Case Presentation
A 69-year-old woman with a history of paroxysmal atrial fibrillation and sick sinus syndrome with a dual-chamber pacemaker was admitted to our institution with *Staphylococcus aureus* bacteremia. She exhibited nonspecific neurological complaints, and head CT demonstrated multiple cerebral lesions consistent with septic emboli. Transesophageal echocardiography revealed a 3-cm vegetation on the right atrial pacemaker lead (Figure 1A, Video I in the Data Supplement). There was no evidence of aortic or mitral valve endocarditis; however, a patent foramen ovale with intermittent right-to-left shunting was identified (Figure 1B and 1C, Video II in the Data Supplement). Surgical removal was considered; however, the potential for hemorrhagic conversion of recent embolic strokes from high-dose heparin needed during cardiopulmonary bypass was prohibitive. Transvenous lead extraction was used and, to protect the cerebral circulation from further embolization, several Cordis Angioguard (Cordis, Miami, FL) devices were deployed to the cerebral circulation before lead extraction (Figure 2). Anticoagulation with 5000 U of heparin was administered for a brief period during Angioguard deployment. Both leads were successfully removed with a combination of powered and mechanical extraction sheaths. Postoperatively, the patient recovered to her baseline mental status with no imaging evidence of additional cerebral embolization.

Discussion
Paradoxical septic emboli associated with cardiac implantable electronic devices, although rare, have been described previously. Here, we present a case of significant cerebral septic embolization from a pacemaker lead vegetation with associated right-to-left shunting from a patent foramen ovale. With large vegetations (>4 cm), open surgical removal has been advocated by some, although there is no consensus regarding this approach. Others have advocated a hybrid transvenous-surgical technique using a minimally invasive thoracotomy. Surgical approaches necessitate prolonged systemic anticoagulation for cardiopulmonary bypass, which, in our patient, was felt to significantly increase the risk of cerebral hemorrhage. When vegetative material is present, distal embolization is always a concern. Typically, this is confined to the pulmonary circulation but, in the presence of right-to-left shunting, can result in systemic embolization and stroke. In an effort to minimize risk during extraction, we used distal embolization protection devices to reduce the risk of further embolization. In our patient, 3 femoral arterial sheaths were required to place the 3 distal protection devices, with a fourth device not needed, as the vertebral arteries were not codominant. Although multiple devices may be successfully placed using femoral access, the use of alternative arterial access, such as radial access, is feasible and may be necessary when peripheral vascular disease is present. The distal protection filters are designed to protect arteries that range from 3 to 6.5 mm in diameter. Ideal deployment sites are straight, without tortuosity or stenosis. The risk of dissection or vasculature injury from a distal protection device is exceedingly low; however, the devices do require heparinization (activated clotting time >250 seconds) to prevent thrombus formation.

To our knowledge, this is the first reported use of these devices for this purpose, while others have successfully used such an approach with left atrial thrombus during atrial fibrillation ablation. This case illustrates the importance of considering paradoxical embolization in pacemaker endocarditis. We think that additional precautions should be taken in such instances to improve the safety profile of lead extraction.

Disclosures
None.
References


Keywords: embolization, therapeutic endocarditis, pacemaker, biologic

Figure 1. A, Transesophageal echocardiogram with a modified bicaval view demonstrating right atrial lead with mobile 3-cm vegetation. B, Color flow Doppler demonstrating evidence of a patent foramen ovale (PFO). C, Right-to-left shunting demonstrated by administration of agitated saline.

Figure 2. Fluoroscopic positions of Angioguard carotid embolic protection devices. Three 6-mm devices are in place in the right and left internal carotid artery and left vertebral artery. The right vertebral artery was small and did not significantly contribute to cerebral circulation. Inset, Angioguard device (Courtesy: Cordis Corporation, Miami, FL).
SUPPLEMENTAL MATERIAL

Video 1 – Transesophageal echocardiogram with a modified bicaval view demonstrating right atrial lead with mobile 3 cm vegetation.

Video 2 – Transesophageal echocardiogram demonstrating a patent foramen ovale with right-to-left shunting demonstrated by administration of agitated saline.