRICAL AND HANDLING CHARACTERISTICS) OF CARDIAC LEADS MADE OF A NEW MATERIAL: OPTIM™

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**Purpose** The acute characteristics of the new St Jude Medical Optim™ leads were evaluated. Optim™ is a silicone-polyurethane co-polymer insulation designed specifically for cardiac leads for better durability (abrasion resistance and biostability) and improved handling (lubricity and flexibility).
**Methods** A total of 91 leads (76 Tendril ST Optim™ 6Fr pacing leads and 15 Riata ST Optim™ 7Fr ICD leads) were implanted in 7 French centers. Electrical properties were measured in bipolar at implant and handling characteristics assessed by each implanter.
**Results** Fifty one leads were implanted in the atrium (78% in appendage, 20% on the lateral wall, 2% on the septum) and 40 in the ventricle (53% in the apex, 47% on the septum).

| Atrial leads: | Implant |
|---|---|
| P wave amplitude (mV) | 3.6±1.5 |
| Threshold @ 0.5 ms (V) | 1.0±0.5 |
| Impedance (Ohms) | 564±113 |

| Ventricular leads: | Implant |
|---|---|
| R wave amplitude (mV) | 12.3±5.2 |
| Threshold @ 0.5 ms (V) | 0.7±0.2 |
| Impedance (Ohms) | 695±140 |

The handling characteristics on a scale of 1/not satisfactory to 5/excellent were 4.7±0.5 for introducing the lead into introducer or cephalic vein, 4.2±0.8 for steering and positioning, and 4.2±0.6 for manipulation with multiple leads.
Compared to the currently preferred standard lead, on a scale of -2/worse, -1/slighty worse, 0/same, +1/slighty better, +2/better, they were rated +1.5±0.7 for introducing the lead into introducer or cephalic vein, +0.8±0.6 for steering and positioning, and +1.0±0.6 for manipulation with multiple leads.
**Conclusions** The acute electrical properties are in line with those of the current leads of the industry. The remarkable change with the Optim leads™ is in the handling characteristics, especially in the reduction of friction into the introducer, through the venous system or vs. other leads, leading to easier implants.

## A NOVEL LEAD DESIGN REDUCES FAR FIELD R-WAVES (FFRWS) AND DECREASES THE INCIDENCE OF INAPPROPRIATE AUTOMATIC MODE SWITCH EPISODES

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**Purpose** Far Field R-waves (FFRWs) are sensed in approximately one-third of patients with DDD pacemakers and represent the primary reason for inappropriate automatic mode switch (AMS). We hypothesized that decreasing the atrial lead anode to cathode tip-to-ring electrode spacing reduces FFRW sensing. The OptiSense® 1699T Lead Study was to determine if a novel atrial lead with 1.1 mm electrode spacing reduced FFRW sensing and decreased inappropriate AMS.
**Methods** Patients with standard pacing indications and without atrial fibrillation were randomized to receive either the 1.1 mm spacing (treatment) or the standard 10 mm (control) bipolar atrial lead. Atrial FFRW signals (with ventricular paced and intrinsic events), AMS episode stored electrograms, sensing and pacing thresholds were evaluated through 3 months.
**Results** Of 99 randomized patients 91.4% of treatment vs 33.3% of control patients did not have FFRWs detected with ventricular paced beats ($p<0.0001$). Detection of intrinsic FFRWs in the two groups was similar (96.4% vs 90.6%, $p=0.47$). The difference in the frequency of inappropriate AMS episodes and the incidence of patients experiencing inappropriate AMS episodes in the treatment and control groups was substantial (0% vs 49%, $p<0.0001$ and 0.0% vs 25.7%, $p=0.0002$). Pacing thresholds in the treatment group were lower than the control group (0.61 CALUIRE ET CUIRE V±0.16 vs 0.85 V±0.26, $p=0.0001$). Sensing thresholds in the treatment and control groups were comparable (2.56 mV±1.3 vs 2.83 mV±1.31, $p=0.35$).
**Conclusion** Close (1.1 mm) electrode spacing reduced detection of paced FFRW signals and the incidence of inappropriate AMS while maintaining comparable pacing and sensing performance. These data indicate that the OptiSense lead improved overall pacemaker performance by reducing inappropriate AMS due to FFRW.

## TEMPORARY TRANSVENOUS CARDIAC PACING IS OVERUSED AND CAN BE DANGEROUS: AN AUDIT FROM A REGIONAL CARDIOTHORACIC CENTRE

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**Introduction** Temporary transvenous cardiac pacing (TTCP) is a frequent emergency procedure in cardiology. There are accepted indications for TTCP, but it is often done by inexperienced operators and complications are frequent. The alternative of non-invasive external pacing is poorly tolerated. We have audited one year of TTCP in this centre, to determine which procedures were done appropriately and to assess complications.
**Techniques** All interventions were undertaken in a dedicated pacing laboratory by middle-grade trainees in cardiology. All had been given specific training in TTCP and most were involved in permanent pacemaker implantation. The usual approach was via the internal jugular vein.
**Results** 42 patients were studied. (27 males, mean age 76+/-8.7 years; 15 females, mean age 80+/-12.5 years). 13 required one or more repositioning procedures. 10 died.
We judged that 24 patients were appropriately treated with TTCP. 10 eventually received a permanent pacemaker (1 bi-V ICD), 1 underwent emergency CABG and 6 were discharged with no further intervention. 7 died.
We considered that 18 patients were inappropriately paced with TTCP. These presented with a history of syncope or presyncope. 10 had complete heart block, 2 had second degree block and 6 had bradycardia and/or pauses. 12 of this group eventually received a permanent pacemaker (1 bi-V ICD) and 3 were discharged with no further intervention. 3 patients died. The length of hospitalisation in the survivors

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was 14.6+/-12.2 days, due to a combination of complications of TTCP and in-patient waiting time for a definitive procedure.
**Conclusions** Some patients are inappropriately treated with TTCP, which is associated with major complications and, when not properly managed, death.
Recommendations:
- senior doctor involvement in management decisions;
- adherence to the indications for temporary pacing;
- training of middle-grade doctors in pacing techniques;
- training of ward staff in the management of temporary external pacemakers;
- education of catheter laboratory staff to appreciate primary permanent pacing as an appropriate procedure.

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## FURTHER DATA ON MYOCARDITIS IN YOUNG SUBJECTS. IDENTIFICATION, FOLLOW-UP, PROGNOSIS AND MEDICO-LEGAL ASPECTS THE BOLOGNA EXPERIENCE

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**Introduction** Infective myocarditis (I M) is one cause of sudden death (SD) in athletes. Thus, a protocol including non invasive cardiology tests (NICT), laboratoristic profile (LP) has been set-up.
**Patients and methods** 119 young athletes (SA) were selected for frequent ventricular arrhythmias (VA), worsening of pre-existing VA, with or without evolutive STT changes. They received NICT and a LP, including IgM, IgA and IgG versus the most common viral and bacterial infections (AI).
**Results** 56 of the 119 subjects (47%) showed LP compatible with AI. 28 of the 56 subjects (50%), with positive LP had also clinical signs of an acute systemic illness (SI) with a concomitant myocardial involvement (MI). In 26 of 28, SA has been discontinued and resumed in 20, after 6-9 months. In 28 with LP, in 12 case IM was due to Echo Coksackie B, Enterovirus, in 4 cases to Toxoplasmosis, of which 1 lethal and 1 evolving in dilated cardiomyopathy, in 4 cases to infectious mononucleosis, in 2 cases to flu virus or Adenovirus, in 2 cases to Mycoplasma Pneumoniae, in 2 cases to Herpes Virus or Herpes Zoster infections, 1 case to borelliosis or Lyme's syndrome and 1 case to Legionellosis. We observed 2 death in the acute phase, and 1 death in the follow-up.
**Conclusions** The signs of a SI could be identified in SA (47%). Clinical picture of an upper respiratory tract o low bowel infection, in association with a typical LP, can be regarded as SI. Signs of pericarditis and or ST changes, frequent VA or worsening of VA can be considered highly indicative of MI involvement. SA should be discontinued for 6-9 months.
A strict adherence to guidelines and to the proposed protocol for screening and follow-up of suspected myocarditis in athletes, is worthwhile in eliminating medico-legal controversies.

