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### WHAT FACTORS INFLUENCES HEMODYNAMIC IMPROVEMENT AFTER RIGHT VENTRICULAR TO BIVENTRICULAR PACING SYSTEM UPGRADE

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It is still hard to predict hemodynamic effects after biventricular pacing system (BiVp) implantation despite established inclusion criteria for CRT and left ventricular pacing (LVp) techniques. The aim of the study was to find the predictors of acute hemodynamic improvement after right ventricular (RVp) to biventricular pacing system upgrade. Methods: The study group consisted of 69 patients with permanently implanted BiV pacing system with standard CRT criteria. Hemodynamic effect was determined using impedance cardiography (BioZ.com; Cardiodynamics). Cardiac Index (CI) and other indirect parameters were determined during 3 min periods of RV and BiV pacing in turn. Correlations were searched among clinical, echocardiographic, ECG and initial hemodynamic parameters and multivariate analysis was performed as well. Results: Cardiac contractility was higher during BiVp than RVp and LVp: CI (l/min/m<sup>2</sup>): RVp 2,29\*; LVp 2,20^; BiVp 2,56\*^ [\*^ANOVA-LSD p<0,05]. Increase of CI after RV to BiV reprogramming correlated with CI during RVp (r=-0,50 p<0,001), Thoracic Fluid Index (TFI) (r=-0,32 p<0,01) and with difference of CI between RVp vs LVp (r=0,57 p<0,001) and LVp vs BiVp (r= 0,30 p<0,05). Values of CI during LVp, BiVp, echocardiographic parameters, NYHA class, RVp-, LVp-, BiVp- QRS durations and axis, and their changes did not correlated with differences of CI during RVp and BiVp. Multivariate analysis showed that only CI during RVp and RVp vs LVp CI difference determined acute hemodynamic effect of BiVp in comparison to RVp. Conclusions: Increase of CI after RVp to BiVp upgrade depends mainly on cardiac performance during right ventricular pacing and its improvement caused by change from RVp to single site LVp.

### PHRENIC NERVE STIMULATION DOES NOT PRECLUDE SUCCESSFUL RESYNCHRONIZATION DEVICE IMPLANT

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**BACKGROUND:** The three accepted criteria for successful implant of a coronary sinus lead for cardiac resynchronization therapy are a lateral lead position, acceptable pacing and sensing thresholds, and the absence of phrenic nerve stimulation. Diaphragmatic pacing may occur while the other criteria are met, and no other alternative lead target sites, or after the patient has left the laboratory. Lead repositioning is the traditional remedy for this. However, if there is a large enough difference between two times the voltage capture threshold and the phrenic nerve stimulation threshold, lead repositioning may not be necessary. This study was performed to see how often reprogramming alone is a successful remedy to this problem. **METHODS:** 7/33 consecutive patients undergoing cardiac resynchronization therapy were found to have phrenic nerve stimulation after final positioning of the lead. In three of these patients, no alternative coronary sinus placement was possible. The other four, with excellent anatomic positions, experienced phrenic nerve pacing remotely after implant. The two times voltage capture threshold-phrenic nerve stimulation threshold margin was calculated for each patient. **RESULTS:** The mean LV capture threshold was 1.0V and the mean diaphragmatic pacing threshold was 2.1V. Four patients had significant differences between the capture thresholds and diaphragmatic pacing thresholds, allowing for reprogramming of the LV lead output. Of the other three, 2 were able to be repositioned. **SUMMARY:** Phrenic nerve stimulation need not be an absolute indication to reposition a coronary sinus lead if there is adequate margin between pacing capture threshold and the phrenic nerve stimulation threshold.

### QUANTIFICATION OF LEFT VENTRICULAR DYSYNCHRONY USING SEGMENTATION AND THREE DIMENSIONAL ECHOCARDIOG

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**Objective:** Accurate characterization of regional wall motion abnormalities requires the evaluation of the entire left ventricle (LV). Three-dimensional echocardiography, with real-time volumetric imaging, has the potential to overcome this limitation by capturing the entire volume of the left ventricle.

The objective of this study was to assess the feasibility of using real-time 3-dimensional echocardiography to detect regional wall motion abnormalities and quantify dyssynchrony in the sheep heart failure model.

**Background:** Mechanical dyssynchrony is an important determinant of cardiac dysfunction in patients with heart failure. Pacing treatments have shown to improve cardiac function by improving mechanical synchrony

Simultaneous electrical stimulation of both ventricles in patients with interventricular conduction disturbance and advanced heart failure improves left ventricular hemodynamics.

**Methods:** Heart failure was induced in 9 sheep. Echocardiographic images are obtained with the transducer in the apical position and the image plane rotating around the LV long axis during right ventricular apical pacing and biventricular pacing. The original 2D images are processed by placing them in their correct spatial and temporal (ECG reference) position using multi beat data fusion. The LV endocardial surface is subdivided in segments.

The difference in time to maximal myocardial contraction between segments is used to measure regional mechanical delay.

**Results:** Fast reconstruction of the LV is feasible for the selection of the optimal pacing site and allowed for the identification of LV segments with dyssynchrony. Left Ventricular reconstruction is available in real time.

**Conclusions:** Transthoracic dynamic 3D echocardiography performed by a fast rotating transducer and combined with automated contour analysis is feasible to determine mechanical asynchrony during LV contraction.

### RIGHT APICAL AND RIGHT OUTFLOW TRACT PACING - LONG-TERM ECHOCARDIOGRAPHIC COMPARISON

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Permanent ventricular pacing is typically obtained with electrode implanted at the right ventricular apex (RVA). However, animal and human studies have demonstrated that RVA pacing may lead to adverse changes in myocardial geometry and haemodynamics. Thus, alternative RV pacing sites are gaining a special interest.

The aim of the study was to compare effects of different RV pacing sites on left ventricular (LV) function in patients with a permanent pacemaker implanted and a lead positioned at the RVA (RVA group) or at the RV outflow tract (RVOT group).

The study group consisted of 27 patients: 14 pts in the RVA group with permanent RVA pacing- follow-up 89+/-9 months and 13 pts in the RVOT group, with permanent RVOT pacing- follow-up 93+/-6 months. Within 1 month after implantation and during the last control visit echocardiographic examination was performed. At time of the last control visit the plasma NT-proBNP level was also measured in both groups.

During long-term follow-up the LV ejection fraction decreased from 54.1% to 52.7% (p=ns) in the RVOT group and from 55.9% to 46.7% (p<0.05) in the RVA group. In comparison with data obtained at base-

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line echocardiography RVA and RVOT pacing had similar effects on the average LV end-systolic and end-diastolic diameter, and the left atrial dimension. The mitral valve regurgitation, assessed in the in 4-grade score, increased in the RVOT pts from 0.7 to 0.8 and in the RVA group from 0.9 to 1.3. The mean plasma NT-proBNP level was 429+/-430 pg/ml in the RVOT and 1034+/-852 pg/ml in the RVA group (p<0.05).

**Conclusions:** Our preliminary data show that in patients with normal LV function at baseline permanent right ventricular pacing leads to its deterioration over time, and progression of mitral valve regurgitation. Pacing at the RVOT may diminish these unfavorable effects in comparison with RVA pacing.

**LEFT VENTRICULAR DIASTOLIC FUNCTION IN PATIENTS WITH LONG-TERM RIGHT VENTRICULAR OUTFLOW TRACT (RVOT) VERSUS RIGHT VENTRICULAR APICAL (RVA) PACING**

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It has been previous suggests shown that RVA pacing may result in changes in myocardial geometry and haemodynamics. The aim of the study was to compare long-term influence of different pacing sites (RVOT versus RVA) on left ventricular diastolic function.

**Method:** In 1996-1997 one-center randomized study was performed in pts referred for permanent pacing and the pacing lead was implanted at RVA or RVOT. This year echocardiographic examination and plasma NT-pro BNP level measurement were performed in 13 RVOT and 14 RVA pts (93±6 and 89±9 months of pacing, respectively). Left ventricle diastolic function was assessed on the basis of the mitral inflow and pulmonary veins pattern. Results: There were no differences between groups with regard to the mitral inflow parameters in the peri-implantation period or long term follow-up. In the RVA group we observed a deterioration of the pulmonary veins pattern. NT-pro BNP levels were significantly lower in the RVOT group.

