Use of a cerebral protection device for the laser extraction of a pacemaker lead traversing a patent foramen ovale

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Introduction
Inadvertent positioning of a pacing lead in the left atrium (LA) or left ventricle (LV) is a rare but well-recognized complication of pacemaker or defibrillator implantation. Traditional management involves systemic anticoagulation to reduce the risk of thromboembolic complications. Although international consensus guidelines (Heart Rhythm Society, 2009) do not recommend routine percutaneous lead extraction in asymptomatic patients (class III indication),1 extraction can be considered “if the clinical scenario is compelling.” Lead extraction from the LA carries a risk of cerebral embolism, and therefore techniques to reduce this risk may be of clinical benefit.

Case report
A woman underwent dual-chamber implantable cardioverter-defibrillator implantation for long QT syndrome 1 and recurrent syncope at the age of 36. At her second generator change 13 years later, a new atrial lead was implanted owing to failure of the original lead. It was difficult to find an atrial site with satisfactory parameters, but eventually a suitable location was achieved.

After the procedure, the patient felt generally unwell with fatigue and muscle and joint pains, although these were attributed to a new diagnosis of systemic lupus erythematosus. She had an episode of transient unilateral paresthesia and although computed tomography of the brain was normal, plain chest radiographs showed a posterior position of the atrial lead. It was difficult to find an atrial site with satisfactory parameters, but eventually a suitable location was achieved.

Anticoagulation with rivaroxaban was commenced and she was referred for consideration of lead extraction. Transesophageal echocardiography (TEE) confirmed that the atrial lead was in the LA (Figure 2), traversing a patent foramen ovale (PFO).

Discussion
In this report, we present a novel approach for cerebral protection during the percutaneous extraction of a left-sided pacemaker lead.

Lead malposition in the LV and, less commonly, the LA is a serious complication of cardiac device implantation and usually...
Led malposition in the left ventricle and, less commonly, the left atrium is a serious complication of cardiac device implantation and usually occurs via an atrial septal defect or patent foramen ovale, or via inadvertent arterial access. The incidence is unknown and difficult to assess, and complications include thromboembolism and left-sided endocarditis.

International consensus guidelines recommend anticoagulation in asymptomatic patients with anomalously placed left ventricular leads (there are no guidelines regarding left atrial leads). In patients with thromboembolism or endocarditis, surgical and percutaneous extraction are clinically indicated and well described.

Cerebral thromboembolism is a potentially devastating consequence of percutaneous extraction of inadvertent left-sided pacing and defibrillator leads. Protection of the cerebral circulation during these procedures, although unproven, is likely to reduce the risk of this complication and has been demonstrated to be beneficial during transcatheter aortic valve implantation procedures.

Echocardiography may not always detect thrombus or vegetation adherent to the lead, and in view of the potentially catastrophic cerebrovascular consequences during left-sided percutaneous extraction procedures, protection of the cerebral circulation is desirable. Although there are previous reports of the use of a Cordis Angioguard (Cordis, Miami Lakes, FL) device for this indication, the Angioguard device requires quadruple arterial access and separate cerebral protection devices to be placed in the left and right common carotid arteries and the left and right vertebral arteries. In contrast, the Sentinel Cerebral Protection Device can be deployed to the brachiocephalic artery and left common carotid artery via a single 6 French right radial or brachial artery sheath, reducing procedural time and risk of femoral arterial complications.

The Sentinel Cerebral Protection Device has been used previously during transcatheter aortic valve implantation, where it has been shown to reduce postprocedural magnetic resonance imaging–detected cerebral lesions and neurocognitive deterioration, and also during thoracic endovascular aneurysm repair and left atrial appendage occlusion. However, to the best of our knowledge, this is the first reported use of the device for a left-sided pacemaker lead extraction.

There are several limitations of this approach. The Sentinel Cerebral Protection Device is available in 1 size only and is suitable for most, but not all, vascular anatomies. It does not protect the left vertebral artery territory, nor does it protect the peripheral circulation from embolization. It is important to minimize peripheral embolization by avoiding oversizing of sheaths (to reduce the risk of air embolization) and by not crossing the PFO with the extraction sheath. Systemic anticoagulation during the procedure is required to

Figure 1  Posteroanterior (left) and lateral (right) plain chest radiographs demonstrating the posterior position of the left atrial lead (blue arrow), the redundant right atrial lead (red arrow), and the right ventricular lead (yellow arrow).
reduce the risk of thrombus formation on the device, and this increases the risk of pocket hematoma formation. Furthermore, although this approach is likely to reduce intraprocedural embolization, postprocedural embolization is still possible and patients with endocardial leads and a PFO have been shown to be at increased risk of cerebrovascular accident/transient ischemic attack, even without left-sided leads.\(^5\)

**Conclusion**

Cerebral thromboembolism is a potentially devastating consequence of percutaneous extraction of inadvertent left-sided pacing and defibrillator leads. Protection of the cerebral circulation during these procedures, although unproven, is likely to reduce the risk of this complication and has been demonstrated to be beneficial during transcatheter aortic valve implantation procedures. This is the first reported use in a lead extraction of a simple protection device that can be delivered rapidly via a single right radial or brachial arterial access.

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