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CASE REPORT
Structural intervention

Percutaneous repair of a sinotubular junction aortic pseudoaneurysm with an atrial septal defect occluder: a case report

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Background Aortic pseudoaneurysms are complications that arise following cardiac surgery, thoracic trauma, infections, or inflammatory conditions. The mainstay treatment for aortic pseudoaneurysm is surgical management. Given significant morbidity and mortality related to thoracotomy, high-risk patients are not considered for cardiac surgery. Novel percutaneous repair using a variety of devices are being explored, especially in those with prohibitive risk for cardiac surgery.

Case summary This case describes the use of an Amplatzer atrial septal defect (ASD) occluder device to manage an aortic pseudoaneurysm in a 69-year-old male who had previously undergone coronary artery bypass graft surgery and pericardial drainage for purulent pericarditis. Following successful implant, there were no complications seen after 2 years of follow-up.

Discussion Percutaneous closure of a mycotic pseudoaneurysm with an Amplatzer ASD occluder device can be a safe and efficacious treatment option, especially in patients with prohibitive surgical risk.

Keywords Case report • Aortic pseudoaneurysm • Percutaneous closure • ASD occluder

ESC curriculum 2.1 Imaging modalities • 7.4 Percutaneous cardiovascular post-procedure • 9.1 Aortic disease

Learning points

- To understand the various treatment options available for aortic pseudoaneurysm.

Introduction

Aortic pseudoaneurysm is an underrecognized complication that can occur following cardiac surgery with an incidence of up to 23% at 15 years.[1] Other rare causes include trauma, inflammatory, or infectious processes. The mainstay treatment for aortic pseudoaneurysms is surgical management, which carries an associated mortality rate reported up to 50%,[2] predominantly driven by fatal bleeding from rupture of the pseudoaneurysm during sternotomy.[3] Unfortunately, untreated aortic pseudoaneurysms are also associated with a markedly elevated mortality of up to ~60% due to complete pseudoaneurysm rupture, thrombosis, distal embolization, and fistula formation.[1] Given the significant morbidity and mortality related to surgical intervention as well as the risk of unsecured pseudoaneurysm, alternative treatment options have been explored.[4] Percutaneous repair is emerging as a novel treatment strategy for aortic pseudoaneurysms, especially in patients with increased risk of adverse events from cardiac surgery. This case report describes such a case where an Amplatzer atrial septal defect (ASD) occluder device was used to successfully treat an aortic pseudoaneurysm.

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Summary figure

5 days prior to admission	Onset of fever and exertional dyspnoea
Day 1 (day of admission)	Diagnosed with late-presenting inferior ST-elevation myocardial infarction along with a large pericardial effusion. Urgent coronary angiogram revealed ectatic coronary arteries with an occluded circumflex and severe lesions in the left main and mid-left anterior descending arteries. Emergent cardiac surgery performed for revascularization and drainage of the pericardial effusion. Post-operatively, the patient was noted to have blood and pericardial tissue cultures positive for methicillin-sensitive *Staphylococcus aureus* (MSSA), confirming the diagnosis of purulent pericarditis.
Days 2–73	Protracted course in intensive care unit with numerous complications including severe left ventricular dysfunction, respiratory failure requiring recurrent intubation, and ultimately a tracheostomy, hospital-acquired pneumonia, anuric acute kidney injury requiring renal replacement therapy, sternal wound infection with dehiscence, bilateral chest tube insertion for pleural effusions, atrial fibrillation with rapid ventricular response, critical illness myopathy, and hyperactive delirium.
Day 74	Incidental sinotubular junction aortic pseudoaneurysm (7.7 × 4.6 cm) noted on computed tomography (CT) chest.
Day 75	Percutaneous closure with an Amplatzer atrial septal defect closure device.
3-month follow-up	Readmitted with fever. Repeat CT chest showed increase in pseudoaneurysm size from 7.7 × 4.6 cm to 8.7 × 5.1 cm. Chronic infective aortitis was suspected and was managed conservatively with suppressive long-term antibiotics.
8-month follow-up	Computed tomography chest showed decrease in the pseudoaneurysm to 5.3 cm in diameter.
2-year follow-up	Computed tomography chest showed a further decrease in size of the pseudoaneurysm to a diameter of 3.7 cm. Patient remained clinically well without repeat admission, myocardial infarction, stroke, or recurrent infection.

