Original article **UDC: 615.817**
doi:10.5633/amm.2014.0105

FLOATING ATRIAL SENSING OF THE VDD PACING SYSTEM AND ITS STABILITY

Tomislav Kostić[1], Zoran Perišić[1], Dragana Stanojević[1], Boris Đinđić[1], Lazar Todorović[1], Aleksandar Stojković[1], Snežana Ćirić Zdravković[1], Predrag Cvetković[1], Mladjan Golubović[2], Dragan Zlatanović[3]

In the late seventies and the early eighties, pacemakers with two electrodes able to stimulate two heart chambers (usually the right atrium and right ventricle) were designed. Those pacemakers were able to detect signals from the same heart chamber, and each of its functions (detection of intrinsing and application of artificial pacemaker signal) was performed as previously programmed. Essential hemodynamic improvement of this type of stimulation was the achievement of AV synchronization allowing that optimized function of the atria and ventricles mimics their natural functioning - timely contraction of the atria in relation to the AV valves and the ventricular outflow tracts.

This study included 130 patients who had VDD pacemaker implanted at the Department of Cardiology, Clinical Center Niš, during 2009-2013. At the time of implantation, atrial sensing was 2.1±1.2 mV. Patients had follow up visits at one month, six months and one year after pacemaker implantation. After one year, the floating sensing in the atrium was 1.6±0.7 mV which was lower but not clinically significant. Bearing in mind the aforementioned, VVD pacing systems may be considered as the first line therapy in patients with AV block and normal SA node function, particularly in elderly patients and in patients with unsuitable anatomical structures of musculoskeletal and venous systems of the upper thoracic part, in cases of which it is sometimes difficult to place two DDDR electrode systems. *Acta Medica Medianae 2014;53(1):25-27.*

***Key words:**: VDD pacemaker, atrial sensing*

Cardiology Clinic, Clinical Centre Niš, Niš, Serbia[1]
Centre for Anaesthesiology and Reanimation, Clinical Centre Niš, Niš, Serbia[2]
Clinic for Physical Medicine, Rehabilitation and Prosthetics, Clinical Centre Niš, Niš, Serbia[3]

Contact: Tomislav Kostić
Cardiology clinic, Clinical Center Niš
Bulevar Dr Zorana Đinđića 48
18000 Niš, Serbia
E-mail: tomislav.kostic1977@gmail.com

Introduction

In the late seventies and in the early eighties, pacemakers with two leads able to stimulate two heart chambers (usually the right atrium and right ventricle) were designed. Those pacemakers were able to detect signals from the same heart chamber they paced, and each of its functions (detection of an intrinsing and application of artificial pacemaker signal) was performed as previously programmed (1). This has opened a wide range of functions for dual chamber pacemakers and heart stimulation with the DDD, DDI, DVI and VDD pacing mode. Essential hemodynamic improvement of this type of stimulation was the achievement of AV synchronization allowing that optimized function of the atria and ventricles mimics their natural functioning timely contraction of the atria in relation to the AV valves and the ventricular outflow tracts (2). The only contraindication for this model of stimulation was permanent absence of intrinsing P wave that could be clearly detected (e.g. in atrial fibrillation, atrial flutter or atrial tachycardia). In the case of intermittent loss of P waves, those pacemakers could be reprogrammed to DDI or DVI pacing modes, in which case there was no AV synchronization and practically pacemaker were functioning in the VVI pacing mode (3).

Patients and results

This study included 130 patients who had VDD pacemaker implanted at the Department of Cardiology, Clinical Center Niš, during 2009-2013. The average age of patients was 61±9.5 years. The youngest patient had 51 and the oldest 78 years of age. There were 82 males and 48 females. In 108 patients, the pacing lead was introduced via the prepared v.cefalica, while in 22 patients the lead was placed after the puncture of the subclavian vein.

Table 1. Basic parameters of the pacemaker

Parameter	P wave (mV)	R wave (mV)	Threshold (V)
at the implantation	2.1±1.2	12±3.2	0.4±0.9
control visit after 1 month	2.0±1.4	11±2.8	0.5±0.7
control visit after 6 months	1.7±0.9	12±3.8	0.5±0.9
control visit after 12 months	1.6±0.7	10±3.7	0.5±0.6

The basic parameters of the pacemaker at the time of implantation were within normal range. The atrial sensing at the implantation was 2.1±1.2 mV. Patients had follow up visits at one month, six months and one year after pacemaker implan-tation. After one year the floating sensing in the atrium was 1.6±0.7 mV which was lower but not clinically significant.

