Tuesday, 26 June 2001
15:30–17:00
P19 Pacing devices, techniques and atrial fibrillation

759

Assessment of pacing algorithms in prevention of atrial fibrillation

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A combination of 3 algorithms (ELA Medical) designed to prevent AF recurrences is being evaluated in a multi-centric prospective study. Sinus Rythm Overdrive achieves permanent atrial pacing just above the sinus rate. Post-Extrasystolic Pause Suppression controls the variation of cycle lentgh after a premature atrial contraction (PAC). Acceleration on PAC's increases temporarily the pacing rate upon frequent PAC's.

Methods: 83 pts with paroxysmal AF and stable anti-arrhythmic medication were selected. A randomized cross-over design DDD70 vs DDD70 + Algorithms (DDD+) was used (6 months phases). Pts were followed every 3 months to record Mode Switches (MS).

Results: Out of 19 pts eligible for analysis, and having completed cross-over, DDD+ is associated with a non significant reduction of time in MS in 13 pts (68%). Median cumulative time in AF at 6-months term is 122 hours (DDD70) vs 77 hours (DDD+).

Conclusion: these preliminary data suggest that algorithms seem to bring a low reduction of AF recurrences when compared to standard DDD70 pacing, but complete assessment requires results from all pts.

954

Efficacy of the DDD^{+} pacing mode in the prevention of atrial fibrillation

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Permanent atrial overdrive pacing has the potential to reduce the incidence of paroxysmal atrial fibrillation (AF) by homogeni- zation of atrial electrical activity and suppression of atrial ectopic beats. The present study has been conducted in 19 centers from 4 countries to evaluate clinical benefits of the DDD$^{\pm}$ mode (Biotronik, Germany) that allows a dynamic right atrial pacing at rates slightly above the sinus rate.

A total of 103 patients with the history of frequent AF were randomized to the DDD or DDD$^{\pm}$ mode at 3-6 months after pacemaker implantation. The mode crossover is to take place six months after the mode randomization. To date, percentage of atrial pacing (AP [%]), mean atrial rate (AR [bpm]), the number and the duration of AF episodes per day (AF# and AF [hrs/day], respectively), and the time interval until the 1st recurrence of AF (1st recur [hrs]) have been obtained in 43 patients followed for 15.3±7.4 months in the DDD mode and in 36 patients followed for 14.4±5.7 months in the DDD$^{\pm}$ mode. The data are shown in the table as mean values ± standard deviations. All patients tolerated DDD$^{\pm}$ mode well, with only 3 persons requiring reprogramming of the overdrive step size to a less aggressive value.

	AP(%)	AR (bpm)	AF#	AF(hrs/day)	1st recur (hrs)
DDD	62±33	72±10	2.6±4.7	2.1±4.2	144±365
DDD±	97±6	81±11	2.1±4.7	2.3±4.9	231±461
p-value	<0.01	<0.01	0.57	0.86	0.34

The interim data analysis indicated the potential of the DDD$^{\pm}$ mode to reduce the recurrence of AF, yet the improvements have not reached statistical significance. By June 2001, additional insights will be available based on the intra-individual comparison of the crossover data.

893

Floating atrial pacing could prevent atrial arrhythmias

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BACKGROUND: Floating atrial pacing might be a suitable approach to shorten the interatrial conduction time, in order to prevent atrial arrhythmias.
METHODOLOGY: We tested 18 pts (age 64 ± 11 years) with prolonged intrinsic P wave (>120 ms), implanted with DDD pacemaker for complete AV block. Eight pts were treated with single-pass DDD pacing (group A) and 10 with conventional DDD pacing (group B). The lower pacing rate was set to 10% above the minimum sinus rate, and patients were followed-up for 12 months. Sinus and paced P (pP) wave duration was measured on surface ECG at implant and after 3, 6 and 12 months. Pacemaker diagnostics allowed to evaluate atrial pacing percentage (AP%), number of atrial sensing events (AS) and premature A-V conducted complexes (PCC%).
RESULTS: There was no difference in AP% (18 ± 2% vs. 20 ± 5%) between group A and group B. In contrast, after 6 months, significantly more PCC% and longer pP duration were recorded in group B ($p<0.05$).
CONCLUSIONS: Permanent floating DDD pacing significantly decreased P wave duration and can be suitable in the overdrive pacing prevention of atrial arrhythmias.

490

Diagnostic functions accuracy of a new device for atrial fibrillation or flutter management

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The aim of the study was to assess the reliability of new diagnostic functions of a DDDR pacemaker (Selection® - Vitatron) to classify atrial fibrillation or flutter (AT).
Methods: 51 patients (pts) were implanted for an usual pacing indication. Only AT above the programmed atrial detection rate and longer than 6 ventricular cycles were recorded in the internal memory of the device. The end of an AT was documented when the atrial rate decreased under the atrial detection rate for at least 10 ventricular cycles. A 24-hour ECG Holter recording was performed on each pt synchronized with the internal data PM storage during at least one follow-up.
Results : 61 Holter were usable. 57 (93%) Holter recordings confirmed completely the PM internal data. 4 Holter partly confirmed the internal data : a permanent AT was identified as several episodes due to atrial blanking (2 pts) or under-sensing (2 pts).
Conclusion : To get an accurate AT documentation, it is necessary to adjust the detection settings to the expected rhythmic pathology and to program the higher atrial sensitivity.