## NON-LINEAR ANALYSIS OF ECG SIGNALS: A NEW METHOD FOR NONINVASIVE RISK STRATIFICATION OF SUDDEN DEATH

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**Introduction** The aim of our study was to assess the effectiveness of the non-linear analysis (NLA)
of ECG in the risk stratification of patients with ventricular arrhythmias, and to correlate these non-invasive parameters with the results of invasive electrophysiological study (EPS).
**Methods** We evaluated 50 patients with history of cardiac arrest, syncope, sustained or nonsustained ventricular tachycardia (VT). All patients underwent electrophysiologic study (EPS) and non-linear analysis (NLA) of ECG. The study group was compared with a control group of 50 healthy subjects, in order to define the normal range of NLA. ECG was processed in order to obtain numerical values, which were analyzed by non-linear mathematical functions. Patients were classified through the application of a clustering procedure to the whole set of functions, and the correlation between the results of non-linear analysis of ECG and EPS was tested.
**Results** NLA assigned all patients with negative EPS to the same class of healthy subjects, whereas the patients in whom VT was inducible had been correctly and clearly isolated into a separate cluster.
In our study, the result of NLA with application of the clustering technique was significantly correlated to that of EPS ($p<0.001$), and was able to predict the result of EPS, with a negative predictive value of 100% and a positive predictive value of 100%.
**Conclusions** NLA can predict the results of EPS with good negative and positive predictive value.
These findings should prompt prospective studies in order to assess the usefulness of NLA for sudden death risk stratification.

## INDUCED HEART RATE TURBULENCE AND BAROREFLEX SENSITIVITY IN PATIENTS WITH CORONARY ARTERY DISEASE

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**Background** Sudden cardiac death is common in patients with coronary artery disease (CAD). As autonomic imbalance plays an important role in the development of malignant ventricular arrhythmia, it is very important to characterize autonomic activity in patients with CAD. Heart rate turbulence and Baroreflex sensitivity has been used as an accurate parameter of autonomic activity.
**Objectives** To characterize heart rate turbulence (HRT) and baroreflex sensitivity (BRS) in patients with CAD and factors influencing its value.
**Materials and Method** It is an observational study in patient with CAD who underwent coronary angiography using single ventricular premature complex stimulation and nitroglyserine 300 micrograms intravenously for HRT and BRS measurement, since March until June 2007 in National Cardiovascular Center Harapan Kita Hospital.
**Result** From 29 patients enrolled, male patients were dominant (25 patients) with age range from 39 until 74 years old with mean of age 58,8+9,6 years. HRT parameter showed broad spectrum of value, Turbulence onset (TO) value was -1,19+3,75% and Turbulence slope (TS) value was 8,75+8,1 msec/RRI. Abnormal HRT value was found in 14 CAD patients (48%). Mean value of BRS is 2,34+3,39 msec/mm Hg. There was correlation between BRS and TS ($r=0,45$; $p=0,034$), but no correlation between BRS and TO. There were no independent variables associated with HRT value after univariate analysis test.
**Conclusion** Almost half of CAD patients enrolled in this study have abnormal HRT parameter values. There is correlation between BRS and TS, but no correlation with TO.
**Keyword** Heart rate turbulence, turbulence onset, turbulence slope,baroreflex sensitivity.

## T-WAVE ALTERNANS FOR NONINVASIVE SUDDEN DEATH RISK STRATIFICATION IN ATHLETES WITH VENTRICULAR ARRHYTHMIAS

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**Introduction** Aim of our study is to evaluate the role of T-wave alternans to stratify the risk of sudden cardiac death in athletes with complex ventricular arrhythmias, and to document a possible correlation between TWA and electrophysiological testing results.

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**Methods** We studied 85 athletes (61 M, mean age 32+/-11 years) with ventricular arrhythmias, defined as the presence of more than 2,000 premature ventricular complexes or episodes of non-sustained ventricular tachycardia at 24 hour Holter ECG. In all cases a cardiological evaluation was performed, including T-wave alternans and Electrophysiologic study with programmed ventricular stimulation. The patients were evaluated during a follow-up of 30+/-21 months. The end-point was the occurrence of sudden death, ventricular fibrillation or sustained ventricular tachycardia.
**Results** T-wave alternans was negative in 57 athletes (68%), positive in 15 (18%) and indeterminate in 13 (14%), with significant correlation between negative T wave alternans and negative Electrophysiologic study ($p<0.001$), positive T-wave alternans and positive Electrophysiologic study ($p<0.001$), and abnormal T-wave alternans (positive + indeterminate) and positive Electrophysiologic study ($p<0.001$). During follow-up we observed a significant difference in end-point occurrence (VT or SD) between athletes with negative or abnormal T-wave alternans (0% vs 25%, $p<0.01$) and between athletes with negative or positive Electrophysiologic study (0% vs 37%).
**Conclusion** T-wave alternans confirms its role as a simple and non-invasive test, and it seems useful for prognostic stratification of athletes with ventricular arrhythmias.

## SYMPATHOVAGAL IMBALANCE IN ACROMEGALIC PATIENTS

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**Background** Acromegaly is a disease with increased GH and IGF-I levels. Acromegaly carries LVH and death due to CHF and arrhythmias. Aim of this study was to evaluate Heart Rate Variability (HRV) and sympato-vagal balance in a group of acromegalic patient.
**Materials and methods** 17 acromegalic patientes without cardiovascular disease were enrolled. All patients underwent to a 24 hours ECG Holter recording to evaluate HRV with Time and Frequency Domain Analyses.
**Results** Mean HR was 68 bpm in 24 hour analyses, 74 on day and 61 on night. Using Time Domain Analyses mean PNN50 was 6.35% on 24 hours: 5.31% on day and 7.75% on night; mean RMSSD was 27.3 on 24 hours: 25.6 on day and 28.6 on night; mean SDANN was 123 on 24 hours: 91 on day and 66 on night; mean SDNN was 135 on 24 hours: 104 on day and 87 on night. Using Frequency Domain Analyses mean TP was 2596 ms on 24 hours: 2228 ms on day and 2889 ms on night; mean LF were 573 ms on 24 hours: 555 ms on day and 613 ms on night; mean HF were 170 ms on 24 hours: 130 msec on day and 216 msec on night; mean LF/HF ratio was 4.6 on 24 hours: 5.5 on day and 4.5 on night. A relation was found between HR with medical control of acromegality and between PNN, RMSSD and TP with patients cured or not. Using simple regression model, linear inverse relations were found between PNN, RMSSD, HR with serum IGF1 levels; a linear direct relation was found between LF/HF ratio with serum IGF-I levels.
**Conclusions** Our population showed a large and high reduction of HRV: both ortho- and parasympatic impairments produce a relative orthosympatic predominance.

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## INTRACARDIAC MAPPING AND RADIOFREQUENCY ABLATION OF INCISIONAL TACHYCARDIAS AFTER THE CORRECTION OF COMPLEX CONGENTIAL HEART DISEASES

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**Purpose** To reveal the particularities of the course and to evaluate the effectiveness of radiofrequency ablation (RFA) of incisional tachycardias in patient after the correction of complex congenital heart diseases (CHD).

**Material and methods** During the period under study (1999-2007) electrophysiological investigation and RFA were performed in 15 patients (6 men and 9 women) after the operations for complex CHD. Mean age of patients was 22,8±5,1 years. Tachycardias duration varied from 1 to 8 years.

In 12 cases incisional atrial tachycardia (IAT) with cycle duration >300 msec was revealed in the area surrounding the postoperative scar, three of these patients had type 1 of AFL. 2 patients had VT and VES developed from the peri-patch area, and 1 patient had junctional rhythm. All arrhythmias had a re-entry mechanism, in 8 cases they were continuous, and in 1 case had a incessant character.

Taking into account the complexity of the defect's anatomy and its subsequent correction, in 10 cases we have use the CARTO system, which allowed us to perform linear RFA in the areas of excitation gap.

**Results** Total effectiveness of RFA was 83,3%. In 3 cases tachycardia recurrence necessitated repeated procedures. In 2 cases RFA was ineffective due to the impossibility to conduct intramural damages in the sites of ablation.

**Conclusion** Atrial re-entry tachycardias around the postoperative scar prevail after the correction of complex CHD.

During RFA it is necessary to use the systems of non-fluoroscopic control (CARTO), allowing for the anatomical reconstruction of heart chambers in patients operated on for complex CHD, for effective endocardial mapping, for the increase of cooled RFA effectiveness and for the decrease of fluoroscopy duration.