	RVOT	RVA	p	RVOT-1	RVA-1	p
NT-pro BNP	428+/-430	1034+/-851	< 0,05	-	-	-
E [cm/s]	75+/-24	83+/-26	ns	77+/-34	62+/-19	ns
DTE [ms]	245+/-77	205+/-61	ns	200+/-64	207+/-69	ns
A [cm/s]	80+/-11	89+/-13	ns	73+/-26	76+/-35	ns
IVRT [ms]	104+/-17	99+/-14	ns	103+/-19	97+/-14	ns
VTI-S [cm]	17+/-6	13+/-4	< 0,1	-	-	-
VTI-D [cm]	9+/-3	12+/-5	< 0,1	-	-	-
A dur-p [ms]	112+/-18	136+/-26	= 0,1	-	-	-
d A dur [ms]	41+/-24	19+/-29	ns	-	-	-

NT-pro BNP [pg/ml]; RVOT-1, RVA-1 - parameters within 1 month after implantation; E - early mitral, A- atrial filling velocity; DTE - E wave deceleration time; IVRT - isovolumic relaxation time; VTI-S, VTI-D - velocity time integral of the systolic and diastolic pulmonary veins inflow; A dur-p - duration of the pulmonary veins A wave; delta A dur - time difference between A wave duration at the level of the mitral and pulmonary veins.

**Conclusions:** Deterioration of the pulmonary veins pattern and higher NT-pro BNP levels observed with permanent RVA pacing suggest faster progression of left ventricular diastolic dysfunction in this group of patients.

**FACTORS INFLUENCING DIFFERENCES OF RVA & RVOT PACING HEMODYNAMIC EFFECTS**

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It was proved that right ventricular apex pacing (RVAp) deteriorates synchrony of ventricular contraction and decreases cardiac performance. Right ventricular outflow tract pacing (RVOTp) is a more favorable pacing option due to better sequence of ventricular activation. The aim of the study was to compare acute hemodynamic effects of RVAp and RVOTp and to find the predictors of differences between those two modes. Methods: In 51 pts, at implantation of pacing system, cardiac performance was evaluated during RVAp and RVOTp by means of impedance cardiography (BioZ.com; Cardiodynamics). Indices of contractility: Acceleration Index (ACI), Velocity Index (VI) and Cardiac Index (CI) were determined as well as the LV ejection time (LVET) and pre-ejection period (PEP). The measurements in 3 min periods were collected and averaged, after the adaptation period of 5 min. Results. In 65% of pts RVOTp showed to be more favourable than RVAp. The difference of CI after replacement of RVA to RVOTp was dependent on cardiac contractility during RVA pacing (CI: r=-0,48 p<0,001; PEP: r=0,27 p=0,052, LVET: r=-0,34 p=0,02; VI: r=-0,29 p=0,04) and ECHO parameters as LVEF (r=-0,36 p=0,02) and LVPWd (r=0,40 p=0,01). The differences did not correlated with RVA paced QRS duration and with change of axis deviation after RVAp to RVOTp change. Multivariate analysis showed that only CI during RVAp was the independent factor influencing RVAp-RVOTp differences of CI. Conclusions: RVOTp provide significantly higher cardiac performance than standard RVAp. The acute positive effect of RVOT vs RVA pacing is more visible in insufficient hearts. RVOTp should be considered as an alternative for patients with impaired cardiac performance (without CRT indications).

**MITRAL REGURGITATION IN RIGHT VENTRICULAR PACING**

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The aim of this study was to investigate the incidence of mitral regurgitation (MR) due to the right ventricular apical pacing (RVAP). Patients (pts) implanted with definitive pacemaker (pm) for bradyarrhythmias underwent an echocardiographic examination. We studied 120 pts with VVI(R) pm programmed at rate 70 beats/min and 30 pts with DDD(R) pm with AV delay of 150ms. The time from implantation pm to exzamination was 4.5 ± 2.1 yrs. Age, RR interval and left ventricular size were similar in the two groups. The incidence of significant MR was 46 (38%) in group with VVI pm and 12(40%) in group with DDD pm. There were no statistical significant difference between the incidence of MR. No significant difference appeared in the distribution of the degree of MR between VVI and DDD pm group: MR 2+ 41(34%) vs 11(37%) and MR 3+ 5(4%) vs 1(3%). In conclusion despite the maintenance of normal AV synchrony (DDD) the pathway of ventricular depolarization resulted a critical determinant for normal mitral valve function.

**A 10-YEAR EXPERIENCE ON 1073 PATIENTS FITTED WITH 4 MM<sup>2</sup> ATRIAL PACING LEADS**

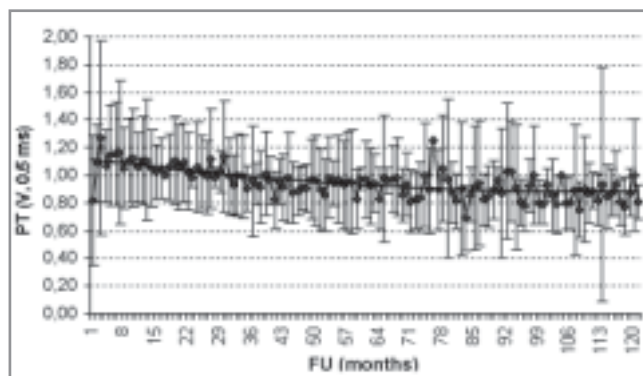
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We report our experience on 10 years concerning screw-in bipolar atrial pacing leads using vitreous carbon tip-electrodes of 4 mm<sup>2</sup> (BS45 and BS45D, ELA Medical, France). We implanted and followed 1073 patients in our institution

(51.9% males, mean age 79±10 years, main pacing indication sick sinus syndrome in 42% of patients and AV block in 58%).

Acute measurements	Mean±STD, median
P-wave (mV)	5.2 ± 3.6, 4.0
Slew rate (V/s)	0.9 ± 1.8, 0.5
Pacing impedance (S)	563 ± 121, 548
Polarization losses (mV)	231 ± 76, 200
Pacing threshold (PT, V, at 0,5 ms)	0.82 ± 0.47, 0.70
Pacing threshold (mA, at 0,5 ms)	1.39 ± 0.86, 1.20

The following figure presents the pacing threshold curves obtained with these leads during follow-up (FU) at 0.5 pulse width, month per month:



We measured a pacing impedance of 536±117 Σ during FU.

**Conclusions.** Our experience confirms that BS45 leads present a long-term chronic PT below 1.1 volt, and a pacing impedance exceeding 500 ohms.

### ACUTE PERFORMANCE AND QUALITATIVE EVALUATION OF A NEW PASSIVE LEAD FAMILY

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The aim of this multicenter register was to evaluate the acute performance of ISOFLEX S passive leads.

**METHOD:** 262 patients (mean age: 79 ± 10 years old) were implanted with an ISOFLEX lead in atrial or ventricular cavity, with passive fixation and silicone insulation coated with FastPass.

Implant side was left side for 34,4% patients, and right side for 64%. Lead insertion was through cephalic vein in 37% of patients, and subclavian vein for 62% (remaining 1% through jugular vein).

Lead electrical characteristics were measured at implant, and a qualitative questionnaire was submitted to the physicians to evaluate the handling of the lead.

**RESULTS:**

	UNI	BI
<b>Ventricular leads</b>		
Threshold	0,38	0,40
Impedance	696,9	685,1
R wave	13,0	11,7
<b>Atrial leads</b>		
Threshold	0,4	0,5
Impedance	373	480
P wave	3,0	4,3

Mean implant time for the lead was 4,8 min, which was quoted 'fast' for 57% of physicians, and 'normal' for 32% of them.

Maniability and X-Ray visibility of the leads were very appreciated by most physicians: respectively 61% and 55% of physicians quoted it as 'excellent', and 38% and 44% quoted it as 'rather good'.

