Long-Term, Persistent Single-Lead DDD Pacing for Complete AV Block with Late Onset Chronotropic Incompetence – A Case Report

D. IGIDBASHIAN, G. LONARDI, M. GEMELLI, G.F. FRANCO
Cardiology Department, Electrophysiology Section, AUSSL 21, Legnago, Italy

R. AUDOGLIO
S.R.A., Pavia, Italy

Summary

A 73-year-old male patient with severely symptomatic, intermittent, complete atrioventricular (AV) block was implanted with a single-lead VDD system. This allows floating atrial backup pacing using the overlapping biphasic (OLBI) stimuli. The emergence of latent chronotropic incompetence with a resting heart rate of 35 – 40 bpm, due to administration of ß-blockers because of cardiac ischemia manifestation, necessiated institution of the DDD pacing with the basic rate of about 60 bpm. This was accomplished simply by activation of the atrial backup OLBI pacing, without implanting an additional lead or replacing the pulse generator. Pacing and sensing values remained stable over 4 years, with > 95 % atrial capture success and no adverse events associated with atrial pacing.

Key Words

Overlapping biphasic (OLBI) stimulation, single-lead VDD pacing, AV block, chronotropic incompetence

Case Report

A 73-year-old male patient, presenting with a severely symptomatic, intermittent, complete atrioventricular (AV) block, was admitted to the hospital in December 1996. In addition to the AV block, he suffered from a remote inferior wall myocardial infarction, a moderate aortic valve stenosis, and a mild-to-moderate chronic renal insufficiency. An echocardiographic investigation showed an aortic valve area of 0.9 cm, left ventricular hypertrophy, septal and posterior wall akinesia, and a left ventricular ejection fraction of 66 %. At the time of admission, he did not show evidence of sinus node dysfunction. Therefore, a single-lead VDD system, consisting of the Dromos SL M7 pacemaker and the SL 60/15-BP lead (Biotronik, Germany), was implanted. This system allows floating atrial backup pacing using the overlapping biphasic (OLBI) stimuli [1].

The implantation was performed according to standard procedure for placing a single-lead VDD system, with the pulse generator located in the high right pectoral region. Acute atrial and ventricular sensing values were 1.2 mV and 17 mV, respectively, associated with the slew rates of 0.5 V/s and 0.83 V/s, respectively. Ventricular pacing threshold was 0.5 V at the 0.5 ms pulse duration. Atrial pacing threshold was measured for the first time after implantation using pacemaker telemetry - the threshold value was 1.9 V at the 0.5-ms pulse duration. At this time, atrial sensing value ranged from 0.5 – 1.2 mV.

One month after discharge, the patient was readmitted to the hospital due to the onset of angina pectoris during mild effort. Coronary arteriography examination, performed because of the frequent recurrence of the angina pectoris, demonstrated three-vessel disease, with a clear indication for aorto-coronary bypass surgery. The patient was afraid of this type of treatment and refused to undergo major surgery, preferring instead to continue with the pharmacological approach adopted before consideration of the major surgery. The pharmacological treatment consisted of ß-blockers (Metoprolol) administered together with Amlodipine, Nitrates, and ASA. This had a satisfactory effect on the symptoms elevating the threshold of the effort angina. However, the patient manifested severe sinus node depression, probably due to latent chronotropic incompetence, which further complicated the situation with a sinus rate at rest ranging from 35 – 40 bpm,

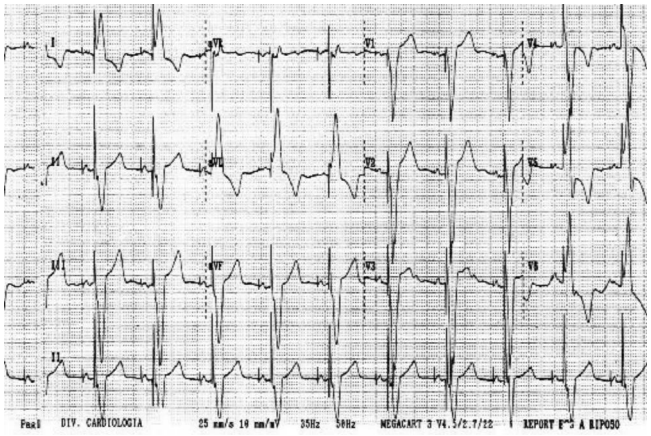


Figure 1. Dual-chamber pacing using overlapping biphasic (OLBI) stimulation delivered from floating atrial electrodes situated on the single AV lead (ECG recording during ambulatory follow-up).