## IMAGE INTEGRATION GUIDED ABLATION OF RIGHT ATRIAL TACHYCARDIA AFTER ATRIOTOMY OF STRUCTURAL HEART DISEASE

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**Objectives** This study was to investigate the value of image integration system (CARTO-merge) in catheter ablation of right atrial tachycardia (AT) after atriotomy of structural heart disease.

**Methods** From January 2005 to December 2006, 40 consecutive, drug-refractory patients with AT underwent electroanatomic mapping of spontaneously occurring and inducible right ATs. After creating anatomic map of LA, a 3-D CT image of LA reconstructed beforehand was superimposed onto the CARTO map via registration software of CARTO-Merge. The ablation strategy was target at focus or critical isthmus revealed by activation mapping. Procedure endpoint was termination and non-inducible of AT.

**Results** CARTO maps of RA were successfully reconstructed in all patients. After registration, CT image was removed in 2 patients because of inaccuracy of their registrations. In the remaining patients, the average deviation of registration was 2.1±0.8 mm and considered accurate. Activation mapping revealed 3 main AT mechanisms: single-loop macroreentrant AT (MAT) (n=36), double-loop MAT (n=16), and focal AT (n=4). In majority of MATs, the incision isthmus (n=36) and the cavotricuspid isthmus (CTI) (n=35) were found to be the critical isthmus. Surgical incision leads to obvious morphological anomalies in 11 patients, which including scar, pouch, and tissue node. Under the guidance of integrated registrations, ablation was individually titrated in these 11 patients to avoid possible manipulation challenges. During a follow-up of 18±10 months, 3 patients (7.5%) had a recurrence of AT and needed an additional ablation.

**Conclusions** Image integration system not only allows reconstruction of AT mechanisms, but also represents an advance in the accurate localization and ablation of the arrhythmogenic substrate of post-surgical AT.

## SIMPLIFIED PROGRESSIVE APPROACH FOR THE ABLATION OF SCAR RELATED ATRIAL MACROREENTRANT TACHYCARDIAS

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**Introduction** Radiofrequency ablation (RF) of scar related atrial flutter is challenging. Long procedures, prolonged fluoroscopic times and high percentages of recurrences are of concern. We present our experience using a simple and progressive approach.

**Methods** We include 22 consecutive patients (68% female) with atrial flutter and history of cardiac surgery. The average age was 43±16 years. An EP study was performed to define localization (left or right) and cavo-tricuspid isthmus (CTI) participation using entrainment mapping. Only one activation map was done with a CARTO system during the clinical arrhythmia. A critical isthmus was localized (CTI or other) and ablation was carried out with an external irrigated tip catheter with a power limit of 30 W. If other arrhythmia was induced or spontaneusly appeared during the ablation, the voltage map was used to localize the potential circuit and confirmed its participation by entrainment. All potential circuits were aimed for ablation.

**Results** The predominant cardiopathy was Interatrial communication with different varieties. All arrhythmias were localized in the right atrium; mean cycle length of the clinical flutter was 274±31 ms. Only 40% had CTI participation. CARTO maps had an average of 119±32 points and 2±1.3 potential circuits, different from the clinical arrhythmia, were found. All potential circuits were targeted for ablation. In 82% of patients no arrhythmias could be induced after the procedure. Mean procedure duration was 180 minutes. None of the patients with successful ablation have had recurrences after 13±9.4 moths of follow-up.

**Conclusions** A progressive approach with only one activation/voltage CARTO map of the atrium and ablation of all potential circuits is a highly effective method for ablating scar related macroreentrant atrial arrhythmias.

## RADIOFREQUENCY ABLATION OF MACROREENTRANT ATRIAL TACHYARRHYTHMIAS IN PATIENTS AFTER REPAIRED CONGENITAL HEART DISEASE

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**Introduction** Macroreentrant Atrial arrhythmias are common in patients after repair of congenital heart disease. A high incidence of isthmus dependent atrial flutter has been described in some studies. Aim: We describe our experience in the treatment of macroreentrant atrial arrhythmias in patients after repaired congenital heart disease.

**Methods** Between 1998 and 2006, 20 patients (12 males, mean age 42±21.9 -range 5-83 years) underwent an electrophysiological study for ablation of macroreentrant atrial tachycardia.

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**Results** Radiofrequency ablation was performed after conventional mapping (entrainment mapping under fluoroscopic guidance) in 17/20 ptes. In 3/20 ptes, the procedure was not performed due to the absence of venous access. A typical isthmus dependent atrial flutter (IDAF) was diagnosed in 7 ptes (40%) and non isthmus dependent atrial flutter (NIDAF) in 10 ptes (60%). RF ablation was succesfull in 11 patients (65%) (6 IDAF and 5 NIDAF) and unsuccessful in 6 (35%) (1 IDAF and 5 NIDAF). Electrocardiographic patterns during atrial flutter suggested and IDAF in 9 ptes (45%) and NIDAF in 11 patients (55%). Succesfull ablation of NIDF was performed in the right atrium in all patients: lateral free wall in 5 patients, posterior wall in 3 patients and anterolateral wall in 1 patient. Recurrence occurred in 2 patients with NIDAF and a second procedure was successfully performed.
**Conclusion** IDAF is more frequent than NIDAF in our patients after repair of congenital heart disease.

## PARTICULARITIES OF CLINICAL COURSE AND RESULTS OF INTERVENTIONAL TREATMENT OF ATRIAL TACHYCARDIAS FROM THE PULMONARY VEIN OSTIA

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**Purpose of study** To reveal the particularities of clinical course and to evaluate the effectiveness of radiofrequency ablation (RFA) in patients with atrial tachycardia (AT) from the pulmonary veins.
**Material and methods** From February 2000 to April 2007 38 patients (24 women and 14 men) underwent RFA procedures (mean 1.16 procedures per 1 patient) according to the AT originating from the PV. Mean age of patients was 33.1±13, 5 years, arrhythmia history - for 6.5±6.1 years. ECG and 24-hour (Holter) ECG monitoring revealed isolated AT in 23 patients, in association with atrial fibrillation-flutter – in 15 patients. Therapy with antiarrhythmic drugs (AAD) proved ineffective in all patients. The analysis of complaints revealed non-rhythmic heartbeats in 27 patients (71%), rhythmic – in 16 (42%), dizziness – in 23 patients (60.5%), weakness – in 35 (92.1%), syncope states – in 11 (28.9%), bradicardia – in 12 (34.2%).
**Results** Application of RF pulses to the arrhythmogenic PV was carried out until the disappearance of all potentials and ectopic activity. Ectopic focus was located in the RSPV in 12 patients (31.6%), in LPV collector in 7 patients (18.4%), in the LIPV in 6 (15.7%), in the LSPV in 8 (21.2%) and in the RIPV – in 5 (13.2%) patients.
**Conclusion** Patients with ectopic AT with arrhythmogenic focus located in the PV have marked clinical symptoms: palpitations, dizziness, weakness, bradicardia and syncope. Primary RFA was effective in 84.2% of cases, with the account of repeated procedures – in 100%. Interventional treatment of ectopic AT from the PV is a highly effective and safe procedure, allowing for radical elimination of this arrhythmia and of the need in AAD.

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## ATRIAL FIBRILLATION: FOCUS ON EFFECTIVE CLINICAL TREATMENT STRATEGIES (AFFECTS) REGISTRY - INITIAL RESULTS

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Clinical trials such as AFFIRM, RACE, and others and sanctioned management guidelines have the capacity to significantly alter practice; but do they? The AFFECTS Registry is an ongoing observational study of the treatment (Rx) patterns of 248 U.S. practicing clinical cardiologists (USC) who managed 1535 patients (pt) and their 1 yr outcome subsequent to the publication of AFFIRM/RACE and the ACC/AHA/ESC atrial fibrillation (AF) guidelines (G). AFFECTS pt had mainly minimal or no structural heart disease or uncomplicated hypertension; >90% had no prior antiarrhythmic drug (AAD) use. This report concerns the first 1000 pt. (1) Despite AFFIRM/RACE, rhythm control (RhC) was chosen over rate control (RaC) as the primary management strategy (MS) in 65%, unaffected by gender, age, ethnicity, or new versus prior AF. RhC was chosen more often in both persistent (Per-AF) (54%) and paroxysmal AF (PAF) (67%). (2) 341 pt were given their 1st AAD during the trial (vs rate Rx or non-drug Rx). Of these, 84.8% received a class IC AAD (69.8%) or sotalol as first AAD in concordance with the G, which were taught to each physician prior to AFFECTS enrollment. Only 13.5% received amiodarone as first AAD (in contrast to its high use in general AF practice). (3) Warfarin use was 68.9% in high-risk RhC pt and 72.8% in high-risk RaC pt which is higher than historical controls prior to the above trials and G. Even 41% and 59.6% of non-high-risk RhC and RaC pt received warfarin. (4) RhC was chosen over RaC in PAF regardless of symptoms but RhC was chosen infrequently in asymptomatic Per-AF pt. Conclusions: AFFIRM/RACE have not suppressed the belief that sinus rhythm and AAD use may benefit most AF pt. G training (not just publication) can improve Rx decisions. AFFIRM/RACE and G have favorably enhanced anticoagulation use.

