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Case Report

A pacemaker lead in the left ventricle: An "unexpected" finding?

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ABSTRACT

Inadvertent malposition of a pacemaker lead in the left ventricle is uncommon, but it should not be misdiagnosed.

We report the case of a 68-year-old woman with symptomatic sick-sinus syndrome requiring pacemaker implantation. Shortly afterwards the lead was extracted and a new pacemaker was contralaterally implanted due to pocket hematoma and suspected lead fracture. Three months later, she was referred to our echocardiography laboratory complaining of asthenia. At transthoracic echocardiography an echo-bright linear structure was recognized in left atrium, passing through the mitral valve and leaning against the posterior left ventricular wall. In short-axis and apical views, the lead apparently crossed the interatrial septum through patent foramen ovale. The QRS-paced electrocardiogram showed right bundle branch block morphology. The lead was apparently well positioned, examining the chest X-ray postero-anterior view. On the contrary, by latero-lateral view and left-anterior oblique view, lead curvature was consistent with misplacement into the left ventricle. Malposition was confirmed by transesophageal echocardiography. Given the relatively recent implant, system revision with lead extraction was scheduled and completed without complications.

This case report is intended to improve our awareness in the prevention and in the prompt detection of misplaced pacemaker leads in order to manage an immediate correction.

<**Learning objective:** During lead implantation, fluoroscopic left-anterior oblique view should be always used to ensure correct positioning. At least 3–6 limb leads should be carefully monitored during the procedure, and a 12-lead standard electrocardiogram should be performed shortly afterwards for the paced QRS morphology. Lateral chest X-ray should always be taken after implantation. In cases of doubt, echocardiography (transthoracic or transesophageal) may confirm abnormal lead placement defining the route covered by the catheter.>

Introduction

Inadvertent malposition of a pacemaker (PM) lead into left ventricle (LV) is an uncommon but probably underestimated device-related complication [1].

Only few cases are reported on this issue.

We refer a case of malposition of a PM lead into LV as an unexpected finding during transthoracic echocardiography (TTE).

Case report

A 68-year-old woman was referred in January 2019 to our echocardiography laboratory complaining of asthenia.

The patient suffered in the past from sick sinus syndrome, with "lone" paroxysmal atrial fibrillation (AF) and symptomatic 5–6 s pauses at the resuming of sinus rhythm. Therefore, in June 2018 she elsewhere was implanted with a ventricular single-chamber (VVI) PM. In October 2018 she fell down, knocking her left shoulder, and the PM interrogation disclosed high thresholds and low sensing values. Lead repositioning was considered not reliable, due to possible traumatic damage. Therefore, the lead was extracted, but the ipsilateral insertion of a new PM catheter failed and a contralateral implantation was required.

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At our TTE examination, in parasternal long-axis view an echo-bright linear structure was seen in left atrium (LA) passing through mitral valve and leaning against posterior LV wall; in short-axis and apical views it was seen to cross the interatrial septum (Fig. 1A, B). Furthermore, a left-to-right shunt was displayed at this level. Inappropriate lead placement in LV was suspected and the patient was admitted to our hospital.

At the PM control ventricular pacing was 10%; electrical parameters were in normal ranges (threshold 0.5 V at 0.4 ms; sensing 9.5 mV, and lead impedance 854 Ω), but the electrocardiogram (ECG) performed during PM stimulation showed right bundle branch block (RBBB) QRS-paced morphology and a −120° deviation in the frontal plane (Fig. 2A).

A chest X-ray was taken: the lead seemed correctly positioned on the postero-anterior (PA) view, while it curved backwards at right atrium (RA) level on the latero-lateral (LL) projection, thus suggesting electrode misplacement into LV or coronary sinus (CS) (Fig. 3A,B).

The use of fluoroscopic left anterior oblique (LAO) view confirmed this suspicion (Fig. 3C–F).

A transesophageal echocardiography (TEE) was subsequently performed, displaying the lead passing through a patent foramen ovale (PFO), then moving into the LA and through the mitral valve orifice into the LV; a left-to-right shunt was proven to be exactly at the site of the lead crossing the interatrial septum (Fig. 1C,D). Even if at TEE no thrombi were detected attached to the lead, apixaban therapy was discontinued and low molecular weight heparin started, since the TEE cannot reliably exclude adherent thrombi and the use of direct oral anticoagulants has not been explored in this setting.

Two treatment strategies were then addressed: maintenance of the lead in the LV position with continuation of warfarin versus lead extraction. Given the relatively recent implant, lead extraction was preferred.

