Left ventricular dysfunction due to right ventricular stimulation: is biventricular upgrade really necessary?

T. den Besten, M.I. Sedney, J. Frederiks, N.M. van Hemel

Left ventricular (LV) dysfunction can occur due to chronic right ventricular apical pacing. Upgrading of the pacemaker to biventricular pacing is an option to reverse LV dysfunction but reprogramming of the atrioventricular (AV) timing can also be favourable. In this case report we describe the effect of AV-time reprogramming in a patient with LV function deterioration that emerged two years after implantation of a dual chamber system for sick sinus syndrome. Echocardiographic studies demonstrated a tremendous improvement in LV function during two years follow-up whereas the percentage of right ventricular pacing diminished dramatically. Careful analysis of the cause of LV deterioration can avoid unnecessary upgrading to biventricular pacing. (Neth Heart J 2010;18:604-5.)

Keywords: Right Ventricular Pacing; Heart Failure; Biventricular Upgrade; Pacemaker; Follow up; AV interval

Several studies have documented unpredictably deleterious effects of chronic right ventricular (RV) apical pacing on the systolic left ventricular (LV) function eliciting symptomatic heart failure or aggravating pre-existent LV heart failure.¹⁻³ An adverse effect of dual chamber pacing (DDD) implicates the chance of unnecessary RV pacing, as can occur if a short AV time has been programmed.

T. den Besten

M.I. Sedney

J. Frederiks

Department of Cardiology, Bronovo Hospital, The Hague, the Netherlands

N.M. van Hemel

Professor Emeritus, Utrecht University, Utrecht, the Netherlands

Correspondence to: T. den Besten
Department of Cardiology, Bronovo Hospital, PO Box 226600,
1100 DD The Hague, the Netherlands
E-mail: tdenbesten@tiscali.nl

When an impaired systolic LV function becomes apparent in paced patients, pacemaker (PM) upgrading to biventricular pacing to reverse LV remodelling due to chronic abnormal LV conduction can be a vital therapeutic option. However, before considering this upgrade, a careful analysis of the pacing programme that might have provoked the LV function deterioration is always required. This case report underscores a potentially unfavourable effect of AV-time programming in DDD pacing on LV function.

Case report

A 73-year-old man underwent aortic and mitral valve surgery. Postoperatively a DDDR pacemaker (Insignia Plus DR 1298; Guidant) was implanted because of sinus bradycardia and pauses of up to 11 seconds. QRS duration was normal without atrioventricular conduction disturbance. After the implantation the PM was programmed in DDDR mode 60 to 145 beats/min, with a dynamic AV duration (150 to 180 ms) and AV offset of -30 ms. The AV interval and AV offset were default settings. The left ventricular function at implantation was normal: LVEF 60%. A few months later the patient underwent right atrial isthmus ablation because of paroxysmal atrial flutter. Nine months after implantation the Doppler echocardiographic study showed an LVEF of 45% and 22 months after implantation the LV function was further impaired (LVEF 30%): LV dyssynchrony as shown by tissue Doppler imaging: septal lateral delay 80 to 90 ms. At that time symptoms of heart failure (NYHA class III) emerged.

The PM memory showed ventricular pacing varying between 79 and 98% (mean 92%) over time during the past 22 months. Medication was administered consisting of amiodarone 200 mg (because of repeating paroxysmal atrial flutter), bisoprolol 2.5 mg, quinapril 40 mg, acenocoumarol and furosemide 40 mg daily but no improvement was observed. Before upgrading to biventricular pacing was considered, adverse effects of chronic RV pacing in this patient with sick sinus syndrome were thought to be the reason of this unfavourable course.

Intervention

Before reprogramming the intrinsic rhythm and conduction were examined. Sinus rhythm varying from 50 to 55 beats/min with normal atrioventricular conduction (180 ms) and QRS duration of 100 ms was observed. To prevent RV pacing as much as possible, the paced AV interval was lengthened to 200 ms and the AV-search mode was programmed to 280 ms. At that time also the echocardiographic parameters were evaluated with and without RV pacing. A clear difference in wall motion was observed with and without RV pacing.

Follow-up

After reprogramming, the percentage of RV pacing diminished to 11% and during the next 24 months this percentage showed a maximal value of 23% (mean 18%). Three weeks after reprogramming LV function improved with an increased LVEF of 50% which persisted after two years whereas asynchrony disappeared completely: septal lateral delay diminished to 20 ms. In the meantime the patient's condition and symptoms improved from NYHA class III to II. Furosemide could be reduced to 20 mg daily.

