Percutaneous Transthoracic Treatment of Ascending Aortic and Root Pseudoaneurysms: Procedural Aspects and Guidance with the Use of Multimodality Imaging

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ABSTRACT

Open repair of ascending aortic pseudoaneurysms (AAPs) is currently the standard of care, but it is associated with high morbidity and mortality. A single-center retrospective experience of 4 patients after cardiac surgery undergoing 5 percutaneous transthoracic embolization procedures is presented. In 3 of the 4 patients, the primary outcome of complete thrombosis was achieved after the first procedure, with a mean follow-up time of 11.5 months. In all 5 procedures, the patients tolerated the procedure well without associated acute complications. Percutaneous transthoracic embolization of AAPs offers an alternate minimally invasive treatment pathway for prohibitive-risk candidates.

ABBREVIATIONS

AAP = ascending aortic pseudoaneurysm, PsA = posterior pseudoaneursym, TEE = transesophageal echocardiography

Ascending aortic pseudoaneurysms (AAPs) may arise in the setting of trauma, mycotic infections, and following cardiac surgery or aortic arch replacement (1,2). Open repair is currently the standard of care. Reoperation, however, requires repeat sternotomy and cardiopulmonary bypass, frequently in patients with multiple comorbidities. Reported mortality rates range from 7 to 41% (1,3,4). Expansion of AAPs is unpredictable and rupture can be fatal (5). There have been a few cases published regarding endovascular approaches to treating AAPs including coil embolization, endovascular stent-graft placement, and implantation of occluder devices (6,7), however not all lesions are suitable for endovascular management. We report our experience utilizing a multimodality imaging based approach for transthoracic percutaneous embolization of AAPs.

MATERIALS AND METHODS

This was a retrospective study with Institutional Review Board approval that waived requirement for informed consent. A total of 4 patients underwent transthoracic percutaneous embolization for AAPs from January 2015 to December 2016. The decision to intervene percutaneously was made by a multidisciplinary team consisting of interventional radiology, cardiology, and cardiothoracic surgery and was based on perceived high preoperative risk factors and suboptimal traditional transvascular access to the AAP. Imaging modalities used consisted of computerized tomography (CT), transesophageal echocardiography (TEE), and fluoroscopy for guidance.

CASE REPORTS

Case 1

A 55-year-old man presented with a recurrent posterior AAP after attempted reoperative repair after a Bentall procedure for a type A aortic dissection (**Fig 1a**, **b**). Preprocedural

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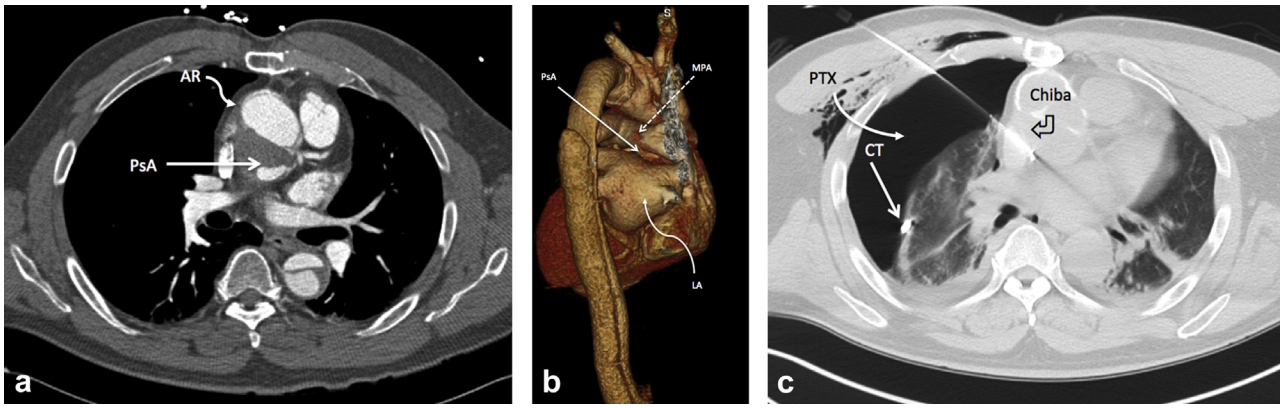