588

Heart rate histogram for controlling ventricular rate in patients with AF

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Heart Rate Histogram (HRH) in Biotronik Actros S pacemaker (PM) enables considerably longer recording heart rate comparing to standard Holter monitoring.
The aim of the study was to evaluate the reduction of ventricular rate above 80/min(HR>80/min)due to HRH in pts with VVI pacing,chronic AF during 14 days follow up (FU).
Methods: 32 pts, mean age 71,7±8,7 years with VVI PM in the mode VVI 40/min (control AF) for 7 days and VVI 80/min for 7 days were studied. Due to Actros S HRH (this function records how often the rate, sense and pace, lies in certain ranges) the reduction of HR> 80/min in certain ranges were estimated during 2 weeks FU.
Results: Mean percentage of the HR>80/min in certain ranges during 7 days at VVI 40/min and 7 days at VVI 80/min was estimated:

HRH- 81-96/min: VVI 40/min=15,8+/-8,2% vs VVI 80/min=4,3+/-2,1%, ($p<0,05$);
HRH- 97-120/min: VVI 40/min=9,3+/-6,5% vs VVI 80/min=1,9+/-1,1, ($p<0,05$);
HRH- 121-160/min: VVI 40/min=2,2+/-1,1% vs VVI 80/min=0,5+/-0,3% ($p<0,05$);
HRH- 161-190/min: VVI 40/min=0,2+/=0,2% vs VVI 80/min=0,1+/-0,1% NS.

Conclusions: 1. Heart Rate Histogram in Biotronik Actros S PM may be useful during long period follow-up in controlling heart rate in patients with chronic AF. 2. Right ventricular pacing 80/min comparing to 40/min in pts with AF provides significantly reduction of the HR> 80/min in majority heart rate ranges.

609

Ideal pacing rate for heart stabilization in patients with atrial fibrillation

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Patients with chronic atrial fibrillation (AF) and VVI pacemaker continue to have symptoms of palpitations, which may due to heart rate variability (HRV). Correct ventricular pacing rate for heart rate stabilization is still unknown. The aim of the study was to evaluate the optimal pacing rate on HRV in pts with Biotronik Actros S pacemaker (PM) and AF.
Methods: 12 patients, mean age 71±5 years, with VVI PM were paced for one hour at each of 6 rates: ranging from 40 to 90 bpm in increments of 10 bpm. The HRV analysis was done using customized system and coefficient of variation -SDNN/mean Heart Rate - (CV) at the pacing rates 50-90 bpm comparing to 40 bpm (control AF pts) was evaluated.
Results: results were as follow: CV - VVI 40/min=0,22+/-0,06
VVI 50/min=0,22+/-0,05(NS); VVI 60/min=0,22+/-0,05 (NS);
VVI 70/min=0,17+/-0,05 (NS); VVI 80/min=0,09+/-0,04 ($p<0,05$);
VVI 90/min=0,08+/-0,04 ($p<0,05$)
Conclusions: 1) Ventricular pacing VVI 80/min in pts with AF results in significantly reduction of coefficient of variation comparing to control AF pts. 2) Increasing VVI pacing rate to 90 bpm does not provide better heart rate stabilization comparing to VVI 80/min pacing.

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332

Effect of revascularization on complete AV block in coronary artery disease

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We sought the effect of revascularization(rvs) on complete av block(CAVB) in patients(Pts) with coronary artery disease(CAD).
All Pts with CAVB but congenitals underwent coronary angiography. 38 Pts (12 F; mean age:646) found to have CAD with critically stenoses without acute coronary syndrome. All Pts received DDD Pacemaker(PM) 28 pts(Group 1)underwent complete rvs (15 PTCA, 13 CABG); Others(Group 2)were given medical therapy because of ineligibility or refusal. All Pts followed up(mean:24months) monthly with ECG and every 6 months with 24 hours Holter records. Pts recovered permanently to normal conduction defined as group 1A, 2A and remaining Pts as Group 1B, 2B.
Seven Pt(25%)from rvs group(3F; mean age:60.2) improved their av conduction permanently proved with normal ECG's and 3 Holter recordings. One Pt(M; Age:61) in Group 2 returned to normal av conduction permanently. No statistically significant difference was found between Group 1 and 2 according to age, gender and returnal to av normal conduction but trend to normalization was noted in rvs group.
Rvs might improve the av conduction in CAD and CAVB but to prove that is needed larger groups.