The passive fixation lead was removed from LV using simple traction without complications. Extraction of the malpositioned lead was performed with active cardiac surgery back-up. The extracted lead was macroscopically normal. In particular, neither macroscopic lead damage, nor unusual calcifications or attached thrombi were observed. Moreover, no adherences with fragments of mitral valve leaflets or subvalvular chordae were detected. Fragments of the pin and the tip of the extracted lead were cut and sent to the microbiology department for bacteriological analyses: they returned negative results. An immediate pacing was not required at that moment, and therefore we preferred to monitor for possible complications for the subsequent 24–48 h, instead of implanting a new PM during the same procedure. Considering the relatively young age of the patient, the relatively scarce symptoms, and the complications due to the previous procedures, we tried avoiding a new PM reimplantation, or at least deferring it for as long as possible. During the same hospital stay we performed repeated Holter monitoring, that, without antiarrhythmic therapy,

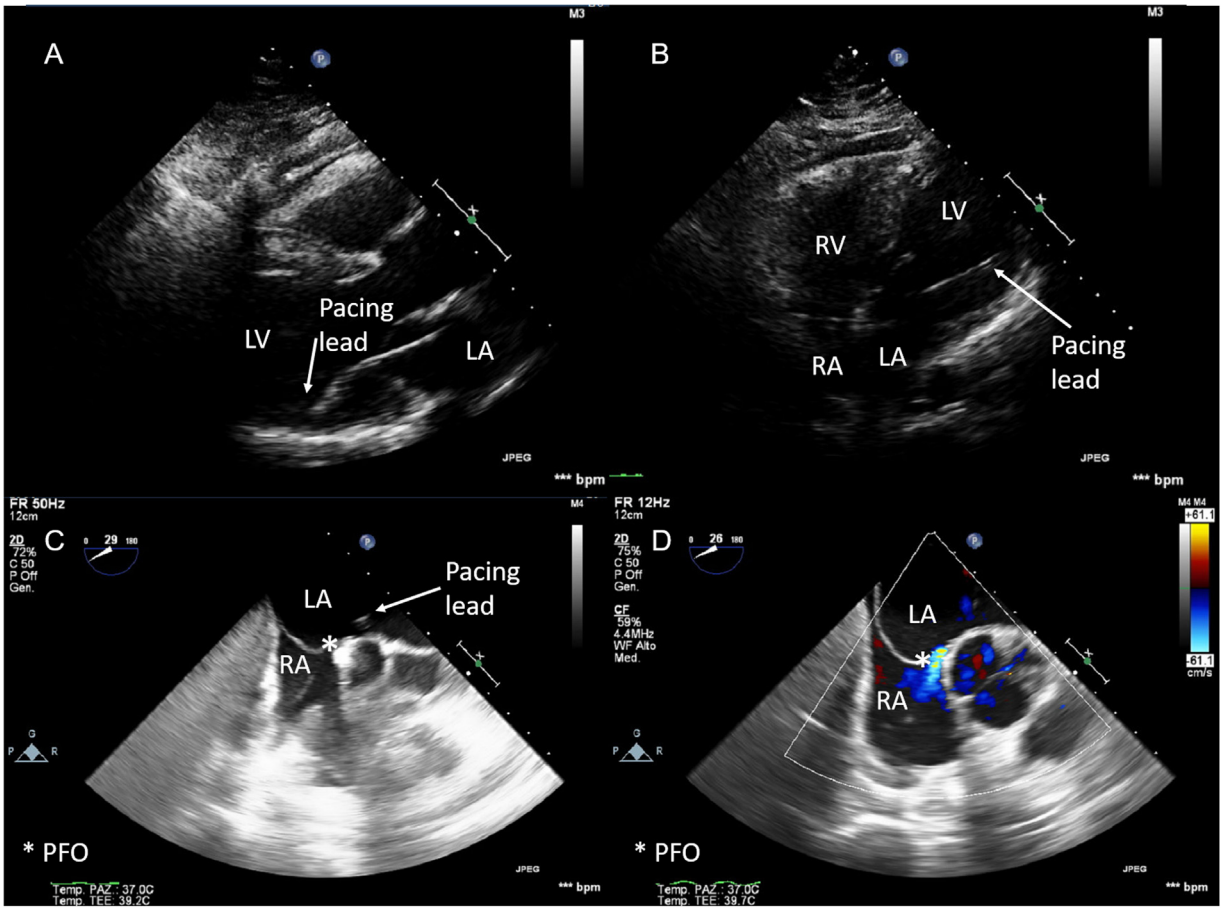

Fig. 1. Composite image of echocardiographic views from transthoracic echocardiography long-axis (A) and apical window (B) and transesophageal echocardiography 30° short-axis view (C,D). The pacing lead can be seen passing from right atrium (RA) to left atrium (LA) through the interatrial septum and then into the left ventricle (LV); a left-to-right shunt proved to be exactly at the site of the lead crossing the interatrial septum.
PFO, patent foramen ovale; RA, right atrium.