History of presenting illness and clinical course

A 69-year-old man with a past medical history of hypertension and dyslipidaemia presented with a 5-day history of exertional dyspnoea and fever. On presentation, he had a normal cardiopulmonary examination and was clinically well perfused. He was diagnosed with a late-presenting inferior ST-elevation myocardial infarction along with a large pericardial effusion, raising the possibility of a contained left ventricular perforation. An urgent coronary angiogram was performed which revealed ectatic coronary arteries with an occluded left circumflex and severe lesions in the left main and mid-left anterior descending (LAD) coronary arteries (*Figure 1*). The patient underwent emergent cardiac surgery for revascularization and drainage of the pericardial effusion. Intra-operatively, there was evidence of pericardial and epicardial inflammation along with purulent pericardial fluid. Pericardial drainage along with three vessel coronary artery bypass grafts (CABGs) was performed. The grafts included a left internal thoracic artery (LITA) to the LAD and saphenous vein grafts (SVG) to the second obtuse marginal (OM2) and posterior descending artery (PDA). Post-operatively, the patient was noted to have blood and pericardial tissue cultures positive for methicillin-sensitive *Staphylococcus aureus* (MSSA), confirming the diagnosis of purulent pericarditis for which he was treated with a prolonged course of intravenous cefazolin 2 g every 12 h adjusted to his renal function.

The patient had a protracted course in the intensive care unit with numerous complications including severe left ventricular dysfunction (left ventricular ejection fraction 28%), respiratory failure requiring recurrent intubation and ultimately a tracheostomy, hospital-acquired pneumonia, anuric acute kidney injury requiring long-term renal replacement therapy, sternal wound infection with dehiscence, bilateral chest tube insertion for pleural effusions, atrial fibrillation with rapid ventricular response, critical illness myopathy, and hyperactive delirium. On post-operative Day 74, he was found to have an incidental pseudoaneurysm (7.7 × 4.6 cm) arising from the posterior aspect of the aorta just above the left coronary cusp, on a computed tomography (CT) of the chest that was performed to assess the lung parenchyma (*Figure 2*). This large pseudoaneurysm was noted to compress the graft to the OM2 as well as the left superior pulmonary vein.

Differential diagnosis

The likely aetiologies for the aortic pseudoaneurysm included mycotic pseudoaneurysm in the context of recent purulent MSSA pericarditis vs. an iatrogenic aetiology related to his recent cardiac surgery, although the location above the left main coronary artery was not surgically manipulated. Other infectious aetiologies of aortitis including syphilis and human immunodeficiency virus (HIV), as well as inflammatory causes such as giant cell arteritis and Takayasu, were lower on the differential diagnosis, and workup for these alternative aetiologies was negative. Given the clinical history, infectious aortitis from MSSA bacteraemia was the favoured diagnosis.

Investigations

The patient underwent a repeat coronary angiogram to further assess the aortic pseudoaneurysm. This demonstrated no significant change in his native coronary anatomy and patent bypass grafts. The pseudoaneurysm was easily entered with a coronary catheter and was noted to be arising from the sinotubular junction above the left main coronary artery.

Management

Various therapeutic options including surgical, percutaneous, and conservative management were discussed. Given his multiple comorbidities, frailty, and recent sternal infection, repeat cardiac surgery was thought to carry a prohibitive risk. Conservative management was also felt to be a poor strategy given high risk of rupture. Following multidisciplinary discussions, percutaneous closure with an Amplatzer ASD closure device was pursued on post-operative Day 75. The procedure was performed