252

Bi-atrial pacing for the prevention of paroxysmal atrial fibrillation

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Atrial conduction disturbances resulting in delayed atrial activation are associated with incidences of atrial fibrillation (af). Bi-atrial pacing (BAP) reducing P wave duration may decrease these events. The purpose of this study was to assess the efficacy of BAP. Subjects were 6 patients of sick sinus syndrome (SSS) with paroxysmal af (Paf). Two leads were implanted in the coronary sinus (CS) (anode) and right atrium (RA) (cathode)(Medtronics inc. model 2188 and 5554). Pacemaker was alternately changed to bipolar for BAP, or to unipolar for RA pacing (RAP) every 3 months. Threshold and sensing of the CS were not changed significantly between at implant and 3 months. P wave duration was 0.14 }0.02 (control), 0.13 }0.03 (RAP) and 0.08 }0.01sec (BAP)(control, RAP vs. BAP;p<0.01). Although the numbers of PAC was less during BAP than RAP (30 }45 vs.728 }1174/day), there were no significant differences of af episodes in 3 months (both decreased compared with control). Conclusions: Reduction of P wave duration or the PAC numbers by BAP dose not cause the decrease of af episodes in patients with SSS in these short periods.

885

Anti-tachy pacing therapies efficacy in the treatment of atrial tachyarrhythmias: Italian AT500 Registry

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Background. Anti-tachy pacing (ATP) therapies may play a role in treating paroxysmal atrial tachyarrythmias (AT). The Medtronic AT500 is a new DDDRP pacemaker with atrial anti-tachy pacing (ATP) therapies, such as Ramp, Burst+ and 50 Hz Burst.
Methods. 105 patients (pts) (age 71±9 year, 54 M) were implanted with the AT500 pacemaker. Implant indication
was sinus node dysfunction or AV block. 98 pts had paroxysmal AT before implant. Pacemaker diagnostics continuously monitors atrial arrhythmia cycle length and classify fast and slow AT according to two detection windows, respectively from 100 ms to 220 ms and from 170 ms and 360 ms. After implant diagnostics features were activated, after 1 month also ATP therapies were enabled in order to treat AT episodes which are detected as slow either at onset or during episode progression. Therapies were delivered in automatic mode after 1 minute of sustained arrhythmia detection.
Results. In a follow up of 3.5±2.0 months, range (1-7) months, 274 AT episodes were treated in 16 patients. At onset 175/274 episodes were classified as slow AT, 99/274 as fast AT. Overall ATP efficacy was 99/274 (36%). Efficacy was equal to 50/99 (50.5%) in slow AT while was equal to 49/175 (27.7%) in AT episodes which, classified fast at onset, became slow during episode progression (hereafter called fast/slow AT). Atrial cycle length, measured before therapy delivery, was 268±37 ms for slow AT and 233±29 ms for fast/slow AT (p<0.01). Therapy delay was 77±26 seconds for slow AT and 662±1091 seconds for fast/slow AT (p<0.001).
Conclusions. ATP therapies may play a role in treating patients with paroxysmal AT. ATP efficacy was higher in episodes with longer atrial cycle length and shorter therapy delay.

948

The effect of atrial pacing ratios on the benefit from fixed overdrive pacing

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These intermediary results of the PROVE study are focused on the influence of different atrial pacing (AP) ratios on the reduction of atrial arrhythmias (AA) in patients implanted with Chorumă or Talentă pacemakers (ELA Medical, Montrouge, France).
AA burden was assessed by using Fallback Mode Switches (FMS) and atrial bursts analysis documented in the pacemaker. After 1- month of monitoring, patients with ≥2 FMS were submitted to the following randomized therapies (T), each with a duration of 3 months. T1, basic rate (BR)= mean atrial rate + 10 bpm, rest rate (rR)= 60 bpm and to T2, BR = rR = 60 bpm. The population was divided into groups (G) according to the difference in AP percentage between T1 and T2, compared to the median: GI,<16%, GII,≥16%.
Among 30 patients (13 M, 71±7 years), 4 had AV-Block (AVB), 10 Sinus Node Dysfunction (SND), 8 Brady-Tachy Syndrome (BTS), 7 AVB±SND±BTS and 1 AV node ablation.

		TI	TII	P*
	Mean atrial pacing %	90±11	88±13	Ns
GI	Mean FMS	#72±101	71±96	Ns
n=15	Mean A bursts #	373±742	464±751	Ns
GII				
n=15	Mean atrial pacing %	80±11	47±17	0.0001

* with sign rank test

Atrial overdrive pacing reduces AA burden in patients with known AA as long as it increases significantly the atrial pacing ratio.

762

ECG validation of the atrial arrhythmia diagnostics in the Vitatron selection 900 E

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Objective: To validate the Atrial Arrhythmia (AA) diagnostic function in the Selection 900 E.
Methods: The validation was performed on patients (pts) undergoing CABG, who were monitored for 4 consecutive days, with an external Selection attached to bipolar epicardial temporary leads. 13 pts were connected to ambulatory ECG holter recorders at the 3rd and/or 4th postoperative day resulting in 16 days of ECG recordings. The pacemaker was programmed to detect AAs above 200 bpm with the atrial sensitivity at 0.25 mV and the atrial blanking after a ventricular event at 50 ms. A maximum of 6 Detailed Onset Reports and 32 start and end points of AA episodes were stored per day (DOR= a beat to beat recording of atrial and ventricular events around the onset of AF).
Results: Because of the 30 % incidence of AF in these patients only 6 of the recordings had overlap with AA data (8 24 hr tapes showed episodes of AF). 15 DORs overlapped with the holter data. AF was confirmed in all cases (100%). 13 DORs (87%) were confirmed as AF onsets. Of the AA episodes 68 out of 70 (97%) AF onsets were confirmed. In two cases, ongoing AF was falsely divided into two episodes due to intermittent loss of atrial signals, either by 2:1 blanking during flutter or atrial undersensing.
Conclusion: The Selection 900 E detects AA-episodes above a specified rate accurately and reliably. Atrial sensitivity higher then 0.25 mV and secure lead placement could prevent undersensing and thus increase the accuracy.