**CONCLUSION:** ISOFLEX S leads provide excellent electrical performances and high quality handling characteristics.

### SUCCESSFUL IMPLANTATION OF ENDOVENOUS PACING SYSTEM IN A CHILD WITH RARE CONGENITAL HEART DISEASE

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Endovenous pacing is a method of choice also in children after surgical correction of congenital heart disease, but sometimes can pose a challenge because of patient size and surgically changed anatomy. We report on a boy, born in 1995, who underwent 7 surgical corrections and 6 catheterizations because of unusual congenital heart malformation: corrected transposition of great vessels in dextrocardia, but with normal abdominal finding, VSD, patent foramen ovale, pulmonary atresia with hypoplastic arteries and multiple aortopulmonary collaterals. After making a central aortopulmonary shunt, R and L Blalock-Taussig shunt, Senning procedure was done, VSD was closed through morphological RV, and morphological LV was connected with aorta, Blalock Rshunt was closed and both pulmonary arteries widened, also Rastelli procedure was done: a graft was implanted between RV and reconstructed bifurcation of pulmonary arteries (with implantation of Hancock valve 18 mm). A VVIR pacemaker was implanted epicardially, but after exhaustion of generator, a new pacing system, endovenous one was successfully implanted 1,5 year ago with excellent acute and chronic pacing parameters: R potential is 27 mV, pacing threshold 0,5V@0,40ms, and the endocardial lead was placed through Senning tunnel into the morphological RV!

### LONG TERM FOLLOW-UP OF ATRIAL LEADS WITH SHORT TIP-TO-RING SPACING: COMPARISON WITH STANDARD LEADS

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Reliable atrial sensing is a prerequisite for accurate device derived diagnostics and for the delivery of appropriate pacing therapies. Oversensing of far-field R-waves (FFRW) or myopotentials produces artefact that can reduce this reliability. Atrial electrodes with short tip-to-ring spacing reduce the incidence of FFRW oversensing. We present a long term follow-up of patients implanted with a pacing lead (Crystalline, Vitatron BV, The Netherlands) with this characteristic. Fifteen patients were included in a clinical evaluation of this lead between March and August 2000. Satisfactory performance of the lead both in general terms and in facilitating the rejection of artefact by pacemaker diagnostic software was confirmed. Subsequently, two patients suffered early atrial lead displacement requiring replacement with standard leads. Three patients have died and two have refused further investigation. The remaining eight patients have been followed up at a mean of 52 months after implant. FFRW oversensing could be demonstrated at maximum sensitivity settings in two (25%) of these patients, but not at normal pacemaker settings. Other lead parameters (threshold, impedance and sensed P-wave amplitude) were all satisfactory. In a control group with standard atrial leads, FFRW oversensing occurred in 40% of patients at maximum sensitivity settings and in a proportion of these at normal settings. Myopotential oversensing did not occur in either group of patients.

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**Conclusions:**

1. The Vitatron Crystalline lead continues to perform satisfactorily in the long term.
2. In this sample, a trend towards an advantage with short tip-to-ring spacing has been demonstrated. A larger sample size is needed to confirm these findings and to assess clinical relevance.

**LEAD BODY ANCHORING BY ABSORBABLE SUTURE: NEW CONCEPTUAL APPROACH IN CHILDREN**

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The position of a transvenous lead should be secured using suture sleeves to prevent dislodgement or migration. Manufacturers do advise to anchor the lead body by heavy non-absorbable suture at the venous entry site. However, there are well-known negative effects of child growth on lead length. We have developed a new method to avoid overstretching of the lead and potential damage of its insulation, coil or both. Actually it means a temporary anchoring of the lead body by absorbable suture (Dexon). Progressive loss of tensile strength and eventual absorption occur between 60-90 days post implantation. Simultaneously, fibrotic process will result in entanglement of the extravascular lead loops placed under the pacemaker. It is anticipated that released lead will finally be integrated into the process determined by the growing patient eventually ensuring long-term pacemaker lead function.

**Material and methods.** There were 2 primary implantations of VVIR and DDDR bipolar pacing systems in 2 children, 13 and 16 years old respectively. Endocardial leads were secured by absorbable sutures at the venous entry site. Protective suture sleeves were used in accordance with the instructions of the manufacturer.

**Results.** Within the last 4-5 months postoperatively cardiac pacing has been effective, patients are doing well. X-ray control has revealed no abnormalities in leads position.

**Conclusions:** 1. Complete absorption of the ligature hopefully will result in loosening of the lead at the anchored point within 2-3 months. 2. It will allow the lead to slide slightly inside the sleeve with gradual intravascular intussusception. 3. It is expected that the lead will automatically readjust in length. 4. Long-term observation is needed to verify the validity of this concept.

**FOLLOW-UP OF THE CHAGASIC DISEASE PATIENTS WITH AICD DEVICES**

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**Background:** the pathogenesis of chronic chagasic myocarditis remains incompletely understood. It is related to progressive and additive focal cellular necrosis and associated reactive myocardial fibrosis and surrounding myocytes hypertrophy. This could imply future therapeutic strategies in the management of chronic chagasic patients to optimize the medical treatment and hopefully improve the prognosis.

**Methods:** The study comprises 26 chagasic patients who underwent implant of AICD (Medtronic, Inc): 19 male, age between 27 and 70 years of old (average 49,6), 19 patients were survivors of sudden death (SD) and 8 had symptomatic ventricular tachycardias that were refractory to drug therapy. All these patients had AICD or shocks. The mean acute defibrillating thresholds were 5 joules. One patient died 3 months after implantation because refractory heart failure.

**Conclusion:** The analysis of the results shows that the AICD are safe devices, with no surgical mortality, effective in arrhythmic reversion and reduction of episodes of sudden death.

Chagasic patients had low defibrillating thresholds and more ATP the therapies.

**FOLLOW-UP PROGRAM: LIFE QUALITY AFTER AICD IMPLANTATION**

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**Background:** The development of the automatic implantable defibrillator has added a strongly to the therapeutic arsenal used to treat malignant ventricular arrhythmia. The survival rate of the patients with AICD (Medtronic, Inc) has been reported between 60 to 95% for follow-up ranging from 1 to 5 years.

**Methods:** Despite the severity of episodes experienced by survivors of sudden death, most of the patients fears and fantasies. Because of this an individual or group psychotherapeutic program was created aiming at giving the patients better quality of life and real possibilities of survival.

**Conclusion:** Once the ventricular function (which has been one of the greatest factors limiting the physical activity of such patients) allows them to, the patients have resumed their professional and leisure activities.

The feedback provided by the patients and their relatives who were involved in the program has been more and more positive, making us sure that the follow-up is something indispensable when you think of the patient.

**INTERDISCIPLINARITY PROGRAM: LIFE QUALITY EVALUATION IN DEFIBRILATOR (MEDTRONIC, INC)**

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The development of the automatic implantable defibrillator has added a strongly to the therapeutic arsenal used to treat malignant ventricular arrhythmia. The survival rate of the patients with defibrillator has been reported between 60 to 95% for follow-up ranging from 01 to 05 years.

Despite the severity of episodes experienced by survivors of sudden death, most of the patients are afraid of the equipment's not working when it is necessary, while other patients are afraid of the equipment's own discharging.

The interdisciplinarity counseling of such patients has become even more evident due to patients' fears and fantasies. Because of this an individual or group psychotherapeutic program was created aiming at giving the patients better quality of life and real possibilities of survival.

Once the ventricular function (which has been one of the greatest factors limiting the physical activity of such patients) allows them to, the patients have resumed their professional and leisure activities.

The feedback provided by the patients and their relatives who were involved in the program has been more and more positive, making us sure that the interdisciplinarity is something indispensable when you think of the patient.



## METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS INFECTION OF IMPLANTABLE ANTIARRHYTHMIC DEVICE

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**Background.** The Methicillin resistant Staphylococcus aureus (MRSA) infection of implantable antiarrhythmic devices, pacemaker (PM) and implantable cardioverter defibrillator (ICD), is a devastating event. But fully examination was not done.