Dicussion

VDD pacemaker was developed as a technologically unique pacing system and not only as a program option for DDD pacemaker. Alongside with this pacemaker special VDD lead (so-called "single-pass lead") was constructed and was widely used, especially in Europe, during a certain period of time. This lead has on its body beside the bipole on the top (placed in ventricle) a special sensing bipole at the right atrium. The indication for implantation of this pacemaker is AV conduction disorder but with preserved function of the sinus node. The timing cycles for VDD pacemaker are limited by lower rate (LR) limit, an AV interval, a ventricular refractory period (VRP), a post ventricular atrial refractory period (PVAR) and by the upper rate limit. Sensed P wave initiates an AV interval (during which the atrial sensing channel is refractory). At the end of the AV interval stimulus is delivered to the ventricle if intrinsic ventricular activity is not detected. This sensing - pacing mode is called "p" following or the P wave tracking. Ventricular activity paced or sensed initiates the PVARP and the ventriculo-atrial (VA) interval (LR minus AV interval). If no P wave intrinsing activity is sensed, pacemaker automatically delivers ventricular pacing at the LR limit (4).

In a healthy heart depolarization begins in the sinus node, than spreads to the AV node for about 30 ms. AV node has prolonged conduction time, which allows an optimal synchronization of contraction of the atria and ventricles. Therefore, the optimal therapy for patients with preserved function of the SA node and AV conduction disturbances is VDD mode of pacing which preserves the physiological sequence of the events.

The benefits of dual chamber single pass lead compared to the DDD systems are:

- lower cost,
- simpler implantation procedure,
- lower incidence of atrial arrhythmias (no physical stimulation by atrial lead and no competition with intrinsic rhythm due to insufficient atrial sensing),
- easier programming and monitoring.

Hemodynamic advantage of preserved AV synchrony is very well known. Hemodynamic benefit from the synchronization of atrial contraction followed by ventricular is clearly verified (VDD vs. VVI (R) – increase in stroke volume by 20% up to 50% in patients with left ventricular dysfun-ction) (5). Lower myocardium oxygen consumption is demonstrated with atrial synchronous stimulation compared to VVIR. Reflections "what if" in terms of future development of SA node dysfunction and hence immediately implan-tation of DDD pacing systems are not proved to be justified because of the low incidence of SA node disease during follow-up years. DDD pacemaker implantation is technically much more demanding, with higher price of the procedure and longer fluoroscopy time. DDD pacemaker implantation carries a much higher risk of com-plications: lead dislodgement, lead fracture and loss of atrial sensing. VDD pacing offers the opportunity for AV synchronous pacing with the simplicity of the VVI implantation procedure (6). The reduction of atrial sensing occurs during walk, run and in the upright posture.

Taking all this into account, VVD pacing systems may be considered as the first line therapy in patients with AV block and normal SA node function, particularly in elderly patients and in patients with unsuitable anatomical musculoskeletal and venous systems structures of the upper part of the chest, where it is sometimes difficult to put two leads of DDDR pacemaker system.

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FLOTIRAJUĆI ATRIJALNI SENZING VDD PEJSING SISTEMA I NJEGOVA STABILNOST

Tomislav Kostić, Zoran Perišić, Dragana Stanojević, Boris Đinđić, Lazar Todorović, Aleksandar Stojković, Snežana Ćirić-Zdravković, Predrag Cvetković, Mlađan Golubović, Dragan Zlatanović

Od kraja sedamdesetih i početka osamdesetih godina konstruisani su pejsmejkeri sa dve elektrode koji su mogli da stimulišu dve srčane šupljine (po pravilu desnu pretkomoru i desnu komoru) i, istovremeno, da detektuju intrinsičke signale iz istih šupljina, tako da obe svoje funkcije (detekciju postojećih i aplikaciju veštačkih pejsmejker signala) obavljaju na programiran način. Suštinski hemodinamski napredak ovog tipa stimulacije bila je korist od sinhronizacije AV sprovođenja, što je omogućavalo optimalno funkcionisanje pretkomora i komora, poput prirodnog, pravovremenu kontrakciju pretkomora u odnosu na AV zaliske i ušća.

U ispitivanju je učestvovalo 130 bolesnika, kojima je u periodu od 2009. do 2013. godine na Klinici za kardiologiju KC Niš ugrađen VDD pejsmejker. Atrijalni senzing na ugradnji iznosio je 2.1±1.2 mV. Bolesnici su praćeni na mesec dana, šest meseci i godinu dana od ugradnje. Nakon godinu dana praćenja, flotirajući senzing u pretkomori iznosio je 1.6±0.7 mV, što je bilo manje, ali ne značajno, u kliničkom smislu. Uzevši sve ovo u obzir, VVD pejsing sistemi se mogu smatrati terapijom izbora kod bolesnika sa AV blokom i normalnom funkcijom SA čvora, naročito kod bolesnika starije populacije i onih sa lošim anatomskim strukturama koštanomišićnog i venskog sistema gornjeg dela grudnog koša, gde je ponekad otežano plasiranje dve elektrode DDDR sistema. *Acta Medica Medianae 2014;53(1):25-27.*

Ključne reči: *VDD pejsmejker, atrijalni senzing*

