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PERCUTANEOUS CLOSURE OF AN ASCENDING AORTIC PSEUDOANEURYSM BY 3D ANGIOGRAPHY GUIDANCE

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Introduction

"He's intelligent, but not experienced. His pattern indicates two-dimensional thinking."

– Spock, from *Star Trek: The Wrath Of Khan*,
in reference to the eponymous villain

The tremendous growth of structural heart interventions has continued to highlight the importance of the relationship of cardiovascular lesions in 3-dimensional (3D) space. Technological innovations have led to an increased use of alternative imaging modalities such as 3D transesophageal echography, intracardiac echocardiography, intravascular ultrasound, and optical coherence tomography. In addition, rotational angiography with 3D reconstruction has emerged as a powerful tool in congenital and structural interventions.[1-3]

The development of postsurgical aortic pseudoaneurysms has been described, and transcatheter closure has been effective in small case series.[4] As with many other structural heart interventions, however, the size and shape of a defect may be difficult to define completely using two-dimensional conventional fluoroscopy. Repeated large volume power-injection angiography in multiple views to evaluate a lesion can be severely harmful to both children and adults with renal insufficiency. We describe a case of transcatheter closure of an ascending aortic pseudoaneurysm in which rotational angiography was used to guide 3D reconstruction of the lesion. The use of rotational angiography in this particular case limited the need for repeated power-injection angiography while simultaneously improving the spatial definition of the lesion and interventional planning.

Case

The patient was an 11-year-old girl who had undergone a heart and lung transplant approximately 2 months prior. Her recovery had been complicated by superior vena cava (SVC) anastomotic site stenosis with concomitant internal jugular and subclavian vein thrombosis and SVC syndrome, requiring transcatheter rheolytic thrombectomy and stenting; in addition, she experienced a hemothorax that required surgical reexploration, oliguric renal failure, cardiac graft rejection, and failure to wean from vent. During follow-up chest computed tomography (CT), she was found to have a large pseudoaneurysm in the mediastinum, possibly arising from the aorta. The structure was poorly defined on CT, and she was referred to the cardiac catheterization laboratory for further evaluation and possible treatment in addition to her planned myocardial biopsy.

After general anesthesia was administered, endomyocardial biopsy and right and left heart hemodynamics were acquired without difficulty. Superior vena cava venography demonstrated no evidence of the pseudoaneurysm arising from the venous side, a potential concern given her prior treatment with rheolytic thrombectomy and stenting to a venous anastomotic site. Aortography, however, demonstrated that the pseudoaneurym arose directly off the ascending aorta and potentially compressed the SVC. Using rapid ventricular pacing to optimize imaging, rotation angiography was performed (Figure 1 A, Video 1) using the standard Toshiba software (Toshiba America Medical Systems, Tustin, CA) and reconstructed on a Toshiba VitreaWorkstation™ (Vital, Toshiba Medical Systems Europe, The Netherlands). Reconstruction (Figure 1 B, Video 2) demonstrated an umbilicated pseudoaneurysm with an elliptical narrow neck (Figure 1 C) arising from the right anterior aspect of the ascending aorta. In addition, ideal imaging working angles were identified by manipulation on the workstation and employed for the remainder of the procedure.

The pseudoaneurysm was gently cannulated using a 4-Fr Judkins right catheter through which a 0.035" Rosen wire was advanced into the pseudoaneurysm. The wire formed a preshaped atraumatic coil in the pseudoaneurysm, and the catheter was exchanged for a 180-degree 8-Fr AMPLATZER TorqVue Delivery Sheath (AGA Medical, Golden Valley, MN). Once the TorqVue sheath was placed and engaged within the neck of the pseudoaneurysm, a 12-mm AGA AMPLATZER® Septal Occluder was advanced into the lesion and deployed. The waist appeared elongated and pinched and the aortic side disk appeared flared, suggesting the device was too large, likely resulting from the elliptoid shape of the neck. The 12-mm device was removed, and a 10-mm device was placed with excellent results (Figure 2 A, Video 3). Final angiography demonstrated slowing flow into the pseudoaneurysm, and by the end of the case, contrast stain was seen suggesting stasis within the cavity (Figure 2 B, Video 4). Postprocedure imaging by echocardiography and chest X-ray demonstrated stable seating of the device, and the patient was scheduled for a 1-month follow-up.