**Method.** From January 1, 1991, through December 31, 2003, 2091 implantable antiarrhythmic devices (1726 PMs, 365 ICDs) were implanted at Tokyo Women's Medical University Hospital, Cardiology Division. All device-related infections were examined retrospectively.

**Results.** Fifteen patients (0.7%) had explantation of their device (9 PMs and 6 ICDs) because of infection, involving 10 male and 6 female patients with mean age of 60 years (range, 30 to 85 years). The blood or pocket cultures were positive in 10 patients, and 6 patients were MRSA infection. The days from implantation of the device to emergence of the sign of infection were significantly shorter in MRSA infection group than that of the other pathogen group (9.8+/-7.5 vs. 171+/-71days, p=0.02). and the mean age of patients tend to be elder in MRSA group (65.8+/-15.9 vs. 47.3+/-11.7years, p=0.06). In all four patients undergone nasal examination, MRSA was found in nasal sample, therefore they were thought to be nasal carriage of MRSA. The device and all lead material were completely removed in 4 of 6 patients. 2 patients did not have removal of all hardware. They were received vancomycin or aminoglycoside antibiotics, and all patients healed. Relapse occurred in no patient during follow-up period.

**Conclusion.** There were high risk group in MRSA device infection, such as elder patients or nasal carriage. In MRSA infection, prompt explantation and proper antibacterial therapy was essential same as other bacterial infection.

## LOST IN INTERROGATION: A STORY OF PM WITH HOLTER FUNCTION

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Most of the pacemakers currently implanted are provided with holter functions for identification and recognition of paroxysmal arrhythmias, allowing an endocardial recording of the episode. Although these functions are easy to activate, often they are underutilized in clinical practice.

We present the case of a 64 years old man, who has experienced an episode of paroxysmal atrial fibrillation, followed by a significant asystolic pause, during the acute phase of an AMI.

Since the patient complained of dizziness, suspecting a brady-tachy syndrome, we decided to implant a dual chamber pacemaker (SJM Inc., Identity DR 5370 pacemaker); AF suppression algorithm and endocavitary recording triggered by auto mode switch were activated.

The systolic function estimated by ventriculography was normal. Ten months after the implantation he experienced a syncopal episode at rest.

He was admitted to the hospital a few hours after the episode. At the pacemaker interrogation, an episode of auto mode switch, triggered by atrial frequency superior to 150 bpm, was recorded at the same time of the syncopal event.

The endocavitary recording stored in the device memory showed that the elevated atrial frequency was due to retrograde conduction of a fast ventricular tachycardia (250 bpm), most probably responsible for the loss of consciousness.

Finding of a syncopal ventricular arrhythmia forced us to modify the diagnosis, upgrading the device by implanting an ICD (SJM Inc., Epic + DR V-236).

By chance a serious arrhythmia which could have been very dangerous for the patient was discovered and this gave us the possibility to set the appropriate therapy.

The ability of the pacemaker to record endocardial cardiac activity during tachyarrhythmias permitted us the correct diagnosis.

For this reason we recommend a careful setting of EGM monitoring functions immediately after a pacemaker implantation, since they may provide information of paramount importance about occurrence of tachyarrhythmias in the followup.

## PACEMAKER LONGEVITY DETERMINES EXCHANGE RATE - IMPLICATIONS FROM THE AVUS REGISTRY

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**Introduction:** Ideal pacemakers should have a service time just outlasting the patients lifetime. As the lifetime is depending on age, gender, and health-conditions, devices with longer than individual service times under all circumstances are unrealistic and uneconomical. Therefore, longevity must be oriented on the statistical survival of the pacemakerpatient population which differs from country to country. In Germany the exchange rate (ratio depleted to implanted pacemakers) is 21.9%, with a mean implant duration of the exhausted pacemakers of 8.5±4.1 years. The question remains on how long pacemakers should function under normal conditions.

**Methods:** Assuming a constant implantation rate over the last decade and an exponentially decreasing survival curve with a time constant of 5.6 years, one can calculate the relation between pacemaker service time and exchange rate.

**Results:** Mean service time calculations of pacemakers of all modes and exchange rates based on the German Annual Pacemaker Report 2002 yield: Exchange rate(%)\Mean service time(years): 35\5.9;25\7.8;15\10.6;5\16.9.

**Conclusion:** Pulse generator longevity prolongation has been an important objective in artificial cardiac pacing since its beginning. After major technological advances, appropriate programming of output settings, like pulse duration and amplitude, remains one solution to extend longevity and to decrease exchange rate. Nonetheless, it is known that pacemakers are frequently never reprogrammed after implantation. Automatic adjustment of pacing output might overcome this issue. Clinical registries like AVUS (AVUS=AutoCapture\_Versus\_Unaffected\_Stimulation) aim to prove for a conventional pacemaker population whether automatic output adjustment algorithms like AutoCapture are an appropriate tool in clinical daily practice to extend service time. Furthermore AVUS registry is addressed to answer the question whether devices with AutoCapture activated show a substantial benefit compared to unaffected pacemakers in terms of safety and follow-up comfort.

## DDD AND SINGLE -LEAD VDD PACING:EVALUATION OF POSTURE, EXERCISE AND PLASMA NATRIURETIC PEPTIDE LEVELS

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**PURPOSE.** The aim of this study was to assess changes of P-wave amplitude occurring in dynamic conditions in two groups of patients

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with a single-lead VDD and with a DDD pacing system, respectively. We wanted to determine whether plasma ANP and/or BNP levels correlate with atrioventricular (AV) synchrony.

**METHODS.** Seventy-five patients with implanted VDD or DDD pacing system in year 2000 were enrolled prospectively. We directly measured sensing threshold in atrium in patients supine, sitting upright and after standardized exercise. Among measured data we evaluated AV synchrony. Blood was collected from an antecubital vein and plasma proANP(1-98) and NT-proBNP levels were measured.

**RESULTS.** Atrial sensing in patients supine, sitting upright and after exercise was significantly lower with VDD compared to DDD ( $p<0,001$ ). The difference between supine and sitting upright among each pacing system was not significant. Atrial sensing was significantly lower after exercise compared to supine with VDD compared to DDD ( $p<0,05$ ). AV synchrony was statistically lower with VDD compared to DDD ( $p<0,001$ ). Peripheral levels of ANP were lower with VDD compared to DDD but the difference was not significant. Peripheral levels of BNP were significantly lower with VDD compared to DDD ( $p<0,05$ ). Peripheral levels of ANP and AV synchrony are negatively correlated ( $r=-0,44$ ,  $p<0,001$ ). Peripheral levels of BNP and AV synchrony are also negatively correlated ( $r=-0,54$ ,  $p<0,001$ ). Peripheral levels of BNP and ANP are positively correlated ( $r=0,71$ ,  $p<0,001$ ).

**CONCLUSIONS.** Posture did not have any significant effect on reliability of atrial sensing. Exercise did affect reliability of atrial sensing with VDD pacing system. Lower AV synchrony with VDD pacing system suggests lower haemodynamic support. Peripheral levels of natriuretic peptides correlate well with AV synchrony. Therefore, haemodynamic support can be well predicted by measuring peripheral levels of either ANP or BNP.

### UNEXPLAINED PACING FAILURE IN A CASE SHOWING OVERLAPPING PHENOTYPE OF BRUGADA AND SICK SINUS SYNDROME WITH A NOVEL SCN5A MUTATION

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Mutations in SCN5A gene, encoding alpha-subunit of cardiac Na channels, cause a disease category called Na channelopathy. It has been noted to produce overlapping phenotypes such as long QT, Brugada syndrome (BS), and Progressive cardiac conduction disorder (PCCD). We experienced a case having a novel SCN5A mutation to generate the phenotypes of sick sinus (SS) and BS, and showed abrupt pacing failure in the atrium without any cause. He has a strong family history of SS and sudden death, especially his sister suffered sudden death in spite of receiving pacemaker implantation.

