Elektrostimulacija srca
Cardiac pacing

7.1.

UPORABA ENDOVENSKE ELEKTRODE ZA ELEKTROSTIMULACIJU KAO KARDIOMEHANIČKI SENZOR

S. Brusich [1], D. Tomašić [2], B. Ferek-Petrić [2], S. Sovilj [3], Z. Čubranić [1], R. Magjarević [3], Ž. Mavrić [4], L. Zaputović [4]

[1] Zavod za kardiovaskularne bolesti, Odjel za aritmije i elektrostimulaciju, KBC Rijeka, Hrvatska
[2] CRDM, Medtronic Adriatic, Zagreb, Hrvatska
[3] Sveučilište u Zagrebu, Fakultet elektrotehnike i računarstva, Zavod za elektroničke sustave o obradbu informacija, Zagreb, Hrvatska
[4] Zavod za kardiovaskularne bolesti, Klinika za internu medicinu, KBC Rijeka, Rijeka, Hrvatska

U današnje vrijeme rad elektrostimulatora temelji se gotovo isključivo na registriranju električnog impulsa koji se stvara u samom miokardu. S obzirom da ti podaci daju ograničene informacije o samoj mehaničkoj aktivaciji srca, elektrostimulacijski sustav koji bi imao mogućnost hemodinamskog nadzora kontraktilnosti miokarda bio bi značajan instrument u poboljšanju kvalitete same srčane elektrostimulacije. Ovim istraživanjem želi se dokazati mogućnost upotrebe srčane elektrode za elektrostimulaciju kao novog, jedinstvenog senzora za monitoriranje kontraktilnosti srca. Senzor se temelji na mjerenju koeficijenta refleksije visokofrekventnog (HF) električnog signala primijenjenog na srčanu elektrodu kojeg smo nazvali LBS (engl. Lead bending signal).

Istraživanje je provedeno na skupini od deset odraslih ovaca u kojima su implantirane tri vrste elektroda. Izvršena je istovremena akvizicija LBS, EKG i tlaka u lijevoj klijetki (LVP), u bazalnim uvjetima, nakon ifuzije dobutamina, esmolola i brze ventrikularne stimulacije. Također su izvršena mjerenja na deset bolesnika tijekom implantacije kardioverter defibrilatora prilikom defibrilacijskog testiranja.

Stabilni, reproducibilni i konzistentni signali dobiveni su u animalnim i humanim ispitivanjima. Dobutamin je uzrokovao signifikantni porast frekvencije srca, krvnoga tlaka, LV dP/dt i akceleracije savijanja elektrode (LBA). Korelacija između LBAmax i LVdp/dtmax pokazala se kao statistički značajna, s visokim Pearsonovim koeficijentom korelacije ($r = 0.855$, $p << 0{,}001$). Dokazana je uspješna detekcija ventrikulske fibrilacije uporabom LBS signala u svih testiranih bolesnika.

Ovo je prvo istraživanje koje je istražilo mogućnost upotrebe HF parametara srčanih elektroda za monitoriranje kontraktilnosti srca. Visoki koeficijent korelacije između akceleracije savijanja elektrode i kontraktilnosti miokarda dokazuje mogućnost njegove uporabe kao hemodinamskog, kardiomehaničkog senzora.

7.2.

CLINICAL SIGNIFICANCE OF PERSISTENT ATRIAL FIBRILLATION IN PATIENTS WITH ATRIOVENTRICULAR BLOCK AND DUAL-CHAMBER PACEMAKER

D. Petrač [1], V. Radeljić [2], D. Delić-Brkljačić [2], Š. Manola [3], G. Cindrić-Bogdan [1], N. Pavlović [3]

[1] Bogdan Cardiology Polyclinic, Zagreb, Croatia
[2] Department of Cardiology, Sestre Milosrdnice University Hospital Center, Zagreb, Croatia
[3] Sestre Milosrdnice University Hospital Center, Zagreb, Croatia

Background: The prognostic significance of development of persistent atrial fibrillation (AF) in patients with atrioventricular (AV) block and dual chamber (DDD) pacemaker has not be separately investigated. We sought to determine whether persistent AF influences clinical outcome in these patients.

Methods: Three hundred and eight consecutive patients with second- or third- degree AV block and implanted a DDD pacemaker were followed for 36±20 months and retrospectively divided into two groups. Thirty-four patients who developed persistent AF formed persistent AF group, and 274 patients who remained free of this arrhythmia control group. Clinical and outcome data of the two groups were compared. The primary outcome was cardiovascular death.