908

The new concept of right atrium sensing for permanent biatrial pacing

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Biatrial pacing is accepted mode of non-pharmacological treatment of reentrant atrial arrhythmias in patients with atrial conduction disturbances. Assurance the synchrony of atrial excitation not only during pacing but both during sinus rhythm and premature atrial beats consist its not yet solved problem. Standard "J" shaped leads with small distance between tip and ring located in right atrium appendage (RAA) gives optimal sensing conditions. Due to anatomical conditions sinus and ectopic atrial beats front of excitation reaches RAA with even 20-30 ms delay and it make impossible early enough left atrial pacing and proper resynchronisation. The aim of the study was searching for a new sensing configuration of right atrium (RA), which offers earlier sensing of spontaneous excitation. The study shows that while using a standard J-shaped lead with its tip in RAA, the beginning of sinus atrial activation is detected with over 30 ms delay after the onset of P wave. The potential which may serve for pacemaker function control is detected after successive 10 ms. Increasing the distance between the tip and ring of atrial lead by moving the anodal electrode to opposite site of arc of standard J shaped lead (positioned in central-superior region of right atrium) causes relevantly earlier (16-20 ms) detection of RA activation wave; it does not provide to significant deteriorating of sensing conditions in atrial channel. It seems that localisation the tip of a lead and its ring in horizontal plain towards the main ventricular activation vector will be one of the solutions to decrease ventricular potential sensing by atrial channel. Introduction of additional anodal ring into central-inferior part of lead are give the chance for earlier detection premature beats originating in low RA region without negative influence on sensing and pacing conditions. Proposed configuration of electrodes does not create the risk of phrenic nerve pacing even after programming maximal energy output.

909

The new concept of permanent atrial resynchronisation using single atrial lead

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Resynchronising atrial pacing stays more and more widely used for prevention of atrial arrhythmias but all proposed systems possess specific disadvantages. During right atrial appendage potential driven septal (Saksena's dual site RA pacing system) or coronary sinus (Daubert's biatrial pacing system) pacing modes, detection of front of excitation is delayed about 30-40 ms in comparison to onset of P wave. It makes that resynchronisation during sinus rhythm can't be so excellent. On the other hand, simple single site CS ostium region pacing (Padeletti's system) offers symmetrical atrial activation only during pacing but even new algorithms (consistent atrial pacing) can't assure continuous pacing. Our long term experience with different resynchronising atrial pacing modes indicated, that increase the distance between tip and ring of atrial lead widens the sensing spectrum and made possible earlier detection of onset native atrial excitation. Using modified (increased distance from tip to ring up to 8 cm) standard Biotronik's Y 60 BP (screw in) lead with tip screw in low posterior atrial septal region and ring in mid anterior part of right atrium, we obtained excellent CS ostium region pacing triggered with onset of atrial excitation in 7 patients with recurrent atrial fibrillation (using simple SSI unit and SST program). The systems works perfectly with satisfied clinical effect. Widening of dipole was not accompanied with deterioration of sensing and pacing conditions (A wave amplitude, A/V ratio, pacing threshold, and impedance) remained in accepted limits. Our primary experience indicates new direction towards simplest but effective resynchronising atrial pacing for drug resistant atrial arrhythmias in patients with atrial conduction disturbances and without chronotropic incompetence.

906

Usefulness of intracardiac electrocardiogram (IEGM) recordings obtained from biatrial pacing system for differential diagnosis of atrial arrhythmias

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Biatrial pacing system permits for simultaneous recording right and left atrial potential but till now nobody evaluated clinical utility of IEGM obtained from biatrial pacing system. The aim of the study was evaluation of usefulness analysis of right and left atrial IEGM for estimation of inter/intraatrial and AV conduction during sinus rhythm, single and multisite atrial pacing. In 73 pts. (average age 69,3 y) with biatrial pacing system, during control examination II lead ECG and biatrial IEGM (with telemetry) were recorded during sinus rhythm (SR) and different atrial pacing modes. Front of sinus excitation in comparison to onset of P wave was recorded with 30 ms delay in RAA and after 100 ms in CS - 19 ms earlier with proximal ring of CS lead (BP sensing configuration) than with 4 cm deeper located distal ring (UP configuration). Total atrial activation time (TAAT) during SR amount 180 ms with UP and BP sensing configuration as well. RAA pacing caused prolongation of AV conduction (by 30 ms), P wave duration (by 17 ms), interatrial conduction time (IACT) (by 40 ms) and TAAT (by 25 ms). Effects of CS pacing were significantly related to polarity and energy of pacing; UP CS pacing moderately aggravated of atrial asynchrony (in comparison to SR) and prolonged AV conduction (by 17 ms) P wave duration (by 9 ms), IACT (by 40 ms) being without influence on values of TAAT. BP CS pacing did not prolonged AV conduction and P wave duration. Biatrial pacing significantly improved synchrony of atrial activation by shortening (or normalisation) P wave duration (by25 ms) and TAAT (by 54 ms). Moderate increase of RAA pacing frequency caused prolongation of TAAT (by 13 ms); following increase frequency of pacing effected following prolongation of TAAT (for 13 ms). CS pacing (with respective frequency) showed similar effects but increase of TAAT was significantly lower (10 and 4 ms respectively). Obtained results indicates that RAA pacing can aggravate of atrial asynchrony and suggests more often utility of resynchronising atrial pacing modes in patients with inter/intraatrial conduction disturbances and recurrent atrial arrhythmias. Conclusions: 1. Telemetric recording of IEGM both of atria (from biatrial pacing system) allows for non invasive evaluation of inter/intraatrial conduction during sinus rhythm and different atrial pacing modes as well. 2. Biatrial pacing system which offers possibility simultaneous non-invasive recording IEGM both of atria consists valuable diagnostic and scientific tool additionally.

