CASE REPORT

Inadvertent left ventricular pacing through a patent foramen ovale: identification, management and implications for postpacemaker implantation checks

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SUMMARY

A dual chamber permanent pacemaker was implanted into an asymptomatic man with complete (third degree) heart block because of the risk of asystole. The ventricular lead was thought to have been attached to the right ventricular septum; however, it inadvertently passed through a patent foramen ovale into the left ventricle. Although the postprocedure ECG showed right bundle branch block this was thought to be due to the presumed septal positioning of the pacing lead. Lead misplacement was not detected on posteroanterior chest X-ray but was clearly demonstrated by transthoracic echocardiography, and subsequently on lateral chest X-ray. The lead was successfully removed and repositioned correctly at the next available opportunity without complication or sequelae.

BACKGROUND

Once the preserve of large tertiary teaching hospitals, permanent pacemaker implantation is now carried out routinely in district hospitals where procedure volumes are lower and complications may not be picked up so readily. Postprocedural investigations such as an ECG and chest X-ray are intended to identify problems and complications but can be misinterpreted and further investigations, such as lateral chest X-ray films and echocardiography may be required (figures 1 and 2).

CASE PRESENTATION

An 81-year-old man was referred by his general practitioner with an incidental finding of bradycardia at routine check-up. He was asymptomatic; however, his ECG revealed complete atrioventricular block with a low ventricular rate and broad complex escape rhythm. Despite his lack of symptoms he was considered to be at high risk of developing asystole and therefore underwent permanent pacemaker implantation. The procedure was performed using a left infraclavicular approach and a dual chamber system was implanted with an active fixation ventricular lead screwed into what was believed to be the low right ventricular septum. The procedure appeared to be completed without complication.

An ECG was performed in the immediate post-procedure period and was noted to show sequential pacing with a right bundle branch block (RBBB) QRS pattern. The ECG was reviewed but, partly because the procedure appeared to have been

performed without difficulty, it was felt that the QRS pattern was due to the septal position of the active fixation lead. An anteroposterior chest X-ray was performed the same evening and appeared to show a satisfactory lead position (figure 2, left panel). In keeping with hospital protocol a lateral film was not performed (figure 2 right panel—performed at a later date).

INVESTIGATIONS

An echocardiogram was performed in the days following the procedure (figure 1). In the initial parasternal long axis view an echobright linear structure was seen passing through the mitral valve (A) and in the short axis and apical views was seen to cross the intra-atrial septum (B, C). A subcostal view clearly showed the pacing lead entering the right atrium, crossing the intraventricular septum and passing through the tricuspid valve into the left ventricle (D).

TREATMENT

Antiplatelet therapy was initiated to try to reduce the risk of thrombus formation on the lead (which was in the systemic circulation and therefore a risk factor for embolic stroke). A lateral chest X-ray confirmed the malpositioned pacing lead (figure 2, right panel). System revision was scheduled at the next available opportunity. The active lead was unscrewed from its position in the left ventricle and removed using simple traction. The lead was then resited at the apex of the right ventricle. The postprocedural ECG showed left bundle branch block morphology paced complexes and posteroanterior and lateral chest X-rays showed correct lead positioning (figure 3).

OUTCOME AND FOLLOW-UP

The pacemaker system revision was completed without complication and the patient was discharged home shortly afterwards. His follow-up since then has been uneventful and he suffered no adverse sequelae.

DISCUSSION

Inadvertent left ventricular placement of a permanent pacing wire through a patent foramen ovale is unusual but several previous reports exist. In all cases where details were disclosed, the ECG showed RBBB. A posteroanterior chest X-ray may not clearly demonstrate the malposition.¹ Although

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Figure 1 Composite image of echocardiographic images from the parasternal long (A) and short (B) axes, apical and subcostal imaging windows. The pacing wire can clearly be seen passing from right atrium to left atrium through the patent foramen ovale and then into the left ventricle. Ao, Aorta; AV, Aortic valve; LA, left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle.

Figure 2 Initial posteroanterior (left panel) and lateral (right panel) chest X-rays. With the positions of the atrioventricular valves highlighted, it can be appreciated that the pacing wire passes through the mitral valve to the left ventricle rather than through the tricuspid valve to the right ventricle as was originally thought. LV, left ventricle; MV, mitral valve; RA, right atrium; RV, right ventricle; TV, tricuspid valve.