## INCIDENCE OF AF IN ICD PATIENTS: DATA FROM A LARGE POPULATION REGISTRY

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**Introduction** The occurrence of paroxysmal atrial fibrillation (PAF) in patients (pts) with a standard implantable cardioverter-defibrillator (ICD) indication can contribute to worsened clinical outcomes and may increase the risk for inappropriate therapy (IT). With the advent of expansion in ICD indications, the frequency of AF and the potential implications of IT in this growing population have not been fully characterized.

**Methods** The St. Jude Medical Advancements in ICD Therapy (ACT) Registry is an outcome-oriented registry collecting demographic and device data in over 5,000 pts during a two-year follow-up period. Data logs from 2,060 pts (76% male, 66±12 yrs, LVEF 28±11%) with ICDs and cardiac resynchronization therapy ICDs (CRT-Ds) enrolled in ACT and followed for 12 months were analyzed for the incidence of post-implantation AF. The presence (AF+) or absence (AF-) of AF prior to implantation was noted.

**Results** PAF was seen in 22% of pts prior to implant and in 7% of pts during the first year after implant. The incidence of PAF post implantation was significantly higher in AF+ pts (12.2%) as compared to AF- pts (5.5%), independent of the type of device (single chamber ICD, dual chamber ICD, or CRT-D), $p<0.001$.

**Conclusions**

1. Among pts undergoing ICD implantation for a standard indication, pre-implantation PAF is relatively common.
2. Post-implant PAF is not uncommon in pts receiving an ICD for present indications, occurring in 7% of such pts over the first year.
3. The development of AF in the ICD population is more than twice as common if AF was present before implantation.
4. Caution in programming device features & in pharmacologic therapy should be exercised to reduce the potential for inappropriate shocks.
5. Further analysis will be required to determine the potential impact of these rhythm abnormalities upon clinical outcomes.

## THE BOLOGNA REGISTRY OF THE CANADIAN ATRIAL FIBRILLATION CHRONIC HEART FAILURE STUDY AF-CHF

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**Introduction** trial fibrillation (AF) and chronic heart failure (CHF) are recognized as the two major epidemics in the 21st century. The treatment of AF in CHF patients remains to be determined.

**Patients and methods** We enrolled 40 consecutive patients, in the Bologna registry, similarly to the Canadian AF-CHF study. The patients were randomly assigned to the two therapeutical strategy of AF in CHF patients: rate control (RAC) or rhythm control (RHYC). Clinical features, associated therapeutical strategies (TS) and prognosis, are reported.

**Results** Ethiology was CAD (55%), followed by DCM (15%), and valvular diseases (VD) (12.5%). 21/40 were randomized to RHYC and 19/40 to RAC. EF% was 30%, in the entire group, 31% and 28% in the RHYC versus RAC groups. The majority of patients were in NYHA class 3 (57.5%) and NYHA class 4 (22.5%). B-blockers and ACEi were administered in 85% and 82% of both groups. Electrical ablation (EA), pacing or CRT, CABG and valvular operations were more frequently applied in RHYC versus RAC. The one year prognosis showed a significant higher mortality in RAC 6/19 (39.5%) versus RHYC 2/21 (9.5%). Only 9/21 (42.8%) were in SR and 0/19 in RAC. 38/40 received OAT.

**Conclusions** CHF patients with AF are characterized by a severely reduced EF%, advanced NYHA classes. The optimal drug therapy should be instituted, including non-anti-arrhythmic agents and OAT. Of the two available therapeutical strategies, RHYC is justified in patients, in whose AF is associated with severe hemodynamic deterioration.

Frequently, non pharmacological treatment, including cardiac surgery (CS), and/or EA should be applied to maintain SR. Conversely, RHYC control should be used when EF% is not clearly associated with symptoms worsening. Only, by applying these guidelines, including CS and/or EA, RHYC seems to be superior to RAC. in the long term prognosis of AF-CHF patients.

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## FACTORS RELATED TO ATRIAL FIBRILLATION RECURRENCE IN A POPULATION OF 47 PATIENTS UNDERWENT TO ELECTRICAL CARDIOVERSION

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**Purpose** Efficacy of electrical cardioversion in restoring sinus rhythm (SR) in atrial fibrillation (AF) patients is extremely effective but is limited by a high number of arrhythmia recurrences within 2 weeks after cardioversion (CV).

**Methods** We performed electrical cardioversion (ECV) in 47 consecutive patients from July 2006 to November 2006 (mean age 70.3±6.6 years, left atrium diameter 45.8±5.4 mm, LVEF 56.6±5.4%) affected by persistent atrial fibrillation (mean duration 9.4±15.6 months), 30/47 pts were at the first episode of AF. All patients received effective anticoagulant therapy. The antiarrhythmic treatment was: 7 pts flecainide, 10 propafenone, 11 amiodarone, 12 amiodarone + flecainide, 5 sotalol and 2 without antiarrhythmic therapy. We evaluated patients at one week after ECV, 1 month, 3 and 6 months. We performed univariate logistic regression analysis in 29 parameters.

**Results** One week after successful ECV 15/47 pts (31.9%) presented AF recurrence. At the 1, 3 and 6 month follow-up no patient presented AF recurrence.

Statistical analysis showed that the use of AT2 blockers and the presence of I degree AV block are correlated with SR at one-week after ECV, while duration of the arrhythmia, presence of left anterior fascicular block and number of previous episodes of AF, are correlated with recurrence of AF.

At one, three and six months none of the evaluated parameters resulted to be statistically significant, as there were no AF recurrences.

**Conclusions** AF recurrence is very high in the first week after ECV (31.9%), thereafter decreases and becomes more constant over time. The presence of I degree AV block, is correlated with a low rate of AF recurrence. The use of AT2 blockers can help maintaining SR. The duration of atrial fibrillation or the presence of left anterior fascicular block is correlated negatively with the recurrence of the arrhythmia.

## PREDICTION OF RECURRENCES IN LONE PAROXYSMAL ATRIAL FIBRILLATION OF NEW ONSET

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**Purpose** The aim of this study was to evaluate the prognostic significance of P wave wavelet analysis for the prediction of recurrences in patients with lone paroxysmal atrial fibrillation (PAF) of new onset.

**Methods** Seventy-two patients (26 males, mean age 56±9 years) divided in 3 Groups. Group A consisted of 15 new onset lone PAF patients (4 males, mean age 59±5 years) who developed recurrences, while Group B consisted of 7 new onset lone PAF patients (3 males, mean age 55±12 years) without recurrences, during 2.2±0.7 years follow up. Group C consisted of 50 normal controls (19 males, mean age 56±9 years) without history of PAF. The P wave was analyzed using the Morlet wavelet and wavelet parameters expressing the mean and max energy of P wave were calculated in the three orthogonal leads (X, Y, Z) and in the vector magnitude (VM), in three frequency bands ($1^{st}$: 200-160 Hz, $2^{nd}$: 150-100 Hz and $3^{rd}$: 90-50 Hz). The difference of P wave duration between Z and X axis (PdurZ-X) was also measured.

**Results** Multivariate logistic regression analysis showed that longer PdurZ-X along with higher max2 energy at Z axis were significant and independent predictors of lone PAF with recurrences, while longer P wave duration at Z axis along with lower Mean1 energy at X axis of non recurrent PAF. PdurZ-X and max2Z at cut-off values of 10.7 msec and 16.3 ÌV held sensitivity, specificity and positive predictive value of 85%, 84% and 73% respectively, while PdurZ and mean1X at 78.2 msec and 1.33 ÌV held 94%, 80% and 98% respectively.

**Conclusions** The development of recurrences in patients with lone PAF of new onset associated with specific atrial excitation characteristics, that can be revealed by P wave wavelet analysis.