Results: The primary outcome occurred more often among the patients in the persistent AF group (6.8% per year) than among those in the control group (2.9% per year; p = 0.028). This difference was primarily because of heart failure-related deaths in the persistent AF group (p=0.009). Secondary outcomes, hospitalization for heart failure and paroxysmal AF episode ≥5 minutes, occurred also more often among the patients in the persistent AF group (p = 0.008, and p < 0.001, respectively), although the risk of nonfatal stroke was similar in both groups (p = 0.628).

Conclusion: In patients with second- or third-degree AV block and DDD pacemaker, the development of persistent AF is associated with an increased risk of cardiovascular death and heart failure.

7.3.

KONGENITALNI KOMPLETNI ATRIOVENTRIKULARNI BLOK – PRIKAZ DVA SLUČAJA

M. Knežević Praveček, K. Cvitkušić Lukenda, I. Dunđer, I. Hadžibegović, K. Gabaldo, Đ. Prvulović, B. Vujeva, P. Samardžić

Kardiologija, OB Dr. J. Benčević, Slavonski Brod, Hrvatska

Prikazali smo dva bolesnika s kongenitalnim kompletnim atrioventrikularnim blokom . U oba opisana slučaja poremećaj srčanog ritma nije posljedica strukturne grješke srca, poremećaji ritma su dijagnosticirani nakon 18. godine života na sistematskim pregledima, a njihove majke su zdrave žene do sada ne liječene i nemaju nikakvih simptoma autoimunih bolesti vezivnog tkiva niti reumatološke bolesti. Bolesnici su se kao djeca razvijala uredno i nisu bili nikada bolnički liječeni. U godini dana praćenja od postavljanja dijagnoze u oba slučaja su ugrađeni trajni srčani elektrostimulatori srca zbog Adams –Stokesovih atake u prvom i kronotropne inkopetencije, te intolerancije napora u drugom slučaju. Kompletni atrioventrikularni blok javlja se s incidencijom od 1:20000–1:25000 živorođene djece. Može se naći u lijevom atrijskom izomerizmu, korigiranoj transpoziciji velikih krvnih žila i zajedničkom AV kanalu zbog abnormalne morfogeneze provodne srčane osovine. U djece sa strukturno zdravim srcem pojava kongenitnog bloka često je povezan s transplacentarnim prelaskom majčinih anti Ro/SSA i antiLA/SSB protutijela. Kongenitalni kompletni atrioventrikularni blok je potencijalno životno ugrožavajuće stanje sa značajnim morbiditetom. U svim životnim razdobljima i bez jasnih loših prognostičkih znakova postoji rizik od nastupa Adams-Stokesove epizode i iznenadne smrti. Stoga se danas preporuča većini adolesecenata i u odraslih s kongenitalnim AV blokom rana profilaktička implantacija trajnog elektrostimulatora srca, a svima ostalima redovito praćenje: jednom godišnja kontrola s Holter monitoriranjem, testom opterećenja i ehokardiografskim nalazom. Sniženje frekvencije vetrikularnog ritma, kronotropna inkompetencija, češća ventrikularna ektopija, pogoršanje mitralne insuficijenije, produženje QTc intervala, širenje QRS kompleksa važni su razlozi za odluku ugradnje trajnog elektrostimulatora srca.

7.4.

USE OF AN ATRIAL LEAD WITH VERY SHORT TIP-TO-RING SPACING AVOIDS OVERSENSING OF FAR-FIELD-R-WAVE

C. Kolb [1], H. Vrazic [2], G. Noelker [3], U. Lotze [4], H. Jetter [5], K. Puerner [6], K. Lang [7], L. Binner [8], V. Schibgilla [9]

[1] *Deutsches Herzzentrum München, Munich, Germany*
[2] *Division of Cardiology, Department of Internal Medicine, University Hospital Dubrava, Zagreb, Croatia*
[3] *Klinikum Coburg, Coburg, Germany*
[4] *Saale-Unstrut-Klinikum Naumburg, Naumburg, Germany*
[5] *Klinikum Memmingen, Memmingen, Germany*
[6] *Kreisklinik Ebersberg, Ebersberg, Germany*
[7] *Marienhausklinik Ottweiler, Ottweiler, Germany*
[8] *Universitätsklinikum Ulm, Ulm, Germany*
[9] *Klinik Fränkische Schweiz, Ebermannstadt, Germany*

Introduction: Far-field-R-wave-sensing (FFS) is the most common cause for inappropriate mode switching (AMS) in dual chamber pacemakers (DCP). Optimisation of the postventricular atrial blanking period (PVAB) significantly reduces FFS. The aim of the prospective randomised AVOID-FFS study is to investigate whether a new bipolar atrial lead (BAL) with a very short tip-to-ring spacing shows equally low incidence of FFS with short PVAB as compared to optimised PVAB with standard BALs.

