Case of Dual Chamber Pacemaker with Cross Stimulation

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MJAFI 2008; 64 : 288-290

Key Words: Pacemaker; Dual chamber cross stimulation

Introduction

There are mainly two types of pacemakers namely single and dual chamber, though a third type of pacemaker, given for different indication is biventricular pacemaker. Single chamber pacemakers are either atrial or ventricular in type. Dual chamber pacemakers have two leads which are to be fixed in specific ports of the generator. If these leads are interchanged in the ports inadvertently, cross stimulation will occur.

Case Report

A 60 years male patient reported with episodes of syncope for the last one week. The syncopal episodes, on two occasions occurred at rest and once when the patient was walking. Each time the episodes lasted for 30-40 seconds. There was no history of chest pain, diabetes, palpitation or breathlessness, bowel or bladder incontinence during the episodes, weakness of any part of the body or headache after the episode. On examination, his blood pressure (BP) was 160/90 mm Hg (he was not a known hypertensive). His heart rate was 60/min. Clinical examination did not reveal any abnormality.

Electrocardiography (ECG) showed right bundle branch block (RBBB) with PR interval of 0.20 second and left axis deviation. Echocardiography showed no regional wall motion abnormality, and ejection fraction was 70%. Electro physiological studies showed HV interval of 80 millisecond and on atrial pacing at 120/minute, he developed 2:1 AV block. So he was given dual chamber pacemaker with possibility of intermittent complete heart block as a cause of his syncope. He was discharged after removal of stitches. During hospital stay, his ECG showed normal sinus rhythm with atrial and ventricular sensing.

The patient reported back after a month with breathlessness on climbing uphill. His ECG was taken, which showed VVI pacing with no apparent P waves or atrial pacing spike, suggesting displacement of atrial lead. But since his previous ECG showed well formed P waves and now there were no P waves, this possibility was not very high. On close examination of ECG, P waves seemed to follow QRS complexes,

better seen in leads V5, V6 (Fig. 1). This was suggestive of two possibilities- either displacement of atrial lead into the ventricle or cross stimulation. Fluoroscopy did not reveal any lead displacement.

Now the programming was done. On VVI pacing, ECG showed P waves followed by QRS complexes (Fig. 2). On Atrial pacing, ECG showed VVI pacing (Fig. 3), thus confirming cross stimulation due to cross connection in generator. This was corrected after opening the generator surgically, which normalized the ECG (Fig. 4).

Discussion

Cross stimulation can be defined as stimulation of one cardiac chamber when stimulation of the other is expected. This could be due to inadvertent placement of the ventricular lead in to the atrial connector and the atrial lead in to the ventricular connector of the pulse generator or dislodgement of either into the other chamber, both of which are true system malfunctions. Coronary sinus placement, either intentionally or accidentally, may cause continued or intermittent cross stimulation. For all these situations, surgical revision of pacing system is the only option for correction. Several reports of cross stimulation have been reported, but they are not due to these situations [1-3]. The internal crossover within the pulse generator may be the cause. This can be seen in dual unipolar system with leads connected but before placement in the pocket as the current crosses from one electrode to the other and back to the pulse generator through the other lead. In this case, because the atrial output is first, atrial capture is obscured by the ventricular capture. Because the impedance in this system is high, it requires a high output with a very low capture threshold. After pulse generator is implanted, the phenomenon ceases. There is also a system that has internal energy crossover, when magnet is applied to the pacemaker. Here the amount of energy crossover is minimal and capture can only be demonstrated when capture threshold is very low. In all

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Fig. 1: ECG showing VVI pacing without atrial pacing spike/P waves. On close observation, P waves are seen following the QRS complexes.

Fig. 2 : On VVI pacing, ECG shows P waves followed by QRS complexes.

Fig. 3 : On AAI pacing, ECG shows VVI pacing.

these cases, this reverts after several weeks as lead maturation resulted in a rise in capture threshold. Although cross stimulation is rare, familiarity with cross stimulation and pseudo cross stimulation is important because its recognition will avoid erroneous diagnosis of lead dislodgement or device malfunction [4].

Our case was due to inadvertent placement of atrial lead into the ventricular connector and ventricular lead into the atrial connector. Since shape of the ends of the

leads connected to the generator is similar, this can happen if we do not pay attention to the red mark on atrial lead near the connecting end. Most of the times, this is detected at once on ECG monitor and so corrected immediately. Unfortunately our patient was in normal sinus rhythm during implantation of pacemaker, with a heart rate of about 80/min. So monitor as well as pacemaker system analyzer showed atrial and ventricular sensing. This continued throughout the

Fig. 4 : ECG after interchanging of lead connection in pacing generator, showing atrial and ventricular pacing.

hospital stay and hence went unnoticed. But when the patient came back for follow-up, his intrinsic sinus rate was low and so patient was in paced rhythm, showing ventricular paced beats followed by atrial paced beats.

To avoid such recurrences, we advocate that in patients who are on their own intrinsic rhythm at the time of implantation of pacemaker, should be paced at low rate above the intrinsic rate in the operating laboratory, so that cross stimulation can be detected and corrected.

Conflicts of Interest

None identified

References

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Answers to MCQs

1. b	2. c	3. a	4. d	5. b
6. a	7. c	8. a	9. d	10. c
11. d	12. c	13. b	14. c	15. d