CASE REPORT

Electrocardiographic Algorithm for the Diagnosis of Inadvertent Implantation of Permanent Pacemaker Lead in the Left Ventricular Cavity

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Inadvertent placement of a pacemaker lead electrode in the left ventricle is an unusual complication and the electrocardiogram is a useful tool for the diagnoses. We present such a patient and review the electrocardiographic characteristics that should raise such a possibility.

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implantable devices; pacemaker-bradyarrhythmias; electrocardiography

INTRODUCTION

Misplacement of a ventricular pacemaker lead into the left ventricle is an unusual complication. The electrocardiogram (ECG) should raise such a possibility. We report a patient with pacemaker lead implantation into the left ventricle through a permanent foramen ovale (PFO) and its ECG characteristics.

CASE REPORT

A permanent VDD pacemaker was implanted in an 85-year-old wheelchair-ridden male patient who presented with weakness and second-degree atrioventricular block, Mobitz type II.

Follow-up ECG showed pacemaker rhythm with a right bundle branch block (RBBB) pattern (Fig. 1). Electrode positioning was confirmed by bed side antero-posterior chest x-ray due to patient poor mobility. The patient was discharged to a nursing home. Follow-up in the pacemaker clinic showed normal parameters.

Six months later the patient complained of new-onset dyspnea. Echocardiography revealed that the pacemaker electrode passed from the right atrium to the left ventricular cavity through a

PFO. Left ventricular function was normal without significant valvular abnormalities. Due to normal pacemaker function and patient stable status a decision not to reposition the pacemaker lead was taken.

DISCUSSION

Usually the ECG during right ventricular (RV) pacing shows a left bundle branch block (LBBB) pattern while left ventricular (LV) pacing shows an RBBB pattern.

An RBBB pattern after attempted RV pacing may be secondary to inadvertent LV pacing or more commonly due to true RV pacing (pseudo RBBB). In such a scenario, standard limb leads show an LBBB pattern and the final QRS vector is oriented to the left, superior, and anterior direction.¹ Pseudo RBBB can be eliminated by recording V1 and V2 leads one intercostal space lower.^{2–4} Disappearance of RBBB pattern by this maneuver is explained by the superior and slightly anterior orientation of the ventricular activation during right ventricular septal pacing. In contrast to pseudo RBBB, during left ventricular pacing the final vector is oriented to the right, inferior, and posterior.⁴

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Figure 1. The surface ECG of the patient with left ventricular electrode.

Table 1. The criteria used to identify right ventricular placement of the electrode in the presence of the right BBB pattern

	Pacemaker Lead in Right Ventricle	Pacemaker Lead in Left Ventricle or Coronary Sinus
RBBB pattern on 12-lead ECG	Yes	Yes
Frontal axis is between -30 and -90°	Yes	No
Precordial transition $<V_3$	Yes	No
Presence of S in L1	No	Yes

Okmen et al.³ proposed an algorithm for determining the location of pacemaker lead in patients with an RBBB ECG pattern during ventricular pacing. Using the following criteria: left superior axis deviation in the frontal plane between -30 and -90 degrees, precordial transition at V_3 , the absence of S wave in lead I and qR or RS in V_1 , the sensitivities and specificities for a correct diagnosis were 97% and 100%; 97% and 100%; 94% and 100%; and 97% and 100%, respectively (Table 1).

The ECG of our patient was compatible with LV malposition according to Okmen algorithm. It showed an undetermined axis, the transitional zone was at V_5 - V_6 , a qR pattern was present in V_1 and an S wave in lead I.

It is necessary to differentiate left ventricular epicardial pacing during cardiac resynchroniza-

tion therapy (CRT), which is a normal location from left ventricular cavity pacing which is an unusual complication of right ventricular pacing implantation.

Usually during CRT pacing the QRS is a fusion beat between RV and LV pacing and the QRS changes accordingly.⁵ It is important to obtain the information regarding the type of pacemaker that was intended to be implanted.

In conclusion, after pacemaker implantation lateral and antero-posterior chest x-ray are indicated for assuring normal lead placement and in doubtful cases echocardiography can be implemented.^{6,7} ECG algorithm as described by Okmen et al. may be useful for diagnosing LV electrode misplacement in cases of attempted RV placement and an ECG RBBB pattern.

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