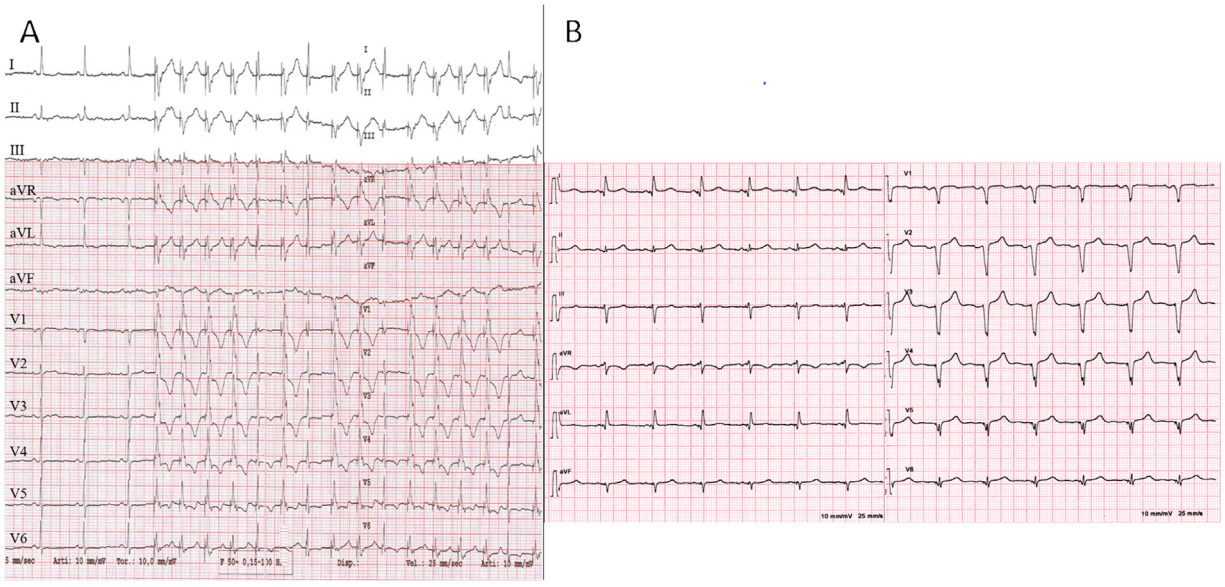

Fig. 2. (A) 12-lead electrocardiogram (ECG) during ventricular pacing showing right bundle branch block morphology of the QRS complex with a frontal plane axis of −120°. (B) Standard 12-lead ECG recorded after the last pacemaker implantation. Note the left-axis deviation in the limb leads. The QRS duration is only slightly enlarged, due to a mid-septal position of the lead tip and to a fusion between spontaneous and paced electrical activation of the ventricle.