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## NODAL OR NODE-LIKE CELLS? ULTRA STRUCTURE STUDY OF PULMONARY VEINS

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**Purpose** Slightly number of studies has been conducted in the field of ultra structure of pulmonary veins (PV) muscular sleeves. There are different data about nodal cells existence in PV muscular sleeves of patients with Atrial Fibrillation (AF). We made an attempt to discover the reason of PV activation (dissociation of PV spike and LA activation with regular PV rate -13-14 bpm) after PV isolation, that we see sometimes after radiofrequency ablation (RFA).
**Methods** In five patients with atrial septal defect without arrhythmia (first group) and five patients with degenerative mitral valve disease and atrial fibrillation (second group) biopsies have been taken from the right superior pulmonary vein and left atrium, during right superior PV canulation.
**Results** The results of electron microscopy investigation indicated that the cells of PV muscle sleeves conditionally can be divided in to two groups: In the first group of patients cells were similar to contractile cardiomyocytes of left atrium, with the exception of atrial granules, in the second group of patients we have found the cells with several ultra structural characteristics similar to the nodal cells i.e. node-like cells (lysis of myofibrils, lack of nexuses in the insertion disc) but we did not find the P cells T cells and Purkinje fibers.
**Conclusion** On the assumption of our ultra structural study we can not strengthen the theory of nodal cells in PV, however node-like cells are proved to exist. These are cells that can probably cause aforementioned phenomenon observed sometimes after RFA of PV.

## SYMPATO-VAGAL IMBALANCES DECTECTED AT HEART RATE VARIABILITY PRECEDED COMMON ATRIO-VENTRICULAR NODAL RE-ENTRY TACHYCARDIA INDUCTION

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Common Atrioventricular Nodal Reentry Tachicardia (AVNRT) is a frequent supraventricular arrhythmia due to a re-entry mechanism. We hypotized that variations in the autonomic tone can shift conduction from fast-pathway to slow-pathway and favour the establishment of the re-entry.
Heart Rate Variability (HRV) is a useful test to evaluate fluctuations of sympato-vagal balance.
**Aim** of the Study was to evaluate the autonomic tone in the hour preceding the induction of AVNRT by HRV analysis.
**Methods** Thirty-two pts (13 M+19 F; 30±21 years) with at least one episode of AVNRT detected at 24 hours ECG-Holter recordings entered the present study. AVNRT diagnosis was confirmed by electrophysiologic study. SDNN, HF, LF and VLF in the hour preceding AVNRT induction (-pre) and mean 24 hours (-24h) values were analyzed. Number of premature supraventricular (PSVC) and ventricular (PVC) complexes in the hour preceding AVNRT induction (-pre) and mean rate per hour (-mean) were recorded.
**Results** Eighty episodes of AVNRT were documented in 32 pts. SDNN-pre was lower than SDNN-24h (56±34 vs 115±28, $p<0.01$), HF-pre was lower than HF-24h (2.78±1.29 vs 3.16±1.76, $p<0.01$), LF-pre was lower than LF-24h (3.66±1.53 vs 4.26±1.12, $p<0.01$); there were no statistical differences between VLF-pre and VLF-24h (5.50±1.38 vs 5.57±0.96). PSVC-pre and PVC-pre did not respectively differ from PSVC-mean and PVC-mean.
**Conclusions** During the hour preceding AVNRT induction there is a high sympathetic discharge. The absence of statistically significant differences between PSVC-pre, PVC-pre and PVSC-mean, PVC-mean and the presence of significant autonomic alterations in the hour preceding the AVNRT demonstrated that the induction of the tachycardia is correlated to modifications of refractory periods of slow and fast-pathway and not to high ectopic stimulation.

## PACING POSTCONDITIONING SHARES SOME SIGNALING PATHWAYS WITH ISCHEMIC POSTCONDITIONING, BUT NOT TRIGGERING BY ADENOSINE RECEPTOR

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**Purpose** Repetitive coronary occlusion (ischemic postconditioning; IschPostC) reduces infarct size in coronary reperfusion procedures. We previously showed that intermittent ventricular pacing also induces cardioprotection (pacing-postconditioning, (PacePostC). We tested whether PacePostC is explained by gradual reperfusion and whether pathways involved in IschPostC (PKC, mitochondrial K+ATP. PI3K-Akt and adenosine receptor) are also involved in PacePostC.
**Methods** Isolated ejecting rabbit hearts were subjected to 30 minutes coronary occlusion and 2 hours reperfusion. PacePostC consisted of 10 30-sec intervals of ventricular pacing during early reperfusion. Studied were control (n=6), PacePostC (n=5) and PacePostC in combination with selective blockers of the mitochondrial K+ATP channel (5HD, n=5), PKC (Chelerythrine, n=6), PI3K (Wortmannin, n=5) and adenosine receptor (8-SPT, n=5). In an additional 5 control and 5 PacePostC hearts fluorescent microspheres were injected during early reperfusion to measure myocardial blood flow (MBF) in the reperfused region during both the ventricular and atrial pacing intervals. Regional myocardial work was estimated from LV pressure and sonomicrometers crystals implanted in the LV wall. Area at risk, and infarct size were determined with blue dye and TTC staining, respectively.
**Results** Ventricular pacing significantly altered regional mechanical work, but did not affect total coronary flow nor lactate release. During early reperfusion MBF in the postischemic myocardium of PacePostC hearts was not different between atrial and ventricular pacing (10.6±5.0 and 8.8.±5.3 ml/min/g, respectively; mean±SD; $p>0.5$) and not from control hearts (10.0±3.5 ml/min/g). Infarct size, normalized to area at risk, was significantly smaller in PacePostC (25.9±1%) than in control hearts (47.0±3%). 5HD, Chelerythrine, and Wortmannin completely abrogated the protection provided by PacePostC (infarct sizes: 49±3%, 45.9±3% and 50±3%, respectively), but not by 8-SPT (infarct size 25±6%).
**Conclusions** PacePostC is not due to an ischemic trigger or gradual reperfusion. PacePostC shares various signaling pathways with IschPostC, but not the initial triggering by adenosine receptor stimulation.

## RELATIONSHIP BETWEEN FREQUENCY AND AMPLITUDE CHANGES IN VENTRICULAR FIBRILLATION IN ISOLATED RABBIT HEART

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Clinical VF studies suggest that ECG amplitude, frequency and survival decrease as the heart becomes ischaemic. This study aimed to

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define the relationship between frequency and amplitude during VF. Isolated hearts were perfused at 40 ml/min (Tyrodes' solution, 37oC). Bath electrodes recorded global ECGs. Fluorescence, representing membrane voltage, was recorded from a 1.5x1.5 cm region on the anterior surface of hearts stained with RH237. After 60s of VF (induced by burst pacing), perfusion was continued at 40 ml/min or reduced to 6 ml/min. Peak-to-peak amplitude and dominant frequency (DF) were determined for the ECG and each optical pixel.
In VF, the ECG amplitude fell with time in full perfusion (56±6% cf. baseline), and to a greater extent in reduced perfusion (35±3%, $p<0.05$). Concurrently, the ECG dominant frequency increased with time in VF in full perfusion (1.23±0.07, $p<0.05$ cf. baseline), but fell in reduced perfusion (0.50±0.10, $p<0.001$). Thus in full perfusion, the declining amplitude was inversely associated with an increasing ECG DF, whereas in reduced perfusion the amplitude decline was directly associated with decreasing ECG DF. Optical mapping showed that the amplitude change was heterogeneous, with the left ventricle (LV) amplitude decreasing more than the right (RV) in both full perfusion (LV 33±5%, RV 63±8%, $p<0.05$) and reduced perfusion (LV 32±3%, RV 49±9%, NS). Previous studies by our group have shown that the optical DF changes are also heterogeneous with increasing LV DF in full perfusion and decreasing LV DF in reduced perfusion (RV amplitude was unaffected by both perfusion rates).
This study shows differential relationships between amplitude and frequency depending on the presence or absence of ischaemia. Amplitude is reduced by VF alone, whereas frequency decline requires the presence of ischaemia. This differential correlation between VF amplitude and frequency suggests that both could be used as predictors of VF duration.