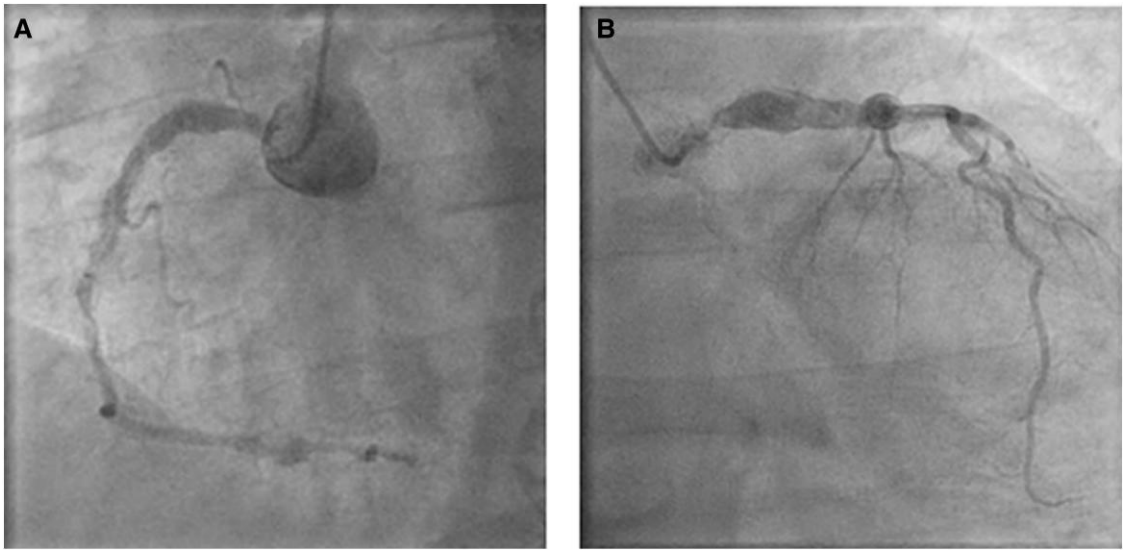

Figure 1 Coronary angiogram demonstration of severe triple vessel disease. (*A*) Moderately ectatic right coronary artery (LAO 30). (*B*) Occluded left circumflex and severe lesions in the left main and mid-left anterior descending coronary arteries (RAO 30 Caudal 25).