Discussion

The use of multiple imaging modalities to support traditional 2D angiography in guiding complex transcatheter interventions is rapidly moving toward the standard of care, and rotational angiography with 3D reconstruction is a powerful addition to the imaging armamentarium. In this case, rotational angiography provided at least two major advantages over a traditional

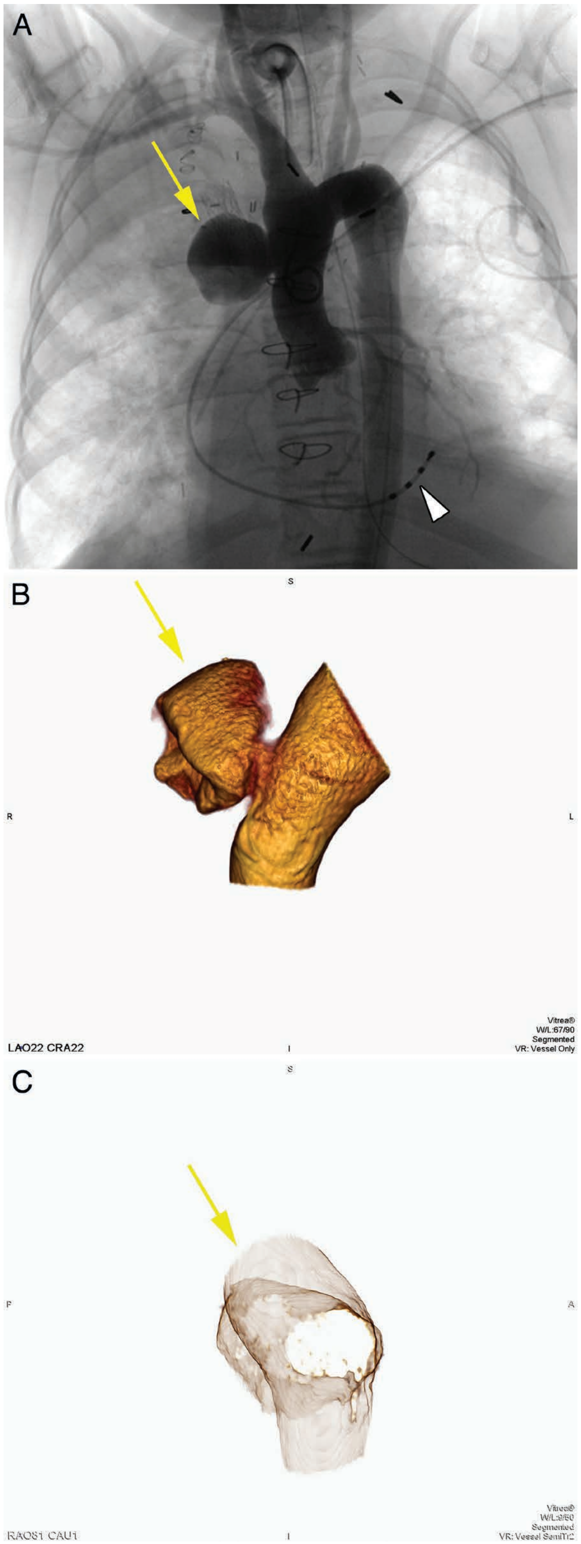

Figure 1. (A) Rotational angiogram. Still frame of rotational angiogram during rapid ventricular pacing (arrowhead). The aortic pseudoaneurysm (arrow) is well defined even in this view, however, the true shape and size of the neck of the pseudoaneurysm cannot be fully determined. (B) 3-dimensional reconstruction of the ascending aortic pseudoaneurysm (arrow). The other vascular structures have been sculpted away to allow visualization of the defect itself. The length, size, and shape of the neck (arrowhead) as well as the defect itself can be measured in detail. (C) Neck of the pseudoaneurysm. View towards the aorta from the pseudoaneurysm demonstrates the elliptical shape of the neck (arrow) of the defect.