799

Pacing for prevention of atrial arrhythmias

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We evaluated the role of increased base atrial rate (IBAR) and biatrial pacing (BAP) techniques to prevent atrial arrhythmias recurrences in patients with bradycardia.
Methods: Fourteen patients with symptomatic bradi-arrhythmias and electrocardiographic evidences of delayed interatrial conduction time were studied. All patients underwent DDD pacing mode programmed with long AV interval. Group I IBAR ¼ 7 patients programmed with low rate of 80bpm. Group II BAP ¼ 7 patients were implant with one atrial leads placed in Coronary Sinus (CS) and other in the right atrial appendage. Non antiarrhythmic drugs were administered. Clinical evaluation, echocardiogram, Holter and ergoespirometric tests were performed as follows: before implant, 60, 120, 180 days later and each 6 months.
Results: After a follow-up period ranging from 10 to 31 months, 2 patients from Group I had assymptomatic atrial arrhythmia recurrence. No patients from Group II had any recurrence of arrhythmias or symptoms and one patient was reoperated due to CS high atrial threshold.
Conclusion: In this short series study, both BAP and IBAR techniques provided symptoms control, but only BAP prevented atrial tachyarrhythmia recurrence.

639

The effects of atrial pacing therapies on spontaneous persistent atrial fibrillation

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Introduction: The aim of this study was to determine if pace termination of persistent atrial fibrillation (AF) was possible using automatic atrial pacing therapies delivered from an atrial implantable cardiac defibrillator.
Methods: The effect of antitachycardia pacing and burst 50Hz atrial pacing on spontaneous atrial events was evaluated in 15 patients implanted with the Jewel AF atrial defibrillator for persistent AF only. Six-months following implant, patients were randomised to either nominal or proven subthreshold "sham" pacing therapies for three-months and crossed over to the other modality for a further three-months.
Results: 36 atrial episodes were treated with 50Hz pacing with outputs programmed to nominal and 34 episodes with sham levels. 50Hz pacing failed to terminate all episodes at both outputs. Ramp ATP was delivered in 30 episodes of AF with 126 sequences during the nominal period and 33 episodes during the sham period. It was ineffective in each case. Burst pacing was ineffective during 17 episodes in the nominal period and 25 episodes in the sham period.
Conclusion: Atrial pacing therapies are ineffective at terminating persistent atrial fibrillation.

595

Biatrial pacing after CABG surgery- prevention of atrial fibrillation?

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Atrial fibrillation (AF) is a frequent arrhythmia after CABG. Antiarrhythmic drug therapy for the prevention of AF has shown limited efficacy and adverse effects. An alternative treatment is temporary atrial pacing therapy (TAP). The purpose of this prospective randomised study was to determine the influence of different pacing sites in the prevention of AF.
Methods: 90 patients (pts) undergoing CABG received temporal right and left atrial epicardial electrodes at the time of surgery. After randomisation into 3 groups: TAP of the upper right atrium (RAP), synchronous TAP of right and left atrium (BAP) and a control group without pacing (NAP). The pts were connected to an external pacemaker programmed to AAT 50-150bpm. The follow-up period was 3 days with continuous Holter monitoring.
Results: Between the groups there was no statistical difference regarding age, ejection fraction and clamping time. 29 pts were randomised in RAP, 30 in BAP and 31 in NAP. AF occurred in total in 27% of the patients: 31% in RAP, 16% in BAP and 32% in NAP.
Conclusions: AF incidence was lowest with BAP, but did not reach statistical significance (p=0.31).