Sixty-eight-year-old male who had received a permanent pacemaker because of SS at age 57 was admitted because of unexplained pacing failure in atrium. Pacing threshold varied from 15V and 05msec to upper the maximum pacemaker output without cause including pacemaker malfunction. Ventricular pacing was capable in small amount of pacing output. Any manipulation did not correct pacing trouble, such as Isoproterenol infusion, change of pacing rate, and mechanical stress to lead. Finally, we tried the Predonisolone, and that stabilized the threshold. He showed Brugada type ECG only at febrile state of 40 degree, that showed AF and ST elevation in right precordial leads. Intravenous pilsicainide infusion (5mg per kg) unmasked typical ECG features of BS, and programmed RV outflow stimulation could produce ventricular fibrillation. Genetic screening for SCN5A identified an abnormal conformer in exon 27 of the pa-

tient and his elderly brother. DNA sequencing revealed that both of them contained an insertion of two nucleotides, aa at 4729. Whole-cell patch-clamp method revealed this mutation led non-functional voltage-gated Na channels. This is a rare case showing overlapping SS and BS, having a novel SCN5A mutation.

### A CASE OF CARDIOMYOPATHY WITH CONDUCTION DISTURBANCES IN EMERY-DREIFUSS MUSCULAR DYSTROPHY

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The Emery-Dreifuss muscular dystrophy (EDMD) is a hereditary syndrome associated with cardiac involvement, with diffused degeneration of cardiac system of conduction. EDMD occurs either as an X-linked disorder (XL-EDMD) or as an autosomal dominant trait (AD-EDMD), caused by mutations in the STA and LMNA genes, respectively, which both encode for nuclear envelope proteins. The patients suffering from EDMD are subject to a higher risk not only for forms of bradyarrhythmia, requiring the implantation of a pacemaker, but also for some forms of tachyarrhythmia, such as atrial fibrillation and flutter, that can also cause embolic stroke. Sudden death can be caused from a tachyarrhythmia or from a cardiac conduction block. Here is reported the case of a 62 year-old patient with a history of severe asthenia and muscular weakness, come to our observation for bradyarrhythmias with dizziness. The ECG showed marked sinus bradycardia with atrioventricular block of 1st degree (PR=400 msec). In the history, the patient revealed familiarity for arrhythmia: a genetic screening, extending to 22 members of the patients family (three sisters affected with conduction disturbances and undergone to the implant of definitive bicameral pacemaker for syncope; a brother suffering from dilatative cardiomyopathy with atrioventricular conduction disturbance and sustained ventricular tachycardia and therefore submitted to the implantation of a bicameral defibrillator) revealed an AD-EDMD. Given the patient and family history, we performed electrophysiologic study. We documented binodal dysfunction, the lower-hissian block and the non-inducibility of sustained ventricular arrhythmia and of automatic atrial or re-entry arrhythmia, indication was made for the implant of a definitive bicameral pacemaker. In conclusion, patients with EDMD show a broad spectrum of cardiac abnormalities and a high risk of cardiovascular events, including atrial fibrillation, cardioembolic stroke and sudden death. Early implant of a pacemaker is advisable when important bradyarrhythmias appear, irrespective of symptoms.

### HYPOTHETICAL CONTROL OF REFRACTORY PERIOD OF MYOCARDIUM: CONSIDERATIONS BASED ON THE PFLUGER'S LAW

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Refractory period of myocardium (RPOM) is the most important electrophysiological parameter. RPOM when properly prolonged (twofold or threefold) and controlled may result in very effective prevention of cardiac tachyarrhythmias of any origin. However, in order to control this parameter a new, preferably non-pharmacological, method is to be discovered.

Pfluger's law may appear to be one of the most realistic approaches. When controlling the electrotonicity of myocardium (EOM) by prolonged pulse of constant current (CC), it may appear that myocardium might be converted into a non-response state for the period of 70% or even greater of the cardiocycle. The control of EOM is likely

to be equivalent to the control of RPOM. This long lasting pulse will condition the muscle and will not allow any outbreaks of ectopic activity. Then, by switching off the anodal (!) pulse of the CC, cardiac response will be evoked (the muscle is much more excitable to the anodal switch off of the CC pulse compared to switch on). An appropriate amount of energy will be required to deliver very long pulses up to 60-70 per/min. An external device and batteries may be used temporarily. Finally, it may appear that a newly constructed device might replace the implantable cardioverter-defibrillator (ICD). Batteries of the ICD containing great amounts of energy might be incorporated into a new universal device.

#### Conclusions:

1. Control of RPOM is crucial in prevention of tachyarrhythmias.
2. Pfluger's law may be helpful to control both EOM and RPOM.
3. A new method, hypothetical yet, is likely to replace the ICDs due to its universal capabilities with simultaneous control of the RPOM and pacing.
4. A new method, if successful, will require significant energy consumption.

### TOWARD NEW THERAPY: STRATEGIC PHILOSOPHY TO REVITALIZE FUTURE DEVELOPMENTS OF PREVENTIVE TOOLS

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Cardiac arrhythmias (CA's) remain one of the most serious challenges worldwide. They are accompanied by pulse irregularity, life threatening haemodynamic collapse and functional disarrangement of the whole cardiovascular system (CVS). **Material and Methods.** As a result of literature study, we have revealed a number of negative side effects of currently applied therapies: recurrence of arrhythmias, proarrhythmias, shocking, inability to control or prevent some CA's, etc. Haemodynamic state of the patient depends on the rhythm, rate, state of myocardium and the compensatory mechanisms. Slow rates are accompanied by high systolic pressure and high stroke volume, but low cardiac output. High rates produce opposite consequences. Mixed rates, i.e. brady-tachyarrhythmias evoke disharmony in CVS response. Long R-R interval commits the CVS to function under bradycardia conditions. However, the following short R-R interval alarms the CVS to reset its adaptive mechanisms to the tachycardia status. Long-term non-physiologic state finally leads to devastating imbalance of CVS. **Results.** These seemingly well-known findings evoked new conceptual approach to CA's. Refractory period of the myocardium (RPM) is the most important electrophysiological parameter which must be artificially (preferably non pharmacologically) influenced -prolonged and controlled. Desired RPM presumably could cover up to 70% of cardiocycle; end stage of cardiocycle could be left for the recovery of cardiac excitability to allow its intrinsic or paced activity. Moderate regulation of heart rate via RPM control is likely to prevent CA's of every origin. **Conclusions.** 1. The duration of RPM is to be effectively controlled within the cardiocycle. 2. Development of reliable, easily controlled and safe method of RPM regulation is desirable. 3. Such a fundamental approach presumably could lead to creation of a universal cardioprotective tool.

### LONG TERM PROGNOSTIC VALUE OF ELECTROPHYSIOLOGIC STUDY AFTER MYOCARDIAL INFARCTION: A TEN YEARS FOLLOW-UP STUDY

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**Purpose:** evaluate the long-term prognostic power of inducible sus-

tained ventricular tachycardia (VT) at an electrophysiologic study (EPS) performed 1 month after myocardial infarction (MI).

**Methods:** We evaluated the clinical outcome of 47 post-MI patients (mean age 58±7 years, male gender 89%, anterior myocardial infarction 66%, thrombolysis treatment 41%, LVEF<0.40 77%, presence of ventricular late potentials 68%, Lown 4A-B 70%) who underwent an EPS because of high arrhythmic risk at non-invasive evaluation. The test was considered positive when sustained monomorphic VT was induced.

**Results:** at 9.5±2.8 years follow-up, 12 (27%) cardiac deaths (sudden in 3 cases), 7 (16%) non cardiac deaths, 7 (16%) non fatal sustained ventricular tachyarrhythmias, and 5 (11%) deaths for unknown causes were recorded. Univariate analysis (referring to the 39 patients with known events) indicated that inducibility of sustained monomorphic VT was significantly different among patients with and without cardiac death (67% vs 26%, p=0.02) as in patients with and without arrhythmic events (90% vs 24%, p=0.001). Multivariate Cox regression analysis showed that only LVEF maintained a significant prognostic power. No significant relationship was found between EPS result and all cause mortality.