Discussion

This case shows that dual chamber pacing for sinus node disease resulted in an avoidable adverse effect consisting of systolic left ventricular heart failure. The reduction of the RV pacing percentage by prolongation of the AV interval, and thereby allowing for normal intraventricular conduction, resulted in persistent improvement of LV function. In this case the manufacturers default setting of pacing parameters ('out of the box setting') was accepted after implantation. Unfortunately, too little attention has been paid to tailoring the pacing parameters to the specific needs of our patient.

The Dutch study FOLLOWPACE demonstrated that after implantation the default programming of the manufacturer was completely accepted in 46% of the patients. In only 19.2% of the remaining patients, the AV interval was reprogrammed following implantation.⁴ Because the frequency of dual chamber PM implantation is currently clearly increasing, while the pacing indication for sinus node disease with usually normal intrinsic AV conduction is also rising, one should assume that most of these patients are unnecessarily RV paced.⁵ In our patient the mean percentage of RV pacing during follow-up, after reprogramming of the AV interval, was 18%. It can be questioned whether this pacing percentage suffices to preserve LV function, and secondly whether the AAIR mode was more preferable to avoid unnecessary RV pacing. The retrospective INTRINSIC-RV study showed a low risk of events including mortality and hospi-

tal admission for heart failure of 3%, in a subset of patients with a cardioverter defibrillator and DDD pacing if RV pacing was 10 to 19%, compared with an event rate of 14% if RV percentage pacing was more than 50%.⁶ In view of these data reprogramming only the AV interval instead of AAIR pacing appears justified in this case.

Finally one can question why upgrading to biventricular pacing was not carried out. According to European guidelines it is stated that chronic RV pacing showing congestive heart failure (NYHA class 3) and LVEF <35% can be treated with biventricular pacing.⁷ However these guidelines also advocate to avoid RV pacing as much as possible. This management dilemma can only be solved by careful analysis of the characteristics of the paced patient and the history of pacing treatment as shown by the PM memories. Our decision to rely on reprogramming of the AV interval only turned out to be successful.

Conclusion and Recommendations

This case shows that after PM implantation programming of the pacing parameters should match the reason for pacing and the characteristics of the PM recipient. Current PMs have extensive technical options to select the optimal pacing and sensing modes and to follow the consequences of the settings. This approach also implicates the avoidance of RV pacing that might deteriorate LV function. The effects of individually selected programming should also be examined during the follow-up with echocardiography and other clinical methods. ■

References

- 1 Antonis S, Manolis Review. The Deleterious Consequences of Right Ventricular Apical Pacing: Time to Seek Alternate Site Pacing. *PACE*. 2006;29:298-315.
- 2 Lupi G, Sassone B, Badano L, Peraldo C, Gaddi O, Sitges M, Parthenakis F, et al. Effects of Right Ventricular Pacing on Intra-Left Ventricular Electromechanical Activation in Patients With Native Narrow QRS. *Am J Cardiol*. 2006;98:219-22.
- 3 Vernooy K, Verbeek XAAM, Peschar M, Prinzen FW. Review: Relation Between Abnormal Ventricular Impulse Conduction and Heart Failure. *J Interv Cardiol*. 2003;16:557-62.
- 4 Eck van JWM, Hemel van NM, Voogt de WG, Meerder JG, Spierenburg HA, Crommentuyn H, et al., on behalf of the FOLLOWPACE investigators. Routine follow-up after pacemaker implantation: frequency, pacemaker programming and professionals in charge. *Europace*. 2008;10:832-37.
- 5 Hooijschuur C, Dijk A. Vijfentwintig jaar nationale pacemaker en ICD registratie: een onmisbare schakel in de zorg en communicatie verzorgd door de SPRN; Vijfentwintig jaar Stichting Pacemaker Registratie Nederland, een verantwoording en terugblik. (2007).
- 6 Olshansky B, Day JD, Lerew DR, Brown S, Stolen KQ, for the INTRINSIC RV Study Investigators. Eliminating right ventricular pacing may not be best for patients requiring implantable cardioverter-defibrillators. *Heart Rhythm*. 2007;4:886-91.
- 7 European Society Cardiology (ESC). Guidelines for cardiac pacing and cardiac resynchronization therapy. *Eur Heart J*. 2007;28:2256-95.