562

Performance of a new PM-autosensing-algorithm in atrial fibrillation

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The aim of the study was to evaluate a new pacemaker (PM) atrial autosensing algorithm (ASA) with respect to auto-mode-switch (AMS) function during induced episode of atrial fibbrillation (AF). Methods: consecutive patients with paroxysmal AF and DDD-PM implantation (Pulsar Max DR-Guidant Inc. St.Paul,MN,USA) were enrolled. Two days after PM-implantation AF was induced via burst pacing and AMS-function was evaluated regarding delay to AMS and stability of AMS for a duration of 2.5 min. Three different atrial sensing-modes were compared: 1) sensitivity 0.25 mV(AS-0.25); 2) 0.5 mV (AS-0.5) and 3) ASA. Results: Sustained AF episodes were inducible in 13/22 tested patients. AMS-delay was 5+/4 s, 32+/60 s, and 8+/-8 s in AS-0.25, AS-05 and ASA respectively. Adequate and sustained AMS-function was observed in 92%, 69%, and 69% (AS-0.25, AS-0.5 and ASA). AMS-failure, mainly due to intermittend atrial flutter, occured 8%, 31%, and 23% in AS-0.25, AS-0.5, and ASA, respectively. Conclusions: the tested ASA and a fixed atrial sensitivity at 0.5 mV achieved a comparable AMS-performance in induced AF-episodes.

823

How to test automatic mode-switch (AMS) in implanted pacemakers (PMs)?

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Aim of the study was to develop a method and an external supraventricular arrhythmias simulator (SAS) to test AMS in implanted PMs.
Methods: SAS delivers low voltage pulses (200 mV, 20 ms) through 2 skin electrodes. Each pulse train lasts 15 sec and starts synchronously with a pacing pulse of the implanted PM. Pulse rate is set at 350, 250, 160 bpm to simulate atrial fibrillation, atrial flutter and atrial tachycardia, respectively. Fifty patients, implanted with Vitatron PMs(21 Diamond II, 14 Clarity DR, 15 Selection 900E), entered the study. Sensing was unipolar 0.5 mV in atrium and bipolar > 2 mV in ventricle.
Results: Atrial channel well detected the external pulses with amplitude 1-3 mV; AMS occurred immediately at the onset and at the offset of simulated arrhythmia; no adverse interference on PMs was seen.
Conclusion: The technique is safe and reliable for both the patient and the PM. It can be proposed to verify proper performance of AMS irrespective of the implanted device.

301

Detection of cardiac arrhythmias by pacemaker telemetry

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Introduction: Pacemaker telemetry data are increasingly used to infer the presence or absence of cardiac arrhythmias. But, as pacemakers are unable to provide continuous Holter recordings, even devices which store electrograms select these, reducing false positive but not false negative arrhythmia detection rates.
Methods & Results: 18 patients with Vigor (Guidant Corp.) DDDR pacemakers implanted for sick-sinus syndrome had simultaneous 24 hour Holter recordings and down-loaded pacemaker telemetry. There was good agreement on heart rate (r=0.98), but pre-defined pacemaker counter criteria (Asense x 120% > Vsense + Vpace - Apace all at >100bpm) achieved only 57% sensitivity with 64% specificity for the presence of at least 5 conducted beats in atrial fibrillation. False-positives resulted from far-field sensing while false-negatives occurred with very short episodes of atrial fibrillation. The pacemakers' anti-tachycardia response counter was not specific for the occurrence of atrial fibrillation.
Conclusion: Simple "beats in bins" algorithms can not differentiate sustained arrhythmias from each other or from multiple single premature beats. Further studies are underway to evaluate more sophisticated arrhythmia detection algorithms and their optimal settings in other devices.

648

Overdrive pacing for atrial fibrillation - complications and ways to overcome them

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Overdrive pacing is suggested to be a useful tool in managing paroxysmal atrial fibrillation (PAF). Pacemaker algorithms based on overdrive pacing mainly aim to provide constant pacing above sinus rate, to suppress atrial ectopics and to prevent post atrial ectopic pauses. Adequate sensing and programming is vital for the proper functioning of these algorithms. We studied the prevalence of far-field R-wave sensing in a population of 24 patients during the monitoring phase (phase I) of the AF-Therapy Study. The pacemaker used was the VITATRON SELECTION 900, which has four preventive pacing algorithms for PAF (Pace Conditioning, Premature Atrial Contraction Suppression, Post Premature Atrial Contraction Response and Post Exercise Response). We also determined the prevalence of inappropriately fast overdrive pacing in the same patients during the therapeutic phase of the study (phase 3) and established a correlation with a possible cause.
RESULTS: Far-field R-wave sensing was detected in 16.7% of the population and in 14.1% of the episodes analysed (276 in total) during phase 1 of the study. Standard setting for the atrial-blanking period was 50ms with the aim of enhancing atrial sensitivity. Extension of the atrial-blanking period was performed to eliminate far-field R-wave sensing. Inadequately fast heart rates were found in 33.3% of the population during phase 3 of the trial (20.8% due to far-field R-wave sensing and 12.5% due to proper sensing). One patient had improper sensing during phase 1 of the trial. Extension of the atrial blanking period and limitation of the maximum therapy rate to 100bpm were successfully performed to overcome the problem.
CONCLUSIONS: Overdrive pacing can be associated with poorly tolerated fast heart rates. Careful programming of the atrial blanking period and maximum therapy rate assures better tolerability of the algorithms built in the SELECTION 900 pacemaker.