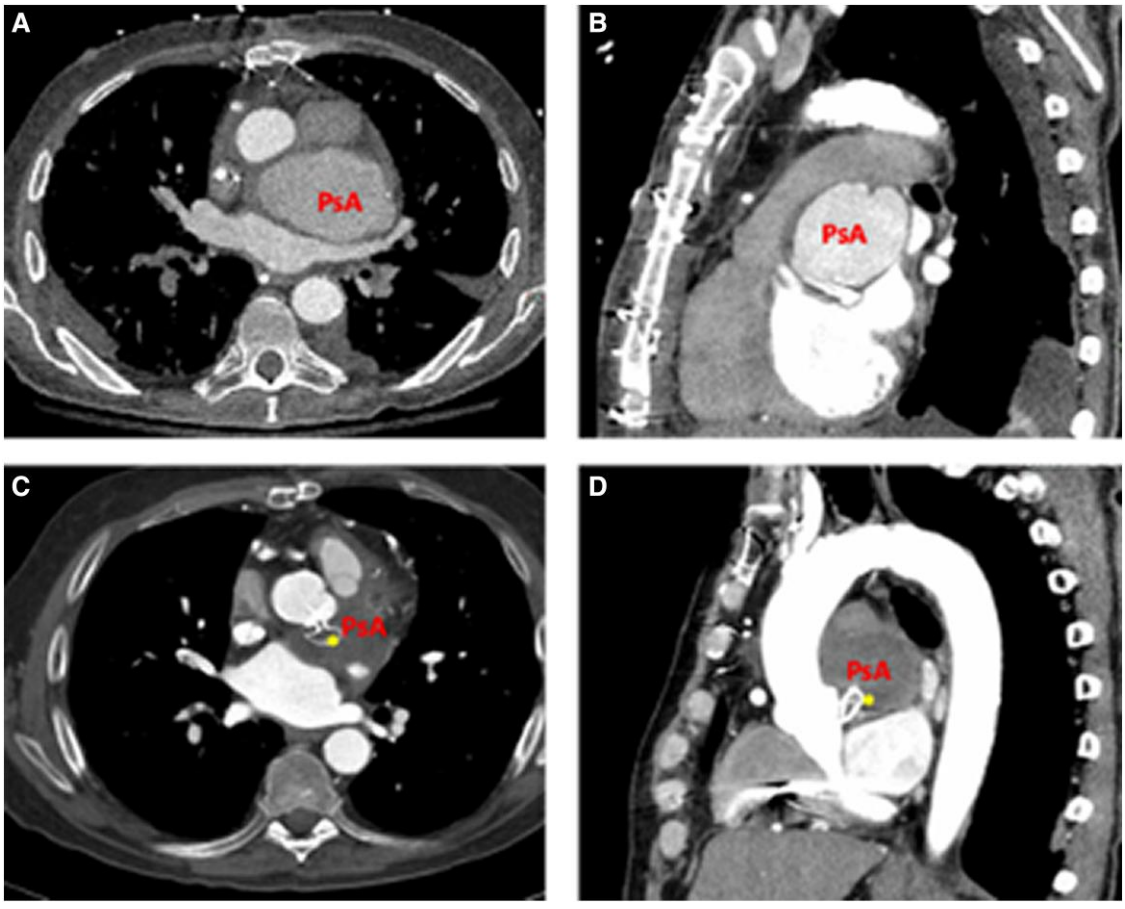

Figure 2 Computed tomography chest demonstration of aortic pseudoaneurysm at the sinotubular junction above the left main coronary artery. (*A*) Axial view of the pseudoaneurysm at time of diagnosis, (*B*) sagittal view of the pseudoaneurysm at time of diagnosis, (*C*) axial view of the pseudoaneurysm at 2-year follow-up, and (*D*) sagittal view of the pseudoaneurysm at 2-year follow-up. (* denotes the location of the Amplatzer atrial septal defect occluder).