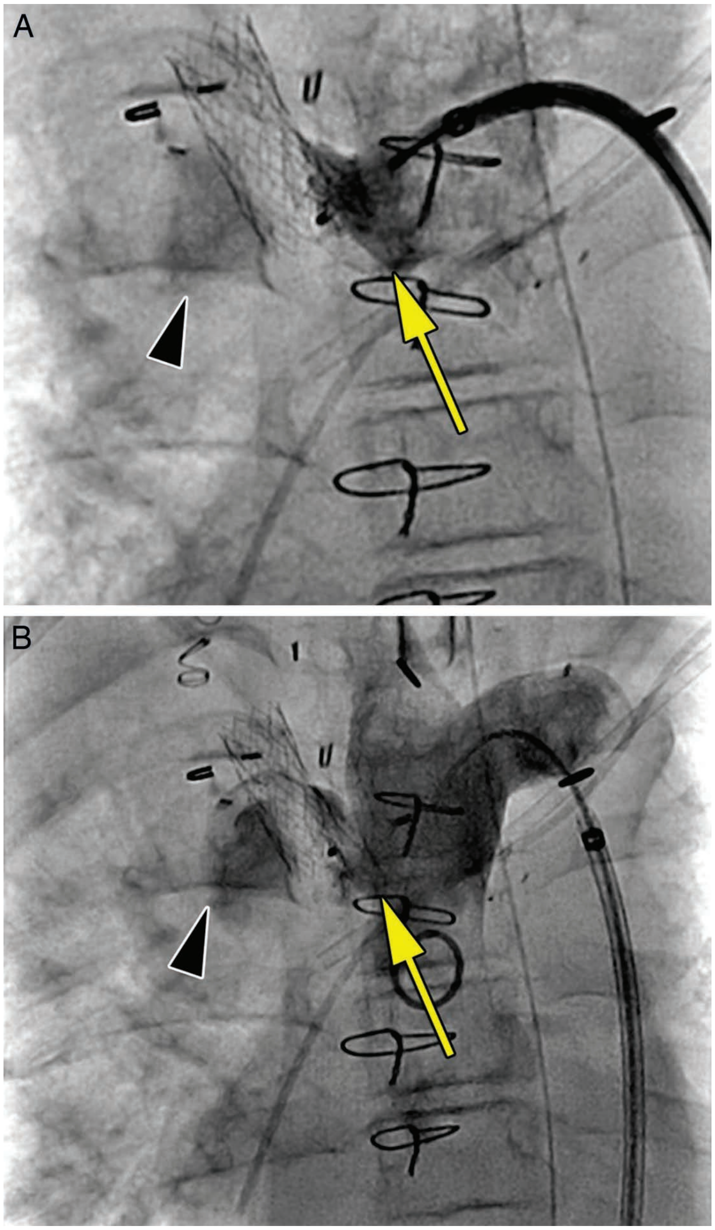

Figure 2. (A) Device closure of pseudoaneurysm. The 10-mm Amplatzer Atrial Septal Occluder (arrow) can be seen placed in the pseudoaneurysm, with residual contrast stain (arrowhead) on the back wall of the defect due to slowing of flow through the defect. (B) Angiography of the defect after closure device (arrow) implantation, with slow contrast flow through device (arrowhead).

approach. First, rotational angiography allowed us to limit the number of angiographies required to define the defect to one single bolus (1.5 cc/kg) of contrast, whereas establishing a clear definition of the defect with traditional angiography may have required one to two additional injections in biplane, raising the contrast use to between 2 and 3 cc/kg in a patient with known renal insufficiency. Second, the 3D reconstruction allowed complete assessment of the shape and size of both the pseudoaneurysm itself and the neck of the defect as well as its relationship with the aorta. This allowed confidence in formulating a strategy regarding device versus coil, device shape, approach, and delivery sheath/guide catheter shape in the setting of a potentially high-risk procedure. Additional studies will be required to optimize contrast use, radiation dose, and application of the technique.

Conflict of Interest Disclosure: Dr. Balzer is a proctor at AGA Medical.
Keywords: aortic pseudoaneurysm, atrial septal occluder, rotations angiography

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