## ROLE OF STRETCH-ACTIVATED CHANNELS ON THE STRETCH-INDUCED CHANGES OF RAT ATRIAL MYOCYTES

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The role of stretch-activated channels (SACs) on the stretch-induced changes of rat atrial myocytes was studied using a computer model that incorporated various ion channels and transporters including SACs. A relationship between the extent of the stretch and the activation of SACs was formulated in the model based on experimental findings to reproduce changes in electrical activity and calcium transients by stretch. Action potentials (APs) were significantly changed by the activation of SACs in the model simulation. The duration of the APs decreased at the initial fast phase and increased at the late slow phase of repolarisation.
The resting membrane potential was depolarised from -82 to -70 mV. The calcium transients were also affected. A prolonged activation of SACs in the model gradually increased the amplitude of the calcium transients. The removal of calcium permeability through SACs, however, had little effect on the stretch-induced changes in electrical activity and calcium transients in the control condition. In contrast, the removal of the sodium permeability nearly abolished these stretch-induced changes. Plotting the peaks of the calcium transients during the activation of the SACs along a time axis revealed that they follow the time course of the intracellular sodium concentration. The calcium transients were not changed when the intracellular sodium concentration was fixed to a control value (5.4 mM). These results predicted by the model suggest that the influx ofsodium rather than calcium through SACs is more crucial to the generation of stretch-induced changes in the electrical activity and associated calcium transients of rat atrial myocytes.

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## THE PATTERN OF DYSSYNCHRONY IS DIFFERENT IN AN ISCHEMIC CARDIOMYOPATHY POPULATION VS. NONISCHEMICS

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**Background** The lateral and posterior walls are generally thought as the most prevalent sites of greatest delay in patients with heart failure. In more than one-third of cases the most delayed wall is located at another site. We therefore investigated if the pattern of wall motion delay is related to whether the etiology is ischemic.
**Methods** We studied 74 normal subjects, 48 nonischemic cardiomyopathy patients (QRS duration 148 ms, 52% CLBBB, LVEF 29%) and 43 ischemic cardiomyopathy patients (QRS duration 157 ms, 45% CLBBB, LVEF 31%) who underwent echo with color tissue Doppler imaging. The interval between QRS onset and peak systolic velocity was measured from the myocardial velocity curves in 12 standard basal and middle segments, and the standard deviation (Ts-SD) was used as a measure of intraventricular dyssynchrony.
**Results** The Ts-SD in normal subjects, nonischemic cardiomyopathy and ischemic cardiomyopathy patients are 22.7±10.5 ms, 45.3±15.6 ms and 45.5±17.0 ms respectively. In normal subjects, the Ts of the inferior wall and posterior septum are significantly longer than that of lateral wall and anterior wall (respectively 154.0±34.2 ms, 151.1±32.3 ms vs 129.6±29.0 ms, 124.9±24.9; $p<0.05$). The values of posterior walls and anterior septal segments are in the middle. In the nonischemic cardiomyopathy patients the Ts of the inferior wall is most delayed, and is significantly longer than the lateral wall, anterior septum and the anterior wall (respectively 244.2±60.9 ms vs 208.5±68.1 ms, 199.1±49.7 ms, 192.6±52.2 ms; $p<0.05$). In the ischemic cardiomyopathy patients, although the increased Ts-SD indicated marked intraventricular dyssynchrony, we found no significant differences of Ts among the lateral wall, the inferior wall and the posterior wall which may be due to the heterogeneous patterns of regional wall motion delay in the ischemic cardiomyopathy patients.
**Conclusion** The pattern of wall motion delay is less predictable and more variable in an ischemic cardiomyopathy population than in a nonischemic group.

## TRIPLE-SITE AND DUAL-SITE LEFT VENTRICULAR RESYNCHRONIZING STIMULATION. IS ONE OF THEM BETTER? MORPHOLOGY, DYSSYNCHRONY AND LEFT VENTRICULAR FUNCTION.

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There is still little known about the influence of left ventricular (LV) stimulation with two leads on LV wall on LV hemodynamics. No data is available about the comparison of classical bi-ventricular stimulation (BiV - one lead on LV) and triple-site ventricular stimulation (TriV).
**Material and methods** The study group consisted of 59 BiV and 24 TriV patients in NYHA class III or IV, with QRS 167+/-21 and 179+/-33 ms, ischemic 50% and 41%, respectively. LV diameters and volumes were comparable in both groups (p=ns). Patients were examined echocardiographically before, at 5$^{th}$ day of resynchronization (opt) and at 1 and 3 month (m). We used standard echo applications or tissue velocity or strain imaging to assess systolic function and ventricular morphology and synchrony: LV diastolic and systolic diameter (LVDd, LVSd),ejection fraction (EF) and time to peak systolic strain (TPS) or onset of systolic velocity (TOV) estimated as the standard deviation (SD) of six basal and six medial LV segments. Data were withdrawn from apical 4-, 3- and 2- chamber views.
**Results** LVDd, SD TPS and SD TPVof basal segments were not different in both groups. LVSd was decreased (BiV/TriV) by -2.9/-7.2 mm (opt*), -7.1/-7.5 (1 m) and -6.3/-9.8 (3 m*). Paralelly, EF increased significantly* in opt and 3 m: 3.8/8.3 (opt*), 6.1/8.5 (1 m) and 4.8/10.1%.
The impact on medial segments resynchronization is presented below (all comparisons BiV vs TriV-statistically significant*):

| *SD TOV [ms]* | *BiV* | *TriV* |
|---|---|---|
| opt vs before | -14.1+/-21.4 | \|-29.4+/-11 |
| 1 m vs before | -13.9+/-25.6 | \| -29.4+/-11 |
| 3 m vs before | -4.8+/-20.8 | \|-20+/-31.5 |
| *SD TPS [ms]* | *BiV* | *TriV* |
| opt vs before | -9.8+/-62.5 | \|-22+/-43.9 |
| 1 m vs before | -18.6+/-20.1 | \|-36.6+/-47.3 |
| 3 m vs before | -4.2+/-37.4 | \|-53.8+/-33.3 |

**Conclusion** TriV stimulation has a favourable impact of left ventricular systolic morphology and function. The better influence on LV systolic synchrony is observed on the level of medial segments of LV myocardium.

## SERIAL NT PRO BNP TEST SHOULD BE INCLUDED IN THE EVALUATION OF PACEMAKER THERAPY EFFICACY AND IN THE IDENTIFICATION OF CANDIDATES FOR UPGRADING TO CRT

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**Introduction** ProBNP is currently applied in the management and risk stratification of patients with CHF, and recently in the efficacy evaluation of devices therapy, mainly VVI versus CRT (DT).
**Patients and methods** In our out patients CHF clinic, inside the SHAPE project, three group of CHF patients were evaluated:
Group A) 10 consecutive non selected patients, with VVI pacing
Group B) 9 patients with CHF and CRT, and
Group C) 7 patients, with VVI or CRT therapies, in control condition and after 3 months of each treatment.
**Results** In Group A, in the 10 patients, proBNP mean value was 2216+/-751 pg/ml. We observed 3 episodes of major HF and 2 recurrences of minor CHF. In Group B, 9 patients showed proBNP mean value 520+/-389 pg/ml. In this group, no recurrences of major or minor HF episodes were observed. In Group C, in the 7 patients, an important decrease of proBNP values were observed in the three months of CRT therapy and a definite increase of proBNP values, during VVI pacing. In this period, a concomitant deterioration of clinical status and echo contractility and EF% was observed.
**Conclusions** Blood peptides values, are an important tool to upgrade VVI pacing to CRT pacing in CHF patients, when the clinical evalu-

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ation of these patients is not completely adequate in selecting them. Moreover, the benefits of CRT versus VVI pacing, in CHF patients, can be assessed by serial proBNP evaluations.

## OPTIMIZATION OF BIVENTRICULAR PACING PARAMETERS IN PATIENTS WITH CONGESTIVE HEART FAILURE

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**Purpose** To study the effectiveness of multi-chamber implantable cardioverters-defibrillators in patients with congestive heart failure (CHF), left bundle branch block (LBBB) and low left ventricular (LV) ejection fraction.
**Material and methods** From July 2004 in Bakoulev Center the systems of biventricular cardioverters-defibrillators have been implanted to 13 men and 3 women (mean age 52.3±15.3 years, average NYHA class 3.33±0.82, LVEF 26.8±9.5%). CHF was caused by idiopathic dilated cardiomyopathy in 11 patients (69%), by ischemic heart disease, postinfarction cardiosclerosis in 5 (31%). All patients have received cardioverters-defibrillators with biventricular pacing function: 3 for monomorphic ventricular tachycardia, 7 for polymorphic ventricular tachycardia, 1 for history of ventricular fibrillation, 5 for primary prophylactics of arrhythmias. The evaluation and the correction of calculated parameters for each patient were carried out using three-dimensional EchoCG investigation with volume reconstruction of the left ventricle with the account of kinetics of each of its 18 segments separately and of both ventricles together.
The most optimal VV-delay was 0 msec in 10 patients, in 3 patients LV pacing before RV proved the most optimal; optimal AV-delay was selected for each patient on individual basis.
**Results** The follow-up period was 25.0±14.4 months (11-40 months). LVEF increased on the average by 39.97% from the initial value, NYHA class – by 1.00±0.71.
**Conclusions** Resynchronization therapy contributes to a significant decrease of CHF symptoms in patients with LBBB. EchoCG revealed the decrease of the area and volume of mitral regurgitation, the shortening of the interval between the start of the aortic flow and the flow into the pulmonary artery, significant increase of aortic dP/dT, improvement of synchronous systolic ventricular contractions.