**Conclusion:** post-MI patients with high arrhythmic non-invasive risk profile and inducible sustained monomorphic VT have a poor cardiac prognosis, but in long-term follow-up only LVEF may be considered a significant predictor of adverse outcome.

### ECG PATTERN OF T WAVE ALTERNANS IN POST AMI PATIENTS

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It has been suggested that presence of microvolt T wave alternans (MTWA) is associated with left ventricular electrical remodeling.

**Methods and results:** MTWA assessment was done in 52 patients, left ventricular ejection fraction (LVEF) > 40%, 8 to 12 weeks after acute myocardial infarction (AMI). 4 patients had ischaemic MTWA. In the remaining 48 patients, MTWA was positive in 35% (n= 17), negative in 48% (n=23) and indeterminate in 17% (n=8) cases. Analysis of spatial distribution of alternans showed that precordial leads V2,V3,V4 presented the maximum level of sustained MTWA in 80% of cases with anterior infarction and in 70% of patients with inferior infarction (p= ns).

**Conclusion:** Spatial distribution of MTWA is independent of initial localization of myocardial necrosis. In the absence of residual myocardial ischaemia, a positive MTWA test after AMI is, probably, associated with left ventricular electrical remodeling.

### REPRODUCIBILITY OF T WAVE ALTERNANS IN POST AMI PATIENTS

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Microvolt T wave alternans (MTWA) is used for the assesment of risk of Sudden Cardiac Death (SCD).

In 20 post acute myocardial infarction (AMI) patients, onset heart rate, spatial distribution and magnitude of MTWA was analyzed during exercise and pacing in two consecutive days. Medium onset heart rate was 95 b/min during exercise and 97 b/min during pacing. Medium magnitude of MTWA was 6,9 microvolt at exercise and 6,4 microvolt at pacing. In 90% of patients, the magnitude of MTWA was greater during exercise than during pacing. Spatial distribution of MTWA was concordant in 90% of patients.

**Conclusion:** In post AMI patients, onset heart rate and spatial distri-



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bution of MTWA were reproducible during consecutive days, in 90% of patients. Magnitude of MTWA was greater during exercise than during pacing. It appears that exercise MTWA assessment is the method of choice for screening the risk of SCD.

### LONG TERM PROGNOSTIC VALUE OF NONINVASIVE TESTS AFTER MYOCARDIAL INFARCTION: A TEN YEARS FOLLOW-UP STUDY

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**Purpose:** to define the long term predictive power of noninvasive arrhythmic risk indicators performed shortly (within 30 days) after myocardial infarction (MI).

**Methods:** 223 post-MI patients (54±8 years; male 86%; anterior MI 49%; left ventricular ejection fraction (LVEF) 48±9%) were subjected to non-invasive arrhythmic risk stratification and telephonic follow-up.

**Results:** after 11.7±2 years follow-up, 23 (10%) cardiac deaths, 20 (9%) non-cardiac deaths, and 8 (4%) deaths of unknown cause were recorded. Among cardiac deaths, 7 (39%) were sudden, 8 (35%) were due to congestive heart failure, and 8 (35%) were due to recurrent acute MI. Sixteen (7%) patients had a non-lethal arrhythmic event. Univariate and multivariate Cox regression analysis were performed for all predefined end-points (all death mortality, cardiac death, arrhythmic events). Independent prognostic markers of total mortality were age (p=0.009), LVEF (p=0.01), and unsustained ventricular tachycardia (p=0.025); independent prognostic markers of cardiac death were LVEF (p=0.01) and subacute sustained ventricular tachycardia (p=0.022); independent prognostic markers of arrhythmic events were subacute sustained ventricular tachycardia (p=0.01), LVEF (p=0.016) and mean cardiac cycle (p=0.02).

**Conclusion:** although some clinical variables have prognostic significance in long-term follow-up after MI, only LVEF can predict all end-points considered, suggesting that prognostic stratification of arrhythmic risk after MI must set off LVEF and clinical data.

### ELECTROANATOMICAL MAPPING OF ARRHYTHMOGENIC SUBSTRATE FOR VENTRICULAR TACHYARRHYTHMIAS IN PATIENTS AFTER CORRECTION OF CONGENITAL HEART DISEASE

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**Introduction:** Patients after correction of congenital heart disease have a higher risk of sudden cardiac death. Scar tissue after surgical procedure provides complex arrhythmogenic substrate for reentrant ventricular tachyarrhythmias (VTs). Our aim was to report the utility of electroanatomical mapping system in characterization of the arrhythmogenic substrate and identification of potential sites for successful catheter ablation

**Methods:** Electroanatomical mapping system (CARTO, Biosense Webster) was used to obtain voltage maps of both ventricles in 5 patients (2 women, mean age 34years) after correction of congenital heart disease (tetralogy of Fallot n=3, pulmonary atresia n=2) with documented monomorphic VT. Detail mapping of low voltage areas was deployed during sinus rhythm in order to identify anatomical barriers, dense scars and zones of slow conduction. Subsequently, catheter radiofrequency ablation was performed in order to abolish all inducible VTs.

**Results:** In all patients was noted extensive scar area on the right ventricular free wall that corresponded to the type of corrective surgery. Critical isthmuses of slow conduction were localized individu-

ally in the borderzone of the scar area. The mean procedural time was 323min and fluoroscopic exposure 7,5min. No significant complications were noted during the procedure. Abolition of all VTs was accomplished in 3 patients (60%), remaining 2 patients were implanted with cardioverter-defibrillator.

**Conclusion:** Despite complex anatomy in patients after surgical correction of congenital heart disease the electroanatomical mapping allows detail characterization of the arrhythmogenic substrate and identification of target areas for catheter ablation.

### CREBROCARDIOGRAPHY IN THE EARLY DIAGNOSIS OF CARDIOVASCULAR DISEASES

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CKG is already introduced in experimental settings to evaluate and to detect coronary artery diseases, left ventricular hypertrophy, arrhythmias and many other cardiac pathologic conditions. Electrocardiographic ultraphase analysis uses statistical tools as Fast Fourier Transform to analyze the traditional electrocardiographic signal and to display, using an expert system (CUPID®), the typical CKG output derivations: Coherence, Cross-correlation, Phase Shift and Impulse Response. This complex computation permits to obtain information about the coronary blood flow, the arrhythmical status and the cardiac global performance, especially in preclinical conditions or in absence of typical symptoms. As for the early diagnosis of left ventricular hypertrophy, preliminary CKG data show better sensitivity with respect to traditional ECG point score system, acceptable sensitivity in the evaluation of coronary artery flow abnormalities, good detection in pre-arrhythmical status, also in subjects with normal sinus rhythm. 12-leads power spectra are furnished by CKG with typical patterns in only 88 seconds of acquisition time and provide the cardiac energetic spectrum based on series of harmonic waves, the first representing heart rate.

The applied technology named ECG multiphase information (EMPI) or cardiac ultraphase information diagnosis (CUPID®) shows relevant clinical diagnostic capabilities of frequency-domain analysis with diagnostic accuracy

### USE OF THE LIFESHIRT SYSTEM IN MONITORING TILTING TEST

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**INTRODUCTION:** Syncope is a spy symptom of various pathologies, from vasovagal to those who recognize an organic substrate. During tilting-test is important the monitoring of different parameters to supervise the patients in order to better individualize the type of syncope according to VASIS classification. LifeShirt of VivoMetrics is a new method to record and analyze neurovegetative parameters of patient.

**AIM:** To verify the usefulness of LifeShirt in monitoring during tilting-test.

**METHODS:** We enrolled 10 patients who underwent tilting-test to evaluate the presence of a syncope. During the tilting-test, each patient was asked to wear a shirt designed to record different parameters as: current volume (Vt), expiratory current Volume (Ve), inspiratory current Volume (Vi), heart rate (HR), O2 saturation (SaO2), respiratory rate (B/M) and ECG trace. All data were recorded by a card and analyzed with the suitable software.