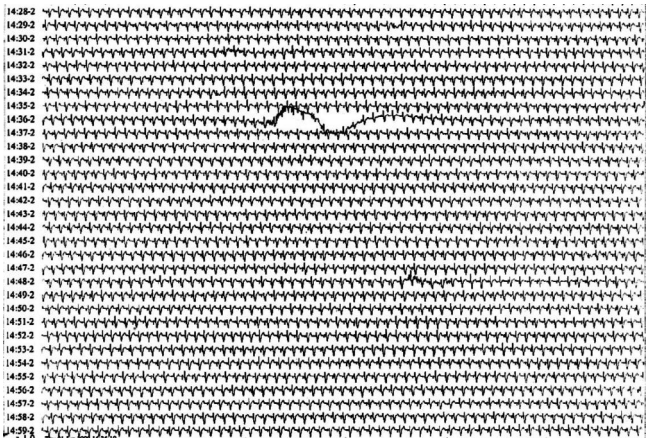


Figure 2. Persistent DDD pacing during 24h Holter ECG monitoring.

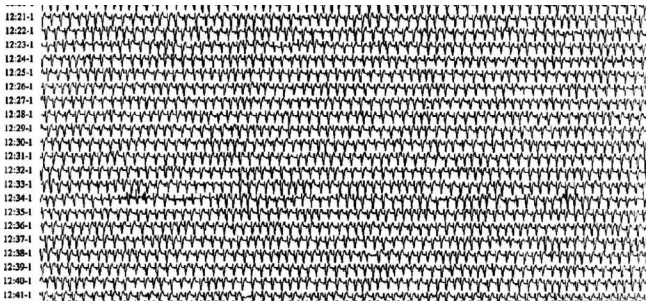
despite reduced ß-blockers dose.After initial uncertainty about the stability of the atrial capture, which was at the time unwarranted for unmonitored DDD pacing, the pacemaker – which had been implanted for an essentially VDD pacing indication – was programmed to the DDD mode with a lower rate of 60 bpm. A subsequent follow-up in 1- and 3-month intervals from then on, showed a slight increase in atrial pacing threshold after the first postoperative month. Thereafter, the threshold remained stable, at about 2.1 V. Atrial sensing value was relatively stable over time, ranging from 0.4 – 1.0 mV. Ventricular sensing and pacing threshold values during the follow-up were around 7.0 mV and 1.1 V (at 0.5 ms). Atrial sensitivity and output amplitude were programmed to 0.2 mV and 2.4 – 3.0 V in the chronic phase, respectively, and ventricular sensitivity and output amplitude to 4 mV and 3 V. Phrenic nerve stimulation and/or thoracic muscle stimulation did not occur spontaneously and could not be induced at the maximum pulse generator output of 4.8 V at the 0.5-ms pulse duration. Although the periodic follow-up and 24-hour ECG Holter recordings (Figures 1 and 2) documented the efficacy of the pulse generator (success of atrial capture > 95 %), the patient's clinical condition deteriorated progressively as a consequence of cardiac ischemia. Recurrent episodes of angina pectoris, expansion of the akinetic area with a significant reduction of the ejection fraction to approximately 40 %, and symptoms of left ventricular insufficiency, made the patient finally accept the surgical therapeutic approach in July 1998. He underwent triple aorto-coronary bypass surgery and aortic valve replacement.

Following the surgery, the patient's general condition improved and the ß-blocker therapy was discontinued with the subsequent moderate increase of the resting sinus rate. The pacemaker remained in the DDD mode with the lower rate programmed to 60 – 65 bpm. 24-hour Holter ECG recordings showed a frequent emergence of sinus activity and VDD stimulation, especially during spontaneous physical activity and during in-clinic exercise testing (Figure 3). At the most recent follow-up, the patient's clinical condition and the pacemaker performance were satisfactory.