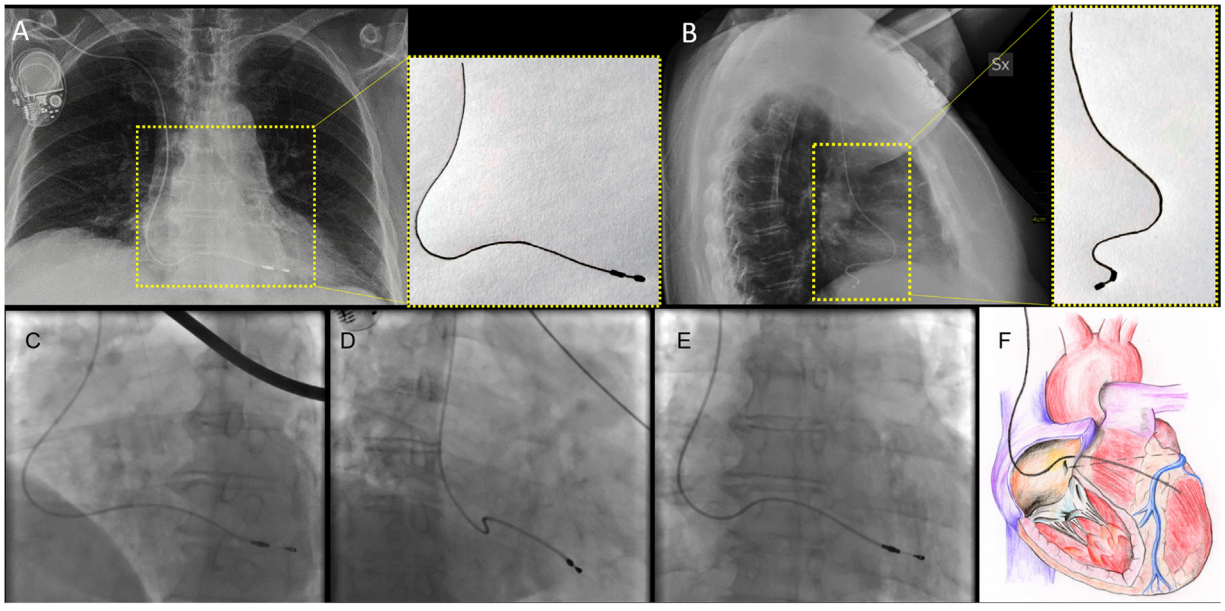

Fig. 3. In the upper box: patient's chest X-ray: postero-anterior (PA) view (A); latero-lateral view (B), with blow-up indicating the pathway of the lead in the two projections; in the lower box: fluoroscopic images: 40° left anterior oblique view (C); 30° right anterior oblique view (D); PA view (E); a schematic representation of the lead malpositioned in the left ventricle, based on the PA projection; the location of the coronary sinus is depicted by the dotted line (F).

never disclosed any pathological pause at the end of AF episodes, an exercise stress test that showed normal chronotropic competence, and finally the patient underwent AF ablation. A loop-recorder was implanted for monitoring potential pauses and for disclosing a clear correlation with symptoms.

Within three months after AF ablation, the loop-recorder disclosed asymptomatic pauses of 4–5 s at the end of recurrent AF episodes. Thus, a DDDR PM implantation was performed. The procedure was made by fluoroscopic multiple-view guidance, and by continuous analysis of a 6-limb lead ECG tracing. Moreover, a TTE recording during the procedure confirmed correct advancing and placement of the PM lead into right ventricle (RV). We preferred a mid-septal position of the lead tip, in this specific case especially for avoiding apical scars with sub-optimal electrical behavior and potential risk of wall perforation due to the previous implantation. The new correct position was also confirmed by a standard 12-lead ECG tracing (Fig. 2B).

Discussion

Anatomic variations largely account for lead misplacement into LV during the implantation of a cardiac device [2].

The most common route is through the interatrial septum, and PFO is the most frequent cause, as in our patient.

Possible complications of a malpositioned lead into the LV are systemic thromboembolic events (more than one-third of cases) [3], perforation of the mitral valve or of the LV wall, mitral valve regurgitation due to the malpositioned lead bending the valve leaflets, risk of aortic and mitral valve infectious endocarditis, and higher probability of diaphragmatic pacing and loss of capture.

Fortunately, none of these complications occurred in our patient, whose malpositioned lead was diagnosed by chance during a routine TTE.

The prevention of lead misplacement is pivotal: the use of fluoroscopic 40° LAO view at the time of implantation is advisable [4]. It clearly identifies interatrial and interventricular septum. The lead inadvertently passed through a PFO into the LV points beyond the spine in the LAO projection, towards LV contour.

After the implantation, careful evaluation of the 12-lead ECG during RV pacing is of a great value to confirm correct lead placement.

Typical QRS morphology during RV stimulation has a left bundle branch block pattern. A paced RBBB morphology should suggest LV capture because of the lead implantation in a CS branch or owing to a "true" endocardial LV placement. An atypical RBBB pattern may also be related to myocardial scar (with consequent conduction block). It may also be due to pseudo-fusion in patients with underlying RBBB. Furthermore, a "pseudo-RBBB pattern" in V1–V2 has been described [5]. Indeed, recording V1 and V2 leads one intercostal space below the usual eliminates the pseudo-RBBB pattern and results in inscription of a QS complex. This may be due to a "true" non-apical RV stimulation, but it may also be related to RV morphology/orientation (i.e. RV dilatation).

Taken as a whole, RBBB pattern may be observed in 8%–20% of the patients during RV pacing; however, a precordial transition at or before lead V3 essentially rules out inadvertent LV pacing while a frontal plane axis of −90° to −180° is specific for LV stimulation [6]. The ECG of our patient was consistent with this algorithm suggesting LV activation.