Figure 1. (**a**) CT angiogram in the axial plane, demonstrating a PsA (straight arrow) arising posterior to the AR (curved arrow). Residual descending thoracic aortic dissection is present. (**b**) CT 3-dimensional reconstruction of the heart and vessels. Posterior and lateral view. PsA (straight arrow) arising posterior to the ascending aorta in close approximation to the left atrium (curved arrow; *LA*) and main pulmonary artery (dotted arrow; *MPA*). (**c**) Noncontrast axial slice through the upper chest. Iatrogenic right pneumothorax (curved arrow; *PTX*) with a chest tube (straight arrow; *CT*) in place. Chiba needle (outlined arrow) traversing minimal lung due to the induced pneumothorax.

evaluation revealed poor transvascular access into the pseudoaneurysm due to proximity to the coronary arteries, a 1 mm neck, and perceived inability to maintain stable transvascular access in the AAP.

Under CT guidance, an iatrogenic pneumothorax was performed with displacement of the lung from the projected transthoracic trajectory. An 18-gauge Chiba needle (Cook, Bloomington, Indiana) was advanced across the thoracic cavity from the right chest wall into the AAP between the right atrial appendage, aorta, and inferior vena cava under CT guidance (Fig 1c).

The patient was then transported to the angiography suite with the needle stabilized in position, where TEE demonstrated blood flow within the partially thrombosed pseudoaneurysm. A Renegade STC microcatheter (Boston Scientific, Marlborough, Massachusetts) was advanced through the needle under fluoroscopic and TEE guidance and the AAP was embolized to stasis with the use of a total of 0.4 cc ethylene-vinyl alcohol copolymer (EVOH; Medtronic, Irvine, California). No nontarget embolization or residual flow was noted on final aortography or TEE.

Post-procedure CT angiography at 10 months' follow-up, however, demonstrated partial recanalization. The patient was brought back and similar access was obtained with a repeated transthoracic percutaneous approach into the AAP. Coil embolization was performed with the use of Concerto microcoils (Medtronic) under fluoroscopic and TEE guidance. CT angiography performed 5 months later showed complete thrombosis of the AAP.

Case 2

A 70-year-old man developed an anterior AAP arising from the innominate arterial suture line after an endovascular stent graft repair of an enlarging descending thoracic aortic aneurysm. The neck of the pseudoaneurysm measured 1.9 mm. An 18-gauge Chiba needle was advanced from the right parasternal space, medial to the right internal mammary artery and vein, into the retrosternal pseudoaneurysm sac under direct fluoroscopic guidance with the use of bony and sternal wires as landmarks. A Renegade STC microcatheter in conjunction with a Transend microwire (Stryker Neurovascular, Kalamazoo, Michigan) was passed through the needle into the AAP. The AAP sac was then embolized with a combination of coils (Interlock; Boston Scientific) and EVOH. Post-embolization aortography showed no filling of the AAP. CT performed after 8 months demonstrated complete hemostasis.

Case 3

A 58-year-old woman with a history of Marfans syndrome status after aortic valve replacement, Bentall procedure, and single-vessel coronary artery bypass grafting was noted to have an enlarging 9 mm pseudoaneurysm (PsA) adjacent to the aortic sinus, with a maximal diameter of 3.2 cm on CT angiography (Fig 2a).

An 18-gauge Chiba needle was advanced from the right chest wall through the right atrial appendage under CT guidance into the AAP (Fig 2b). The patient was then moved to the angiography suite, where TEE demonstrated bidirectional flow in the PsA sac and appropriate positioning of the needle (Fig 2c). With the use of bimodal fluoroscopic and echocardiographic guidance, the aneurysm sac was coil embolized to stasis (Fig 2d, e). Follow-up CT angiography and cardiac magnetic resonance imaging after 8 months showed complete hemostasis.

Case 4

A 58-year-old woman was noted to have a persistent AAP after multiple aortic valve replacements for bicuspid aortic valve, and a previous attempt at AAP closure with the use of an Amplatzer Muscular ventricular septal defect occluder (AGA Medical Corp, Plymouth, Minnesota) was unsuccessful. Post-procedure aortography showed a residual leak seen at the inferior aspect of the AAP. The leak was seen