**RESULTS:** Four of the 10 patients resulted positive for a heart-inhibitory syncope and presented the following parameters during the



period of heart-inhibition: Vt:  $30,5 \pm 1,3$  L, Vi:  $200 \pm 25$  mL, Ve:  $400 \pm 30$  mL, HR:  $9 \pm 1$  bpm, B/M:  $10 \pm 2$ . After the recovering of the sinus rhythm the parameters were: Vt:  $31,7 \pm 1,5$  L, Vi:  $70 \pm 12$  mL, Ve:  $500 \pm 22$  mL, HR:  $38 \pm 10$  bpm, B/M:  $18 \pm 2$ . The ECG trace recorded during the tilting test with the shirt allowed to quantify precisely the time of brady-asytote.

**CONCLUSIONS:** The LifeShirt allowed us to monitor the vital functions of the patient during the tilting-test, correlating the ECG changes, the respiratory volumes and O<sub>2</sub> saturation to the presence of syncope. All these data can provide information that help us to better identify the type of syncope, reducing the presence of negative false results.

### HAND GRIP AND ARM TESTING FOR SYNCOPE I AND III (VASIS) TREATMENT: EFFICACY AND RESULTS DURING FOLLOW-UP

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**INTRODUCTION:** Syncope can be classified, according to the Vasis classification, in type I, mixed, with presence of decreases of blood pressure and of heart rate, type II, heart-inhibitory, if present a asystole >3 sec or marked bradycardia (< 40 bpm) more than 10 sec or type III when there is only decrease of blood pressure. In type I and III syncope drug treatment has demonstrated insufficient happening. Recently it has been showed as the execution of manoeuvres of counter-pressure like hand grip and arm testing can produce an increase of the blood pressure reducing symptoms.

**AIM:** To estimate the effectiveness of the hand grip and arm testing in patients affected with type I and III syncope.

**METHODS:** We have enrolled 40 patients, with diagnosis of type I (28 pts) or III (12 pts) syncope at tilting test, training them at arm tensing and handgrip. Patients were divided in two groups according the duration of premonitory symptoms: 30-60 sec and > 60 sec. Every 3 months patients answered to the following questionnaire: duration of symptoms, if happened syncope, manoeuvres preferred and if an improvement of the symptoms had been produced.

**RESULTS:** In a 18 months follow-up 6 drop-out, 4 for lacked compliance, 1 for death or other cause, 1 for acute coronary syndrome. Manoeuvres have been effective in 97% of the patients, reducing symptoms and extending the premonitory symptoms, reducing the occurrence of syncope in 83% of the patients with type III syncope and the number of episodes in 55% of the patients with type I syncope.

**CONCLUSIONS:** The arm tensing and handgrip manoeuvres are effective in improving the symptoms of patients with type I and III syncope, effectively reducing also the number of the episodes, in particular for type III syncope.

### INTRAATRIAL CONDUCTION TIME IN COMPLETE ISTHIMICAL BLOCK

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**Aim:** The linear ablation of the isthmus between inferior vena cava (IVC) or Eustachion valve (EV) and tricuspid annulus (TC) is the treatment of choice in the typical atrial flutter.

The presence of double potentials (defined as split potentials separated by an interval of = 30 msec, registered along the line of lesion, are primary criteria of complete block. It is debatable whether the complete isthimal block can coexist with the presence of triple po-

tentials or fractioned electrograms. This paper means to verify if the analysis of the intraatrial conduction time could be of some help in clarifying this point.

**Material and method:** We examined 58 pts, 35 males (60%) and 23 females (40%) with a mean age of  $62 \pm 14$  years, we were treated with linear ablation of the isthmus TC - IVC or TC - EV with a complete isthimal block. They were divided in two groups according to the presence along the line of lesion of double (group 1) or the triple or fragmented potentials (group 2). The sequence of clockwise and counterclockwise activation was observed before and after ablation during pacing from the lower lateral atrial wall (LLA) and from the coronary sinus os (C.SOS). Moreover the LLA - CSOS and His - CSOS conduction times during pacing from LLA, and CSOS-LLA and His-LLA during pacing from CSOS were calculated. These data from the group 1 patients were compared with those from the groups 2.

**Results:** During the pacing from LLA the LLA - CSOS and HIS-CSOS intervals did not show any significant difference between the two groups (P=NS). During pacing from CSOS, CSOS- LLA and HIS-LLA intervals did not show any significant difference (P=NS).

**Conclusion:** The occurring of identical conduction time in patients with double (group 1) or fragmented potentials (group 2) suggest that the complete isthimal block can co-exist with the presence, along the line of lesion, of triple or fractioned potentials. They do not necessarily indicate a slowed down conduction gap.

### EFFECTIVENESS OF CATHETER ABLATION FOR SVT IN ATHLETES RESUMING COMPETITIVE SPORTS

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**Background.** Sustained supraventricular tachycardias (SVT) in competitive athletes may be associated with severe symptoms or cause hemodynamic collapse and require definitive treatment. In this setting, radiofrequency ablation is curative and may be the preferred initial approach.

**Study objective.** To evaluate the resumption of athletic activity in competitive athletes disqualified because of SVT, who underwent successful catheter ablation.

**Methods.** Data from 1992 to 2002, relative to competitive athletes referred to our Centre and treated with catheter ablation for SVT, were retrospectively evaluated. Usually, both the diagnosis and the catheter ablation procedure were accomplished in a single session, after the identification of the site of origin of the arrhythmia. Moreover, all patients underwent non-invasive and when requested invasive cardiac screening to detect structural heart disease. Follow-up was focused on the resumption of competitive sports.

**Results.** Fifty-seven symptomatic athletes (33 male; mean age  $27 \pm 8.5$  years) excluded from competitive sports were treated. The arrhythmic diagnosis was: 1) AV nodal reentrant tachycardia in 19 (33.3%); 2) AV reentrant tachycardia in 34 (59.7%), with a manifest accessory pathway in 26 (76.4%); 3) common atrial flutter in 2 (3.5%); and automatic atrial tachycardia in 2 (3.5%) cases.

The catheter ablation procedure was successful in all cases. In 3 (5.3%) subjects, a mild cardiomyopathy was detected. The 54 athletes without structural heart disease and successful ablation were subsequently allowed to resume active sport practice. During follow-up none of them had recurrence of arrhythmia or any event during activity.

**Conclusions.** Our data confirm the current recommendations that allow resumption of all competitive sports in athletes after successful catheter ablation for SVT, regardless of the mechanism of the arrhythmia.

## THE TREATMENT OF ATRIAL FIBRILLATION USING RADIOFREQUENCY MAZE PROCEDURE – HEART RHYTHM DURING FOLLOW UP

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Creation of linear lesions in the left atrium has been suggested as a therapeutic option for patients (pts) indicated for cardiac surgery for valvular heart disease or coronary artery disease (CAD) and concomitant atrial fibrillation (AF).

The aim of the study was to analyze heart rhythm during FU in the group of pts treated by radiofrequency (RF) maze procedure used in our institution.

**Methods:** Since August 2000 till August 2004, 248 pts (105 female, mean age 67,5 years, range 25- 84 yrs) with chronic or paroxysmal AF were indicated for heart surgery with RF maze procedure. Contiguous left atrial lesion lines between the mitral annulus and the pulmonary veins were created by RF energy (MAZEPEN, Medtronic Inc) before valve surgery or coronary artery bypass grafting. Pts were divided according to underlying heart disease: group I (mitral valve disease) - 74 pts, group II (CAD in combination with aortic valve disease or ischemic mitral valve disease) - 127 pts and group III (CAD) - 47 pts.

**Results:** Eight pts died in the early postoperative period, no complications related to the ablation procedure were observed. Three pts had transitory cerebral attack, cardiac pacemaker was implanted in another eleven cases. RF catheter ablation because of symptomatic atrial tachycardia was performed in five pts during FU. Sinus rhythm was present at discharge in 66%, 64%, 69%, at 3months of FU 54%, 53%, 76%, at 6months of FU 71%, 62%, 72%, at 12months of FU 66%, 64%, 60% pts and at 24months of FU 60%, 75%, 67% in groups I, II, III, respectively.