Methods: Patients (P) with indication for DCP implantation were included in the AVOID-FFS-Study and randomly assigned to either receive a BAL with a very short tip-to-ring spacing of 1.1 mm (Optisense, St. Jude Medical; study group (SG)) or a lead with conventional tip-to-ring spacing of 10 mm (Tendril 1388, 1688, 1788 or 1888, St. Jude Medical; control group (CG)). PVAB was not optimised in the SG but programmed to the shortest possible value of 60 ms. In the CG PVAB was optimised to a value at least 25 ms longer than the measured interval between QRS and sensed FFS at an atrial sensitivity of 0.1 mV. Atrial sensing threshold was programmed to 0.3 mV in both groups. False positive AMS caused by FFS was evaluated using stored intracardiac electrograms at 1 and 3 months post implant.

Results: 204 P (121 male; age 73±10 y) were included in 10 centers: 103 P (SG), 101 P (CG), with no difference in P characteristics between both groups. PVAB was 68±26 ms (SG) vs. 121±32 ms (CG) ($p<0.005$). False positive AMS caused by FFS was detected in 1 (1%) P of the SG and 2 (2%) of the CG ($p=0.62$).

Conclusions: The use of a lead with a very short tip-to-ring spacing avoids inappropriate AMS caused by FFS without need for PVAB optimisation and shows similar results as the use of a conventional lead combined with PVAB optimisation. The implantation of a lead with a very short tip-to-ring spacing has the potential to reduce the follow up burden and increases the validity of pacemaker diagnostic data.

7.5.

SAFETY OF IMPLANTABLE PACEMAKERS AND CARDIOVERTER DEFIBRILLATORS IN THE MAGNETIC FIELD OF HAND METAL DETECTORS

H. Vrazic [1], C. Jilek [2], H. Badran [3], H. Lesevic [2], S. Tzeis [4], V. Semmler [2], I. Deisenhofer [2], C. Kolb [2]

[1] *Division of Cardiology, Department of Internal Medicine, University Hospital Dubrava, Zagreb, Croatia*
[2] *Deutsches Herzzentrum München, Munich, Germany*
[3] *Ain Shams University Hospital, Department of Cardiology, Cairo, Egypt*
[4] *Department of Cardiology, Hospital Henry Dunant, Athens, Greece*

Introduction: Electromagnetic interference (EMI) can cause temporary or permanent system malfunction of pacemaker (PM) and implantable cardioverter defibrillator (ICD) systems. Use of security screening systems in patients (P) with implanted PM and ICD systems is coming into focus, as there are many sources of EMI which are present in our daily life and because of widely present risk of terrorism. The Food

& Drug Administration reported 20 cases of potential interferences of hand metal detectors (HMD) with implanted rhythm devices in the 1990s. The aim of this study was to systematically evaluate potential EMI of HMD among P with implanted PM and ICD systems.

Methods: 170 P (97 with implanted PMs, 43 with ICDs, and 30 with cardiac resynchronisation therapy ICDs) who presented for routine follow-up to the outpatient clinic of Deutsches Herzzentrum München were scanned with two HMD usually used at airport security controls. Predetermined magnetic field strength of the HMD was 3.82 μT and 6.3 μT. In order to observe potential EMI, devices were programmed during testing to ensure pacing. In case of dual chamber devices atrial-triggered ventricular-paced mode was programmed; while in ICDs, the arrhythmia detection criteria were programmed ensuring maximum sensitivity with ventricular tachycardia (VT) zone at lowest possible detection rate. As a safety measure, antitachycardia pacing and shocks were inactivated.

Results: Normal pacing and detection function during and after repeated exposition to the electromagnetic field of the HMD used in this study was observed in all tested PM and ICD systems (generators and leads). No changes in parameter settings, battery status and internally stored data were observed in tested devices.

Conclusion: No interference with implanted PM and ICD systems was observed with HMD used in this study. Therefore, routine use of commercially available HMD as these used in our study among P with implanted PM or ICD systems seems to be safe.

7.6.

IMPLANTABLE CARDIOVERTER DEFIBRILLATOR RECIPIENTS: WHO ARE THE ONES WITH HIGHEST INTEREST IN REMOTE MONITORING?