628

Dual-site RA pacing reduces recurrences of atrial fibrillation

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Multi-site pacing has been shown to prevent recurrence of atrial fibrillation (AF).
Methods: In a prospective randomized cross-over study the effect of chronic dual-site RA pacing (DRAP) was compared with single-site high RA pacing (SHRAP) in patients (pts) with drug-refractory persistent or paroxysmal AF. Primary endpoints were Arrhythmia Free Interval (AFI) and Event Free Interval (EFI). An Event was defined as persistent AF (>48h) requiring electrical cardioversion. Two leads, implanted in the RA appendage and near the coronary sinus ostium, were connected to a DDD pacemaker, programmed in AAT mode at 70 ppm. Pts were randomized to DRAP (Group I) or SHRAP (Group II) and crossed over after 6 months.
Results: 40 patients (24M/16F) completed 1 year follow-up. Baseline characteristics between groups were not different with respect to age, LA dimension, LVEF and NYHA class. During the first treatment period AFI and EFI were significantly better in Group I than II ($p<0.01$). Though a carry-over effect due to treatment sequence played a major role, crossover analysis showed a clear trend for improvement with DRAP (AFI: p=0.061; EFI: p=0.055).
Conclusion: DRAP appears to be more effective than SHRAP in the prevention of AF recurrences probably by modifying the substrate for AF.

873

Improved QoL with dual-site RA pacing in patients with paroxysmal AF

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QoL analysis was performed as part of a prospective, single-blind, randomized cross-over study, evaluating the effects of dual-site (DRAP) as compared with single-site high RA pacing (SHRAP).
Methods: Patients (pts) with documented, drug-refractory paroxysmal AF with minimal or no structural heart disease and without conventional indications for pacing, were implanted with 2 atrial leads (RA appendage and coronary sinus ostium). Leads were connected to a DDD pacemaker, allowing randomized programming of SHRAP or DRAP. The pacing mode was crossed-over after 6 months. The lower rate was 70 ppm, aiming RA synchronization during intrinsic rate. The pts completed the Karolinska QoL questionnaire as well as the Symptom Checklist prior to implantation (base line) and after each treatment period.
Results: 40 pts completed the 1 year follow-up, 18 were randomized for DRAP first (Group I) and 22 for SHRAP first (Group II). Baseline characteristics did not differ between groups. There was a significant improvement in Group I after the first 6 months, with respect to frequency and severity of symptoms, dizziness, dyspnea, sleep and depression, which was not observed in Group II. Overall, crossover analysis revealed a significant improvement for DRAP versus SHRAP treatment in alertness ($p<0.001$), mental activation and frequency of symptoms ($p<0.01$).
Conclusion: DRAP appears to be more effective than SHRAP to relieve symptoms and improve QoL in patients with drug-refractory paroxysmal AF.

950

Atrial overdrive pacing benefit in decreasing arrhythmic burden

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The aim of the PROVE study was to assess the benefit of fixed atrial (A) overdrive pacing in patients implanted with Chorum™ or Talent™ Pacemakers (ELA Medical, Montrouge, France).
The arrhythmic burden was assessed using Fallback Mode Switches (FMS) and A bursts analysis. After 1 month of monitoring, patients were classified in 2 classes (C): CI, patients presenting ≥ 2 FMS; CII, other patients. Basic rate (BR) and rest rate (rR) were then programmed according to 2 randomized Therapies (T) of 3 months duration each: TI: for CI, BR = mean atrial rate + 10 bpm, rR = 60 bpm; for CII, BR ≥ 70 bpm, rR ≤ 55 bpm; TII: BR = rR = 60 bpm for both classes.
Among 30 CI patients (13 M, 71±7 years), 4 had AV-Block (AVB), 10 Sinus Node Dysfunction (SND), 8 Brady-Tachy Syndrome (BTS), 7 AVB±SND±BTS and 1 AV node ablation. 54 patients were of CII (34 M, 67±11 years): 17 had AVB, 18 SND, 4 BTS and 15 AVB±SND±BTS.

Fixed A overdrive pacing reduces A arrhythmic burden in patients presenting A arrhythmias history.

383

Right atrial bifocal pacing to prevent AF: results from the DuSti-trial

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Objectives: A randomized prospective cross-over trial was conducted in order to compare the preventive effects of unifocal vs. bifocal right atrial overdrive stimulation against paroxysmal AF under controlled medication with sotalol.
Methods: In 19 patients (age 60.9 ± 11.6 years) with sinus node dysfunction and paroxysmal AF a DDDR pacemaker (Medtronic Kappa DR) with two right atrial leads (lateral and CS ostium) was chronically implanted. After a 3 month run in period (DDI 50/min) the patients were randomly assigned to continuous unifocal and bifocal atrial overdrive stimulation for 3 months each, using a cross-over protocol. Relative time in AF during the periods was measured according to the pacemaker's counter.
Results: The per protocol analysis showed 8.3% AF during run in, 5.2% during unifocal and 5.5% during bifocal stimulation (p=n.s. unifocal vs. bifocal, p=0.02 run in vs. unifocal, p=0.06 run in vs. bifocal).
Conclusion: Continuous right atrial overdrive pacing reduces AF burden in patients with sinus node dysfunction under sotalol treatment. An additional protective effect of bifocal pacing when compared with unifocal pacing cannot be confirmed.