The postoperative chest radiograph is also a valuable aid for identifying lead malposition [7]: LL projection is the clarifying view. On the LL view the tip of a malpositioned LV lead is characteristically steered toward the spine. On the posteroanterior (PA) chest X-ray the lead malpositioned in the LV may be hardly distinguishable from the one correctly implanted in the CS, as the radiological appearance may look similar. However, in the LL radiograph, a lead inadvertently placed in the LV will be visualized within the posterior border of the heart, whereas a lead placed in the CS will hug such a border since it is epicardial.

Only a PA X-ray view was taken after the implantation and this might explain the missed diagnosis at discharge.

TTE is the imaging tool of choice to confirm the exact position of the electrode and trace its route [8]. TEE should be done if TTE is not clarifying.

In our patient the malpositioned lead was clearly detectable by TTE and TEE and malposition in CS was excluded.

Treatment of patients with misplaced electrode in the LV remains controversial. The behavior depends on the implantation time, clinical presentation, and occurrence of complications. If diagnosis is made immediately after implantation, percutaneous lead extraction can reduce the risk of future thromboembolic events without the need for lifelong anticoagulation. Percutaneous LV lead extraction has been performed successfully up to 9 months after implantation [9]. In cases of chronic implantation into the LV, the Heart Rhythm Society Expert Consensus on lead extraction [10] states that lead removal is not indicated.

Indeed, when diagnosis is delayed, thrombi may develop around the site of lead placement, with subsequent systemic embolization risk. The patients who remain asymptomatic may opt for anticoagulation with warfarin, targeting international normalized ratio between 2.5 and 3.5. If cerebral embolic events occur, catheter surgical extraction should be reconsidered.

In the reported case, LV lead placement was recognized about 3 months after implantation and the percutaneous lead extraction was performed without complications.

Consent

The authors confirm that written consent for submission and publication of this case report including images and associated text has been obtained from the patient in line with Committee on Publication Ethics guidance.

Declarations of interest

The authors declare that there is no conflict of interest.

Source of funding

None.

References

[1] Ohlow MA, Roos M, Lauer B, Von Korn H, Geller JC. Incidence, predictors, and outcome of inadvertent malposition of transvenous pacing or defibrillation lead in the left heart. Europace 2016;18:1049–54.
[2] Ninot S, Sanchez G, Mestres CA. An unusual travel of an endocardial pacing lead to the left ventricle. Interact Cardiovasc Thorac Surg 2003;2:624–5.
[3] van Gelder BM, Bracke FA, Oto A, Yildirir A, Haas PC, Seger JJ, et al. Diagnosis and management of inadvertently placed pacing and ICD leads in the left ventricle: a multicenter experience and review of the literature. Pacing Clin Electrophysiol 2000;23:877–83.
[4] Trohman RG, Sharma PS. Detecting and managing device leads inadvertently placed in the left ventricle. Cleve Clin J Med 2018;85:69–75.
[5] Klein HO, Beker B, Sareli P, DiSegni E, Dean H, Kaplinsky E. Unusual QRS morphology associated with transvenous pacemakers. The pseudo RBBB pattern. Chest 1985;87:517–21.
[6] Coman JA, Trohman RG. Incidence and electrocardiographic localization of safe right bundle branch block configurations during permanent ventricular pacing. Am J Cardiol 1995;76:781–4.
[7] Wynn GJ, Weston C, Cooper RJ, Somauroo JD. Inadvertent left ventricular pacing through a patent foramen ovale: identification, management and implications for postpacemaker implantation checks. BMJ Case Rep 2013;2013. pii:bcr2012008312.
[8] Ananthasubramaniam K, Alam M, Karthikeyan V. Abnormal implantation of permanent pacemaker lead in the left ventricle via a patent foramen ovale: clinical and echocardiographic recognition of a rare complication. J Am Soc Echocardiogr 2001;14:231–3.
[9] de Cock CC, van Campen CM, Kamp O, Visser CA. Successful percutaneous extraction of an inadvertently placed left ventricular pacing lead. Europace 2003;5:195–7.
[10] Wilkoff BL, Love CJ, Byrd CL, Bongiorni MG, Carrillo RG, Crossley 3rd GH, et al. Transvenous lead extraction: Heart Rhythm Society expert consensus on facilities, training, indications, and patient management: this document was endorsed by the American Heart Association (AHA). Heart Rhythm 2009;6:1085–104.