Figure 3 Posteroanterior (left panel) and lateral (right panel) chest X-rays performed after pacemaker system revision showing correct lead positioning. RA, right atrium; RV, right ventricle.

RBBB can be seen with right ventricular pacing it is unusual and there is a high likelihood of a lead malposition and therefore a lateral chest X-ray should be considered obligatory.² For device implanters, the use of fluoroscopic left anterior oblique angulation at the time of implantation is advisable. This view clearly separates the posterior left ventricle and mitral valve from the anterior right ventricle and tricuspid valve.

In reported cases the presenting feature in 1/3 was a thromboembolic event, which is the most serious concern about a lead in the systemic side of the circulation. Other complications including severe mitral regurgitation have also been reported.³ Various management strategies have been advocated.

The longest reported event free interval without any intervention is 16 years; however, thrombus has been demonstrated as early as 2 weeks, with the soonest reported thromboembolic event 1 month postlead insertion.⁴ Antiplatelet therapy is probably inadequate to prevent thromboembolism.^{4–5} Transcatheter revision is associated with risk of dislodging already formed thrombus and debris risking procedural embolic stroke.⁶ Surgical removal carries significant morbidity and risk, including the possibility of requiring cardiopulmonary bypass. However, the risk of thrombus dislodgement from the lead is lowest with a surgical approach and this is undoubtedly the technique of choice if there is a separate surgical indication (eg, concomitant coronary artery bypass grafting).⁷ Cases have been reported with no thromboembolic events while on long-term anticoagulation for up to 10 years.⁸ Unfortunately, even transoesophageal echocardiography may be inadequate to reliably identify lead-adherent thrombus preprocedurally.⁹

Where very early lead extraction can be performed this is probably the treatment of choice, particularly within the first 2 weeks, which may possibly be extended if antiplatelet therapy has been used. Leads implanted for more than a year may be technically difficult to extract and long-term anticoagulation is likely to be the safest option. When lead misplacement is discovered between a fortnight and a year after implantation the decision on management must be made on a case-by-case basis.

Learning points

- ▶ Pacing leads can pass easily through a patent foramen ovale and may not be noticed if the implanting physician does not remain alert to the possibility.
- ▶ Right ventricular pacing usually produces broad left bundle branch block on the ECG and any other electrocardiographic pattern should alert the clinician to the possibility of a misplaced lead.
- ▶ Despite the nomenclature the right and left ventricles lie in the same plane when viewed on a standard posteroanterior chest X-ray and a lead passing to the left ventricle may be missed without a lateral chest X-ray, particularly if the lead is intended to be implanted at the right ventricular septum rather than the apex.
- ▶ Echocardiography can be a useful tool if there is uncertainty about the position of a pacing lead.
- ▶ When inadvertent left ventricular pacing is discovered early the treatment of choice is lead removal and repositioning. Chronically implanted leads may be best managed with life-long anticoagulation.

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REFERENCES

- 1 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.

- 2 Reising S, Safford R, Castello R, *et al.* A stroke of bad luck: left ventricular pacemaker malposition. *J Am Soc Echocardiogr* 2007;20:1316.e1–3.
- 3 Rodriguez Y, Baltodano P, Tower A, *et al.* Management of symptomatic inadvertently placed endocardial leads in the left ventricle. *Pacing Clin Electrophysiol* 2011;34:1192–200.
- 4 VanGelder BM, Bracke FA, Oto A, *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.
- 5 Bohm A, Banyai F, Komaromy K, *et al.* Cerebral embolism due to a retained pacemaker lead: a case report. *PACE* 1998;21:629–30.
- 6 Kutarski A, Pietura R, Tomaszewski A, *et al.* Transvenous extraction of a five year-old ventricular lead inadvertently implanted in the left ventricle. *Kardiol Pol* 2011;69:625–8.
- 7 Ergun K, Cagli K, Sahin O, *et al.* Atrioventricular membrane perforation: a very rare complication of transvenous pacemaker implantation. *J Am Soc Echocardiogr* 2005;18:71–4.
- 8 Trohman RC, Wilkoff BL, Byrne T, *et al.* Successful percutaneous extraction of a chronic left ventricular pacing lead. *PACE* 1991;14:1448–51.
- 9 Sharifi M, Sorkin R, Sharifi V, *et al.* Inadvertent malposition of a transvenous-inserted pacing lead in the left ventricular chamber. *Am J Card* 1995;76:92–5.

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