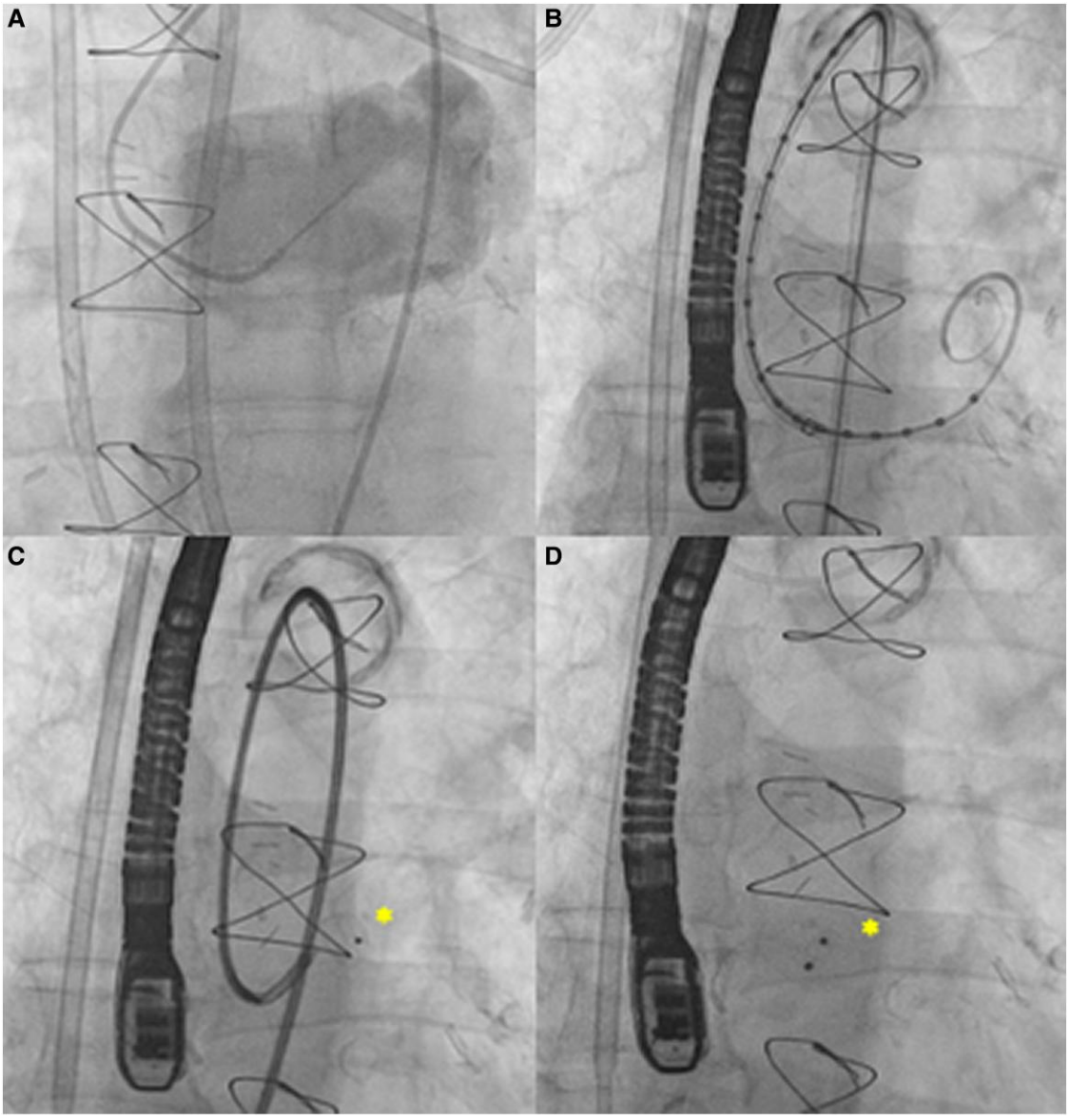

Figure 3 Exclusion of the sinotubular junction ascending aortic pseudoaneurysm with an Amplatzer atrial septal defect (ASD) occluder on fluoroscopy. (*A*) Identification of pseudoaneurysm by contrast injection. (*B*) Pigtail catheter placement to guide ASD occluder device delivery. (*C*) Delivery of the Amplatzer ASD occluder device. (*D*) Confirmation of ASD occluder device placement. (* denotes the location of the Amplatzer ASD occluder). Videos available in the supplementary material section.

under general anaesthesia with endotracheal intubation and with both transoesophageal echocardiography and fluoroscopy guidance. Vascular access was obtained via the right femoral artery with a 6-French sheath. A Judkins left coronary catheter was used to cannulate the pseudoaneurysm, and an exchange length Wholey wire was placed in the aneurysm. A pigtail catheter was then inserted, and the Wholey wire was exchanged for an extra small loop Safari wire which was placed for additional support. The pigtail was then readvanced mother-in-child in an 8-French extra backup (EBU) catheter, and the pigtail and wire were both removed. Subsequently, an 8 mm ASD occluder was passed through the EBU and deployed under fluoroscopy using anterior–posterior projection (*Figure 3*) and transoesophageal echocardiography guidance (*Figure 4*) without any complications.

A transthoracic echocardiogram was performed immediately following the procedure demonstrated that the ASD occluder was well seated. A transoesophageal echocardiogram performed 48 h post-procedure once again confirmed appropriate position of the ASD occluder along with thrombus and a residual shunt within the pseudoaneurysm which now measured 7 × 4 cm. A repeat transoesophageal echocardiogram performed 15 days post-procedure showed a decrease in pseudoaneurysm size to 5.7 cm × 5.5 cm with thrombus and again an ongoing residual shunt. The patient was planned to be continued on antibiotic therapy lifelong for presumptive infective aortitis.

Follow-up

Three months after the procedure, the patient presented to the hospital again with fever and malaise. Repeat blood cultures were negative. A repeat CT chest showed that the pseudoaneurysm had increased in