**Conclusions:** Intraoperative RF ablation in the left atrium seems to be an effective and safe method for the treatment of AF that results in long-term restoration of sinus rhythm in at least 60% pts with previous chronic or persistent AF.

## TREATMENT OF ATRIAL FIBRILLATION IN PATIENTS WITH MITRAL VALVE DISEASE USING ENDOCARDIAL ABLATION

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**Background:** Some patients (pts) after mitral valve replacement does not improve functionally, because of concomitant atrial fibrillation (AF). The purpose of this study was to assess the efficacy of radiofrequency endocardial ablation in pts with chronic mitral valve disease.

**Material and methods:** Our study involved 16 pts (9 female and 7 male) at the age of 56+5 years. The primary indication for surgery was isolated mitral stenosis (n=4), mitral regurgitation (n=5) or complex mitral valve disease (n=7). All pts were operated with the use of cardiopulmonary bypass. After left atrium was opened, endocardial radiofrequency ablation was applied according to modified Maze technique (Cardioablate, Medtronic Inc., Minnesota, USA), then mitral valve surgery was performed.

**Results:** All pts survived operation. Application time of ablation was 7.38+3.12 minutes. Four pts (25.0%) were referred from the operating room to the intensive care unit in sinus rhythm, 1 pt (6.3%) with AF and 11 pts (68.7%) required temporary external pacing. At the time of release from hospital, 11 pts (68.7%) were in sinus rhythm, 5 pts (31.3%) had AF and required antiarrhythmic drugs. Three months after operation 10 pts (62.5%) stayed in sinus rhythm.

**Conclusion:** The preliminary results of surgical treatment of AF in

patients with chronic mitral valve disease are promising. More cases and longer follow up is necessary to prove the efficacy of this therapeutic method.

## FACTORS CONTRIBUTING EFFECTIVENESS OF CIRCUMFERENTIAL PULMONARY VEINS ABLATION IN ATRIAL FIBRILLATION

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Circumferential pulmonary vein ablation (CPVA) has recently become more and more widely used method of treatment in highly symptomatic patients (pts) with drug refractory atrial fibrillation (AF). The aim of our study was to evaluate factors that may identify successful results of treatment.

**Methods:** Eighty six pts (54 males, mean age 54 + 10 yrs, 56% with idiopathic AF) after CPVA using a 3D electroanatomic mapping system were followed up. Pts were examined with symptoms, medication, ECG, one and 7 days holter monitoring, event holter, echocardiography every three months.

**Results:** During a 12 to 36 month follow up (median 18 months) 28% of pts were free from AF, 57% of pts had single short lasting episodes of AF. According to our results the following factors prove to be statistically significant in increasing the success of ablation: the size of left atrium < 45 mm (OR 11.5), interventricular septum diameter < 12 mm (OR 7.38), idiopathic AF (OR 5.35), absence of mitral regurgitation (OR 3.2).

**Conclusions:** Our results suggest that the best candidates for CPVA are the pts with idiopathic aetiology of AF, with no enlarged left atrial size or left ventricular hypertrophy.

## LEFT ATRIAL ABLATION USING INTRACARDIAC ECHOCARDIOGRAPHY

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**Introduction.** Left atrium ablation (LA ABL) distant from the pulmonary vein os (PVO) has been reported to be effective in curing AF. Intracardiac echocardiography (ICE) has become one of the tools used in ABL procedures, because it has the benefit of obtaining anatomical and hemodynamic information during the procedure. However, there have been few reports on LA ABL using ICE. We report the utility of ICE during LA ABL.

**Methods.** Thirteen patients (mean age 65) with drug refractory AF underwent LA ABL under ICE guidance. A 9-Mhz ICE catheter was introduced into the LA via the transeptal punctual method and positioned at LA cavity near PVO. A circular mapping catheter was introduced into the intra-PV region to monitor the PV electrograms (PVEs) and an 8-mm ABL catheter was used for the ablation. ABL was performed at the sites determined by ICE positioning. Each application was conducted for 20-30 seconds with a temperature setting of 55 degrees and power of 40-45 watt.

**Results.** The images obtained by the ICE clearly confirmed the LA morphology near the PVO and degree of contact between the catheter and LA wall. RF applications were capable to apply along the LA wall circumferentially under guidance by the ICE images without fluoroscopy. Complete PV isolation was obtained in 10 patients. AF was cured in 8 patients without antiarrhythmic drugs and 4 patients with drugs. No complications except one CVD were observed over an average follow up of 10 months.

**Conclusions.** LA ABL distant from the PVO under guidance with

ICE imaging is a useful method for curing AF, because it obtains real images of the LA anatomy and precise catheter positions during the RF application. It provides safe and easier catheter manipulation, and may result in a high success rate.

### CATHETER ABLATION OF INCESSANT VENTRICULAR TACHYCARDIA DUE TO RIGHT VENTRICULAR DYSPLASIA IN THE SETTING OF CARDIOGENIC SHOCK - CASE REPORT

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**Case Report:** in female, age 42, with 14-years history of arrhythmogenic right ventricular dysplasia (ARVD), incessant form of VT was established lasted for 7 days before admission to our Department, with persistent rate 135 bpm despite repeated pharmacological (lidocain, mexiletine, ajmaline, amiodarone, propafenone) and electrical cardioversion attempts. Long-lasting VT was associated with development of extensive systemic venous congestion and signs of extremely reduced cardiac output. Chest radiography showed large left pleural effusion and echocardiogram discover new massive right lateral atrial mural thrombus and huge right ventricle (64mm). In the setting of cardiogenic shock successful single-catheter radiofrequency ablation (RFA) with 4 mm tip catheter was performed in the right ventricular outflow tract where the local ventricular depolarization maximally preceded onset of QRS complex during VT (70msec). In the first second of the RF energy delivery (50 Celsius degrees for 60sec) stable sinus rhythm was achieved with immediate and impressive hemodynamic improvement. Another one 'safety' RF pulse was applied in the same place during sinus rhythm, guided by local late ventricular potentials. Further clinical course was complicated by transient ischemic and/or toxic (drug-induced) hepatitis and echocardiogram showed thrombus resolution at the discharge. During twelve months follow-up patient was without VT and signs of CHF, taking former antiarrhythmic drug therapy and oral anticoagulation.

### EVA STUDY: ELECTROGRAMS FOR VALIDATION OF ARRHYTHMIAS

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**Aim of the study:** The aim of this study was to evaluate the specificity of the automatic mode switching function (AMS) using stored intracardiac electrograms (IEGM) to confirm device diagnosis. The secondary objective was to estimate the incidence of atrial arrhythmias in pacemaker patients population.

**Method:** A multicenter, prospective longitudinal study was conducted in 121 patients (56% of males, mean age 75,2±13,4 years old). They were implanted for conventional indications of permanent pacing with an Identity DR pacemaker (St Jude Medical) and a bipolar atrial lead. Usual device tests were realized at implant and pre-discharge. Within the first six months follow-up (FU), IEGM triggers: AMS entry and AMS exit were activated. At FU2 and FU3 (within 6 months from previous FU), diagnostics and IEGM were retrieved and analyzed.

**Results:** Pacing indications were AVB for 68% of patients (19% brady/tachy, 39% SND).

Follow-up	Population	AMS occurrences
FU1	103	43%
FU2	98	56,1%
FU3	55	59,7%

In population that experienced AMS, duration of the episodes was less than 1% for 80% of them. After a close examination of IEGM, 77% of AMS entry were classified as appropriate (45,4% NSAT; 14,6% AT; 2,3% Flutter; 15,4% AF). According to data analysis, inappropriate AMS can be avoided by a proper device setting (atrial sensing, blanking). AMS exit were inappropriate in 36% of cases. A corrective action can be taken for one third by using a better atrial sensing.

**Conclusions:** Switching in asynchronous mode occurs appropriately in 77% of the time. Specificity can be improved with proper device settings. Switch back in DDD is appropriate in 64% of cases and can be improved for 13% of inappropriate events. Study completion will provide more information about atrial arrhythmia incidence on the pacemaker population.