## INTERNAL ELECTROGRAMS BASED DELAY OPTIMIZATION IN CRT DEVICES. COMPARISON WITH ECHO-DOPPLER METHOD

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**Purpose** The aim of this study is to compare the results obtained from a new algorithm, based on the analysis of endocavitary electrograms (IEGM), in the definition of the optimal AV/PV and VV intervals in patients with CRT device, with the data obtained using echocardiographic Doppler and Tissue Synchronization Imaging (TSI).
**Materials and methods** Twenty-three patients (age 72+6.2 years; 78% male; 56% NYHA III; 84% ischemic), all implanted according to current guidelines with CRT-D device with Quick-opt® algorithm, were enrolled. The optimal AV/PV and VV interval was evaluated in the same session, according to a randomized sequence, with echocardiography and IEGM-based method. The measurements of the diastolic filling time were carried out with AV/PV intervals from 80 to 200 msec with 20 msec intervals, maintaining the VV interval at 0. The echocardiograph evaluations of the best VV interval were carried out at five different VV interval values (RV-LV= 0, +80, +40, -40, -80 msec), calculating the lowest SD of the 12 segments time-to-peak velocities through the TSI module.
**Results** The duration of the diastole at the optimized AV/PV interval was 511.7+136 msec, when the AV/PV interval was optimized by an echocardiograph method; the duration of the diastole at AV/PV intervals identified by the IEGM-based algorithm was 496.2+135 (p=0.01).
The correlation coefficient between the two series was 0.97 (p<0.0001). The SD values of delay at echo optimized VV interval were 26.1+9 msec, vs 43.8+14 at IECG optimized VV (p<0,00001).
The concordance between the optimal VV interval identified by the echo and that indicated by the IEGM was found in 12/18 cases (66.6%).
**Conclusions** An excellent concordance between IEGM and Echo method and was found for the AV/PV delay optimization. However the VV delay setting obtained through the IEGM-based algorithm leads to a worse resychronization pattern, when compared with the VV delay optimized through TSI, with a low concordance level.

## CARDIAC RESYNCHRONIZATION THERAPY (CRT) IN PATIENTS WITH ADVANCED HEART FAILURE AND ATRIAL FIBRILLATION

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**Purpose of study** To estimate efficiency and safety of implantation of cardiac resynchronization device to patients (pts) with a heart failure (HF) and atrial fibrillation (AF).
**Material and methods** 19 pacemakers were implanted with CRT function to pts with AF and HF. QRS initial duration 162±14.4 ms, II-III degree of mitral regurgitation (MR), left ventricular ejection fraction (LVEF) 33.4±8.8%. 10 pts had coronary artery disease with cardiomyopathy, 9 had dilated cardiomyopathy , 5 pts had LBBB. In 13 pts RFA of AVN was executed.
**Results** To all pts biventricular pacemakers were implanted. In all cases it was possible to implant left ventricular electrode Attain OTW 4193-78 with reception of satisfactory parameters: a threshold of stimulation – 1.2±0.3 V, sensitivity 12.0 mV, resistance 440±65 Ohm. In two cases left ventricular electrode was implanted in anterolateral vein of CS, is close to a locating of a phrenic nerve, however at stimulation in 1.5 V and duration 0.6 ms reductions of a diaphragm was not observed. Six months after operation parameters of stimulation and sensitivity did not worsen. The best parameters of synchronization were received at VV=20+8 ms. All pts went from 3-4 in 1-2 NYHA class. Quality of a life and acceptability of loads considerably improved.
**Conclusion** Cardiac resynchronization therapy offers a new therapeutic approach for treating pts with ventricular dyssynchrony and moderate-to-severe HF. All pts managed to implant successfully LV electrode. Use posterolateral veins of CS was more preferable, but application anterolateral veins also was possible without complications, especially at LBBB. CRT in pts with moderate-to-severe HF was associated with reverse LV remodeling, as evidenced by reduction in LV volumes, improved systolic and diastolic function, and decreased severity of MR.

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## PROGNOSTIC SIGNIFICANCE OF NT PRO BNP TEST IN PATIENTS WITH CHF AND DEVICES THERAPY. HIGH VALUES ARE RELATED TO PROGNOSIS AND ICD DISCHARGES

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**Introduction** ProBNP is currently applied in the management and risk stratification of patients with CHF, and in the effectiveness evaluation of devices therapy (DT).
**Patients and methods** In the SHAPE project, two groups of CHF patients were evaluated: Group A) 160 consecutive non selected patients, Group B) of 26 patients with CHF and an ICD).
**Results** In Group A, in the 20 patients with a proBNP of more than 2500-3000 pg/ml, we observed 5 episodes of HF and two CD in the following 3 months, 4 recurrences of minor CHF, in the group with a proBNP value betweeen 2500 and 1500. No problems or clinical recurrences, were observed below 500 or less of proBNP. In the range between 501 and 1500 pg/ml, all the patients had history of cardiac disease, CHF or abnormal EF%, but no clinical episodes were observed. In Group B, 9/26 with appropriate discharges or ATP treatments, were observed with a mean value of proBNP of 2100+/-560 pg/ml. In one patient, with a reduced value of proBNP, a severe hypokalemia was the cause of the arrhythmic storm and of ICD discharges. Conversely, no discharges were observed in 17/26, with a mean value of 420+/-550.
**Conclusions** Patients, with appropriate DT interventions, show higher mean value of NTproBNP. Thus, patients with unstable CHF, as documented by high blood peptide values, are at high risk of ventricular arrhythmias.

## COMPARISON OF VENTRICULAR SENSING IN INTEGRATED VS. DEDICATED RIGHT VENTRICULAR LEADS IN CRT-D SYSTEMS

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**Background** In CRT-D systems, integrated bipolar (INT) RV leads have been shown to be associated with less anodal RV stimulation during extended bipolar LV pacing compared to dedicated (DED) RV leads. However, there is concern about sensing characteristics of INT RV leads compared to DED RV leads.
**Purpose** Compare DED and INT bipolar RV leads in CRT-D systems with respect to undersensing, oversensing and inappropriate therapies due to myopotentials or other electrical noise.
**Methods** This is a prospective, randomized, multicenter study. Patients (75% males, 69±12 years, EF 24.8±6.4%) implanted with CRT-D device were randomized at implant to receive either Riata INT (tip-coil spacing= 17 mm) or Riata DED (tip-ring spacing= 11 mm) RV lead (St. Jude Medical). All received SJM Epic HF or Atlas HF CRT-D generators. 130 pts received DED leads and 118 pts received INT leads. Pts were followed up to 6 mo post implant (mean 5.4±1.5 mo). Ventricular sensitivity was programmed using automatic sensitivity control algorithm, with 93% of pts programmed to nominal maximum sensitivity value (0.3 mV). Device based stored electrograms were used to identify any episodes of at least 1 undersensed or oversensed beat and any related inappropriate therapy due to noise.
**Results** There was no significant difference in frequency of undersensing (1/130 DED leads vs 0/118 INT leads) or oversensing (10/130 DED leads vs 15/118 INT leads). There were no inappropriate therapies for oversensing of myopotentials or other electrical noise with either lead design.
**Conclusions** Oversensing and undersensing were uncommon with both dedicated and integrated RV leads. No patient received inappropriate therapy due to myopotentials or other electrical noise. The absence of inappropriate therapies due to noise oversensing with integrated RV leads in this series may be specific to particular RV ICD lead designs and CRT-D generator sensing algorithms.