338

Inhibition of supraventricular arrhythmia by triggered pacing

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Objectives: We hypothesised that continuous atrial pacing could prevent ectopic contractions. The aim of this study was to investigate the effect of the atrial triggered pacing (DDTA) in preventing supraventricular arrhythmias and atrial fibrillation after DDD pacemaker implantation.
Methods: The study consisted in four sequential periods of one month each: (a) DDD mode (b) DDTA mode 5.0 V (c) DDTA mode 2.5V (d) Reversed to DDD mode. We defined atrial arrhythmias as (i) sustained supraventricular arrhythmias (ii) premature atrial contraction runs lasting less than 5 beats (iii) more than 5 beats. Pacemaker counters were retrieved at the end of each period. DDD pacemakers (ELA medical S.A. model Talent® DR 213) were implanted in 12 patients (6 men, 69 years mean age).
Results: Arrhythmias were found in 4/12 patients. Counts Inhibition Rates in these three types of supraventricular arrhythmias between DDD and DDTA mode 5.0V were 8.6%, 0.5%, and 35.2%, respectively.
Conclusion: Atrial triggered pacing appears to be a beneficial therapy for supraventricular arrhythmias prevention. However, more patients are required to confirm the results of this preliminary study.

273

Atrial tachyarrhythmia burden + quality of life in pacemaker patients

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Health-related quality of life (QoL) is impaired in patients (pts) with intermittent atrial tachyarrhythmias (AT). This study evaluates the relationship between the AT burden (B) and QoL in pts implanted with a DDDRP pacemaker (Medtronic AT500).
The AT500 stores AT B and offers preventive and automatic antitachy pacing for AT treatment. QoL and AT B were evaluated in 121 pts with known AT. 3 months post implant, a SF36 health survey was administered and stored AT B was retrieved.
Mean AT B was 0.13±0.25 h/day. Mean QoL values ranged from 54.9±42.5 (physical role) to 84.1±20.2 (social function). No strong correlation was found between AT B and QoL. In 6 out of 8 subscales though (general health, vitality, pain index, social function, emotional and physical role), pts with low (<1 h/day) B (n=80 pts) had a higher QoL than pts with high (>=1h/day) B (n=41 pts). Baseline characteristics of pts with low / high B did no differ.
Low AT B has a positive impact on single aspects of QoL. No strong correlation though was found between QoL and AT B.

515

Heart rate turbulence calculated using single and multiple ventricular premature complexes

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Background: The characteristic pattern of acceleration (turbulence onset) and subsequent deceleration (turbulence slope) of the sinus rhythm cycle length following a ventricular premature complex (VPC) is called heart rate turbulence (HRT). HRT has recently been shown to have prognostic significance, post myocardial infarction.
Method: Using data obtained from the St. George's Post Myocardial Infarction Research Survey Program, turbulence onset (TO) and turbulence slope (TS) were calculated and averaged for both single VPCs and ventricular couplets (VCs) from 24-hour Holter recordings for each patient, and compared using the Wilcoxon matched pairs test.
Results: Data were obtained from 65 patients. Mean values for TO (SD) were: -0.00832 (± 0.02868) and -0.00065 (± 0.06540) for single VPCs and VCs, respectively (p = 0.79). Corresponding values for TS were 4.16 (± 3.55) and 11.61 (± 11.14), respectively (p < 0.0001).
Conclusion: Compared to single VPCs, VCs facilitate the mechanism of HRT with an augmented effect on TS but not TO. As VCs exert greater haemodynamic changes compared with single VPCs, an exaggerated but preserved baroreflex may account for these findings. Hence, although the exact mechanism of HRT is unknown, these findings support a baroreflex response for the pathophysiological mechanism of HRT.

1043

How to predict prevention of atrial fibrillation by atrial pacing?

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The aim of the study is to determine retrospectively the relationship between the percentage of atrial pacing and the recurrence of atrial fibrillation in patients implanted for brady-tachy syndrome.
One hundred and forty-five consecutive patients (86 males and 59 females) with previous history of drug-resistant paroxysmal AF and sinus node dysfunction were included. A DDD pacemaker with a basic rate of 67± 7 bpm was implanted in all patients.
During follow-up period (29± 13 months) 3 groups of patients were identified: group I with stable sinus rhythm, group II with only paroxysmal AF, group III with permanent AF. The groups were similar in terms of age, sex ratio, heart disease and basic pacing rate.
Groups II and III used a higher number of drugs and had a longer P-wave duration than patients of group I. The percentage of atrial pacing was lower in group III patients.
Results:

	Group I	Group II	Group III
Patients	57	45	43
Drugs before pacing (n)	1.3± 1.1	2.0± 1.5*	2.6± 1.7*
Drugs after pacing (n)	22/57	37/45*	3/43*
Sinus P-wave duration (ms)	100± 20	115± 28*	117± 22*
Atrial paced beats (%)	76± 27	80± 21	56± 29*

*p< 0.05 vs. group I
Conclusion: Right atrial pacing seems poorly effective in preventing AF. Prolonged P-wave and a low percentage of atrial pacing are predictive of AF recurrence. A goal of > 80% atrial pacing seems desirable to prevent AF.