H. Vrazic [1], T. Braun [2], T. Reents [2], M. Felizeter [2], K.H. Ladwig [3], M. Milosevic [4], V. Semmler [2], C. Lennerz [2], C. Kolb [2]

[1] *Division of Cardiology, Department of Internal Medicine, University Hospital Dubrava, Zagreb, Croatia*
[2] *Klinik für Herz- und Kreislauferkrankungen, Deutsches Herzzentrum München, Technische Universität München, Munich, Germany*
[3] *Klinik für Psychosomatische Medizin, Klinikum rechts der Isar, Technische Universität München, Munich, Germany*
[4] *Andrija Stampar School of Public Health, Zagreb, Croatia*

Introduction: Remote monitoring (RM) of implantable cardioverter defibrillators (ICD) is a feasible and safe new development in ICD therapy. The aim of SAN REMO 1 (Treatment Satisfaction with Remote Monitoring in Implantable Cardioverter Defibrillator Recipients) was to investigate factors associated with patientsž willingness to accept a FU by RM.

Methods: SAN REMO 1 was a single centre, non-randomised, cross-sectional anonymous survey using a self-administered questionnaire among 450 consecutive patients. The patients´ interest in RM – under the premise that RM would completely replace all routine FUs – was measured by a visual analogue scale and correlated with baseline socio-demographic and clinical data.

Results: 292 of 450 (65%) of patients responded and they were grouped according to their level of interest (great versus moderate/little) in using RM as a substitute for regular face to face FU. Patients favouring RM FU were more frequently treated exclusively by our centre (45% vs. 29%, p=0.046), had more frequently experienced an unplanned or emergency admission to hospital (44% vs. 29%, p=0.025), and reported more frequently poor exercise tolerance (37% vs. 25%, p=0.019). No significant differences were found in relation to distance from our centre, age, gender, family or working status, education level, the time from the initial implant of the device, having been resuscitated, having had myocardial infarctions, shocks or device complications.

Conclusions: A subgroup of patients characterised by being treated exclusively in our centre, having had an unplanned or emergency hospitalisation (not necessarily related to the device) or exhibiting limited exercise tolerance show high interest in replacing standard face to face FU for a RM.. Surprisingly, other factors such as distance to our centre do not seem to play an important role.

7.7.

LEAD INTEGRITY ALERT – AN EXAMPLE OF A PATIENT WITH A MALFUNCTIONING ICD LEAD

H. Vrazic [1], I. Rajcan-Spoljaric [1], Z. Durasevic [1], B. Starcevic [1], C. Kolb [2]

[1] *Division of Cardiology, Department of Internal Medicine, University Hospital Dubrava, Zagreb, Croatia*
[2] *Klinik für Herz- und Kreislauferkrankungen, Deutsches Herzzentrum München, Technische Universität München, Munich, Germany*

Introduction: Implantable cardioverter defibrillators (ICD) are used for termination of ventricular arrhythmias and prevention of sudden cardiac death. Failure of leads can occur, leading to malfunction of an ICD – an inappropriate shock discharge (ISD) is usually the first symptom of lead failure in 30–70% of cases. Awareness of this potential problem has led ICD manufacturers to offer solutions trying to prevent or at least delay ISD.

Case report: A 60-year old man was implanted with a VVI-ICD in 2004 in German Heart Center in Munich, Germany. A dual-coil defibrillation lead was implanted (Medtronic Fidelis 6948, later shown to have somewhat higher lead failure rates); therefore the patient was in regular follow-up controls every 6 months, last in 01/2012. He arrived to Croatia on holiday shortly before the next planned follow-up. Upon hearing an alarm from his ICD he came to the outpatient clinic of University Hospital Dubrava. Interrogation of the device revealed that the cause of an alarm was triggering of lead integrity alert (LIA) because pacing impedance rose to >3000 Ohm, in combination with a large number of short V-V intervals and nsVT episodes. No episodes of VT or VF were detected, and there were no ISD.

All detection and alarms have been turned off, and an indication was set for a lead revision. As the dual-coil lead was implanted for almost 8 years, it was decided that the patient would be transferred to his native center where transvenous lead extractions (TLE) are performed on a routine basis.

On the third day since his presentation to our outpatient clinic he was transferred to Munich, Germany, where TLE was performed, and a new lead was implanted. The patient has been doing fine since.

Conclusion: This case shows beneficial result of introduction of LIA algorithm in ICD devices. LIA signaled a problem due to lead malfunction before ISD was delivered. Lead exchange was performed successfully and the patient was spared of receiving inadequate shock.