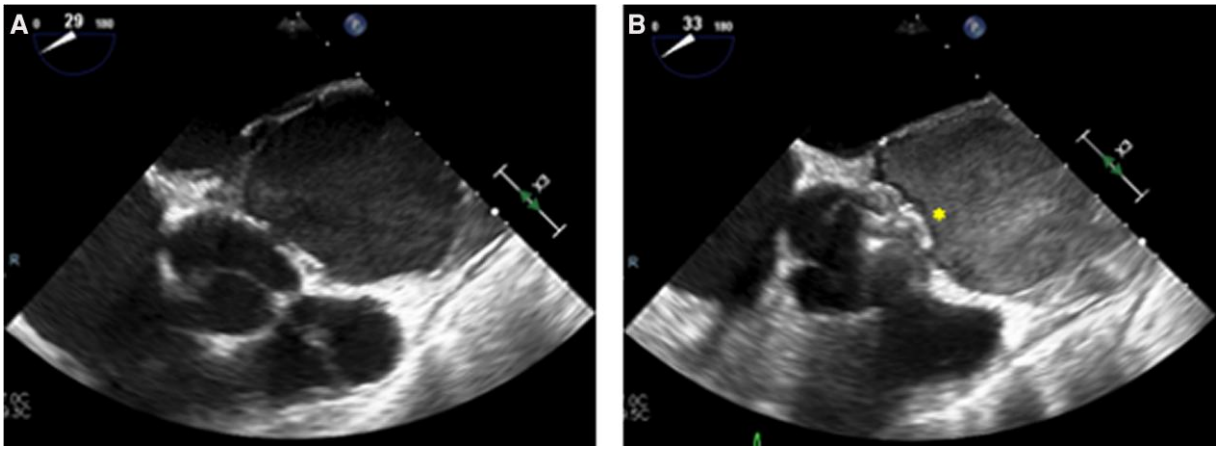

Figure 4 Exclusion of the sinotubular junction ascending aortic pseudoaneurysm with an Amplatzer atrial septal defect (ASD) occluder on transoesophageal echocardiography. (*A*) Identification of pseudoaneurysm. (*B*) Confirmation of the ASD occluder device placement. (* denotes the location of the Amplatzer ASD occluder).

size from 7.7 × 4.6 cm to 8.7 × 5.1 cm with compression of the main and right pulmonary artery as well as the left superior pulmonary vein. The perfused portion of the pseudoaneurysm was 3.0–3.5 cm. This increase in size was felt to be in the context of chronic infective aortitis. This was managed conservatively with continuation of suppressive long-term antibiotics. A repeat CT chest 8 months after the ASD occluder placement showed a decrease in the pseudoaneurysm to 5.3 cm in diameter with an overall significant reduction in the size of the remaining flow through the device, along with a decrease in the opacified cavity from 2.0 × 4.0 cm to 1.1 × 1.4 cm. After 2 years of follow-up, the patient was clinically well without rehospitalization, myocardial infarction, stroke, or recurrent infection. The most recent CT chest reveals a further decrease in size of the pseudoaneurysm to a maximum diameter of 3.7 cm. Given the concerns for chronic infective aortitis, the patient continues suppressive lifelong antibiotics with intravenous cefazolin 2 g post-dialysis three times a week.

Discussion

Conventional surgical repair of aortic pseudoaneurysm involves sternotomy, cardioplegia, and placement on cardiopulmonary bypass followed by replacement of the pseudoaneurysm with a tube graft with or without a patch.[5] The arterial cannulation necessary for cardiopulmonary bypass further increases future pseudoaneurysm formation.[5] In contrast, percutaneous repair involves cannulation of a peripheral artery to deliver the device to the lumen of the pseudoaneurysm to exclude blood flow. A series of wires are passed through catheters and manoeuvred to achieve optimal position of the device. The type of device is selected according to the location and size of the pseudoaneurysm. Endovascular stent graft, occluder devices [ASD, ventricular septal defect (VSD), and duct occluder], vascular plugs, and coils are some of the percutaneous repair strategies currently being utilized. Of these, ASD occluders are commonly chosen in large neck pseudoaneurysms due to straightforward operative approach. Pre-procedure planning including sizing of the device and assessment of the proximity of the pseudoaneurysm to adjacent vital structures is facilitated by CT and transoesophageal imaging. The size of the ASD occluder is chosen to be 1 to 2 mm larger than the diameter of the pseudoaneurysm neck. Coils or vascular plugs may be preferrable in more anatomically complicated pseudoaneurysms with narrow neck, especially those with steep angulations into the entry site of the pseudoaneurysm. Once again, characterizing the size of the pseudoaneurysm neck is vital to prevent embolization of the coils.[6,7]

This case clearly demonstrates successful utilization of an Amplatzer ASD occluder device to exclude an aortic pseudoaneurysm at the sinotubular junction. There were no significant adverse outcomes, and we observed eventual occlusion of the pseudoaneurysm. The initial expansion noted in this case at 3 months was likely secondary to a chronic infectious process and residual flow. With continued treatment of the infection with lifelong suppressive antibiotics, the size of the pseudoaneurysm continued to decrease with improvement in the residual shunt. Ultimately, the patient was well with no significant complications at 2-year follow-up.

Conclusion

Percutaneous closure of a mycotic pseudoaneurysm with an ASD occluder device can be a safe and efficacious treatment option, especially in patients with prohibitive surgical risk.

Lead author biography

Joanne Joseph is a second year cardiology resident at the University of Ottawa Heart Institute. She completed her medical school and internal medicine training at the University of Ottawa.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

Consent: The authors confirm that written consent for submission and publication of this case report including the images and associated

text has been obtained from the patient in line with the Committee on Publication Ethics (COPE) guidance.

Conflict of interest: None declared.

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Data availability

The data underlying this article are available in the article and in its online supplementary material.

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