## QRS DURATION CAN PREDICT LONG TERM CLINICAL EVOLUTION IN PATIENTS WITH CONVENTIONAL DUAL CHAMBER RIGHT VENTRICULAR APICAL PACING AND NORMAL LEFT VENTRICULAR FUNCTION?

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Conventional dual chamber right ventricular apical pacing (DRVAp) prolonges QRS duration which can induce remodeling and deterioration of the left ventricular (LV) function. However the consequences of permanent DRVAp are not still clearly defined in the clinical setting.
**Aim** Evaluate if evolution of QRS duration after permanent DRVAp can predict the long term clinical course in patients (pts) who have normal LV function before implantation.
Population: we prospectively studied 32 pts (20 male, 12 female, mean age 75±4 years) with advanced atrio-ventricular block and clinical indication to DRVAp. All pts had pre-implantation left ventricular ejection fraction (LVEF)>50%.
**Methods** Pacemaker interrogation, clinical and Echo Doppler follow-ups were performed at post-implantation and after 12, 24 and 36 months. The following parameters were collected: QRS duration, LVEF, left ventricular end-diastolic diameter (LVDD), NYHA class, Quality of Life (QoL), heart failure (HF) hospitalization.
**Results** The percentage of ventricular pacing was >95% and of atrio-ventricular synchronism >96%. After 36 months follow-up there was no statistical variations in LVEF (p=NS), LVDD (p=NS), NYHA class (p=NS) and QoL (p=NS). However in a subgroup of pts paced QRS duration greater than 160 ms positively correlated with NYHA class (P=0.001), LVDD (p<0.05) and inversely with LVEF (p<0.05) during follow-up. Also pts with a paced QRS duration>160 ms have a significant increase in the overall morbidity of HF hospitalization as compared to pts with paced QRS<160 ms (p<0.05). Multivariate analysis identified QRS>160 ms as predictor of morbity (p<0.05).
**Conclusions** In pts without LV dysfunction requiring permanent DRVAp the presence of post-implantation QRS duration>60 ms correlates with worsening of clinical conditions and increased morbidity for HF. Paced QRS is a useful indicator for the selection of pts who present a negative evolution in the long term period and can need an alternative and/or integrated modality of pacing for the preservation of LV integrity.

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## RELATIONSHIP BETWEEN 12-LEAD-ELECTROCARDIOGRAMS AND ELECTROGRAMS STORED IN IMPLANTABLE CARDIOVERTER DEFIBRILLATORS

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**Background** In the era of ICD primary prevention, an increasing proportion of patients have ICD electrograms (EGs) as the only documentation of VT.
**Methods** In 11 patients undergoing a LV electroanatomic map and having an ICD chronically implanted, we prospectively obtained 12-lead ECG from a mean of 18 LV pacing sites (range 8-36) while manually recording the ICD EG. Each ICD-EG was subsequently digitized and at least 3 beats per pacing site averaged for analysis.
**Results** EG quantitative parameters were compared with 12-lead ECG simple dicotomic variables (axis in the frontal plane, morphology in V1, see table) and correlated with quantitative parameters in aVL (a lead theoretically similar to EG).

| | sup vs inf | | right vs left | | RBB vs LBB | |
|---|---|---|---|---|---|---|
| | sup | inf | right | left | RBB | LBB |
| Qvolt (mV) EG | 0.579± 0.617 | 0.936± 0.632* | 0.922± 0.659 | 0.327± 0.397* | 0.846± 0.661 | 0.274± 0.327* |
| Rvolt (mV) EG | 1.518± 0.678 | 1.229± 0.515* | 1.349± 0.610 | 1.539± 0.677* | 1.396± 0.634 | 1.477± 0.658 |
| ratio Q/R EG | 0.45± 0.47 | 0.79± 0.46* | 0.75± 0.47 | 0.26± 0.36* | 0.69± 0.49 | 0.2± 0.2* |
| S-SEG (ms) | 51.8± 26.8 | 49.9± 29.6 | 50.7± 23.5 | 51.9± 33.9 | 48±24 | 58±34* |
| SEG-BEG (ms) | 69.9± 32.7 | 74.1± 42.5 | 73.9± 37.1 | 66.6± 34.3 | 78±32 | 49±38* |

Correlation Qvolt in aVL and EG: R2=0.001. Correlation Rvolt in aVL and EG: R2=0.08. Correlation ratio Q/R in aVL and EG: R2=0.005. *p<0.05; Q, R: first negative and first positive deflection; S-SEG: interval between stimulus and shock EG; SEG-BEG: interval between shock EG and bipolar EG.

**Conclusions** ICD-EG analysis can approximate some information as to 12-lead-ECG of VT (in case ECG is lacking). Lack of correlation between aVL and ICD_EG suggests substantial differences between these 2 recording sources despite their theoretical similarities.

## EFFECTIVENESS AND FEASIBILITY OF A TRANSTELEPHONIC MONITORING PROGRAM

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Transtelephonic monitoring of pacemakers (TTM) has been established at our institution for several years, however, the program has not been systematically evaluated.
**Aims** To assess feasibility and effectiveness of the TTM program and to perform a cost-benefit analysis.
**Methods** Retrospective analysis of all patients in the TTM program from Jan 1st to Oct 30th, 2006. For cost-benefit analysis, a virtual model of in-office visits was created. A LifeSignsTM Receiving Center, Instromedix; was used for TTM decoding and recording.
**Results** 303 patients had 1468 encounters (4.7±2.8 encounters per patient), mean age 81.6±10.2 years old, 51.2% female. The reasons for a TTM strategy included anticipated impending battery failure (50%), immobility of the patient (50%), living far from the hospital (47%), device under "recall" (6%). 56% of the patients evaluated monthly and 44% evaluated every three months. Patients on a monthly schedule were more likely to be directed to attend the clinic in person (4.9% vs 2.1%; p<0.02). Reasons for direct the patient to the clinic were: Elective Replacement Indication 30%, technical difficulties 4%, regular annual visit 66%. Dual chamber pacemakers (p=0.004), battery longevity (p<0.03) and reduced mobility of the patient (p=0.02) were significantly associated with referrals to the pacemaker clinic. Twelve patients (4%) died during this period. Only age (80.5 vs 87.3 years old; p<0.02) and reduced mobility (p=0.001) were associated with death during follow-up. The cost of the TTM strategy was $11,744.00. A cost model calculated based on attendance of all TTM patients at the clinic at the same follow-up frequency resulted in an estimate of $88,230.00 - 8 times more costly than the TTM strategy.
**Conclusion** TTM for pacemaker follow-up is safe and permits follow-up for patients who have difficulty coming to the clinic. Large numbers of patients can be followed in a cost effective manner.

## POOR QUALITY OF LIFE BEFORE, FOLLOWED BY IMPRESSIVE IMPROVEMENT DURING FIRST YEAR AFTER PACEMAKER IMPLANTATION FOR CONVENTIONAL INDICATIONS

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**Aims** This prospective study aimed to determine health related quality of life (HRQoL) of PM patients before 1st PM implantation, to compare the results with an age comparable sample of the general Dutch population (controls) and other patient groups, and to determine how QoL improves after PM implantation and whether subgroup lineair regression analysis could determine predictors of HRQoL one year after the implantation.
**Methods and results** Data of patient data with conventional pacing diagnosis are stored in the Dutch multicenter, longitudinal, PM registry (Followpace study) that prospectively documents patient prognosis, HRQoL (generic F-36 and PM specific Aquarel), and PM events after first implantation in 23 of the104 Dutch PM centers In 818 patients all pre-implant generic SF 36 subscales showed dramatic lower values than that in a sample of an age comparable general Dutch population (P<0.05) but comparable to patients with chronic rheumatic arthritis and chronic angina pectoris. After PM implantation, measured in 31 patients, all SF 36 scales except for "General Health perception" improved and all 3 subscales of the disease specific Aquarel QoL instrument and the EuroQol QoL also improved drastically. The HRQoL as measured with SF-36 at one year after implantation adjusted for the HRQoL at baseline was related to gender, age, cardiac history, presence of diabetes mellitus, indication for

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implantation and pacemaker chamber system (dual vs single chamber). The results show that the best results of pacemaker therapy in terms of HRQoL can be expected in younger patients suffering from atrial fibrillation.

**Conclusion** The outcome of the Followpace study shows a poor HRQoL of patients before pacemaker implantation and an impressive improvement during the first year thereafter. These findings advocate to implant as soon as possible after established pacing diagnosis and to support the PM recipient with counselling.