Discussion

Efficacy of DDD pacing using OLBI stimulation delivered from floating atrial electrodes situated on the single AV lead was documented in this study over a nearly 4-year follow-up period. Atrial capture success was > 95 % during daily life. Besides complete intermittent AV block, the patient was presented with several factors complicating his clinical treatment. If the patient had been implanted with a conventional DDD pacemaker connected to a standard atrial and ventricular lead, the only possible discussion would be – could some sort of chronotropic incompetence have been foreseen? If yes, additional rate-responsive option would have been more appropriate.

However, there was no evidence of chronotropic incompetence at the time of implantation and this could not be predicted by the physician, who instead had in mind the possibility of a future need for cardiac surgery due to aortic valve stenosis. In particular, the physician considered the likelihood of problems rising during surgery due to



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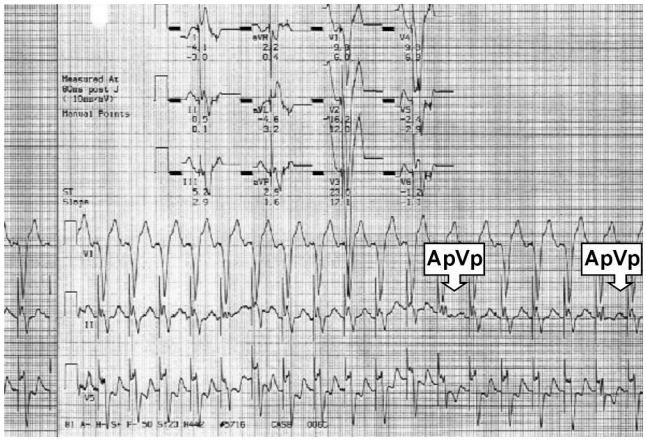

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Figure 3. a) Alternation of DDD and VDD pacing during spontaneous physical activity . All events of type ApVp (atrial pace – ventricular pace), i.e. DDD pacing, are those in which the P wave is negative.
b) Episodes of DDD and VDD pacing during in-clinic exercise testing. Atrial paced beats are indicated as ApVp, all other events are of type AsVp (atrial sense-ventricular pace)

the presence of two separate leads, along with the distinct possibility of atrial lead dislodgment, a development of high atrial pacing thresholds, and a significant drop in atrial sensing values after the surgery, essentially due to the introduction and removal of the extracorporeal circulation lines. Aside from not overstressing the circulatory system, the adopted solution, the use of a single AV lead, did not exclude the possibility of implanting a separate atrial lead if absolutely necessary.
The case presented in this article is to our knowledge the longest single experience of stable DDD pacing using OLBI atrial stimulation [2]. The events showed how this pacing system satisfactorily contributed to the solution of a peculiar situation, without undesirable effects and without the necessity of inserting an additional atrial lead or replacing the pulse generator.

Conclusions

The presented case report is an example of a complex, but not unusual, clinical situation complicating an AV block. It was treated by implanting a single-lead VDD system with an option for backup atrial pacing using OLBI stimuli. The unexpected necessity of permanent DDD pacing, which arose because of the development of chronotropic incompetence after pacemaker implantation, was satisfactorily resolved using the OLBI floating atrial pacing modality. The stability of favorable atrial sensing and pacing threshold values over time, obtained with these non-traditional atrial electrodes, contributed to the long-term favorable results. Besides providing particularly effective dual-chamber pacing for almost four years, the system did not give rise to any undesirable effect described in previous attempts to pace the atrium with the non-contact electrodes.
The outcome encourages the use of the single-lead VDD system with an option for backup atrial pacing in those patients in whom a clear indication for traditional double-lead dual-chamber stimulation is not mandatory at the time of implantation.

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Contact
Diran Igidbashian, MD
Divisione di Cardiologia
Ospedale Civile
Via Giannella 1
37045 Legnago
Italy
Telephone: +39 0442632229
E-mail: diran@libero.it