# Occlusion of an ascending aortic pseudoaneurysm with intraoperative echocardiography and a printed model

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A 3D disease model of an AAP.

**Central Message**

We conducted an intraoperative TEE-guided, successful occlusion of an AAP using a 3D printing model.

Three-dimensional (3D) printing has generated increased interest in clinical practice; however, its application in treating cardiovascular diseases has been scarcely explored. We report the successful occlusion of an ascending aortic pseudoaneurysm (AAP) with intraoperative transesophageal echocardiography (TEE) and a 3D printing model. To our knowledge, this is the first report of such treatments.

## Case Report

A 44-year-old man was admitted to the department of thoracic surgery with a chief symptom of minimal fresh blood in the sputum for 3 weeks. No fever, hemoptysis, dyspnea, or dizziness was presented.

He denied a history of major diseases, trauma, or surgery. There were no positive findings on physical examination, except a grade 1/6 early diastolic murmur in the aortic valve region. Laboratory test results were insignificant.

Initial plain computed tomography (CT) scan of the chest revealed a mass in the right anterior superior mediastinum, and a diagnosis of thymoma was suggested. However, a subsequent echocardiography suggested dilation of the ascending aorta and the aortic sinuses with mild aortic regurgitation. Enhanced CT scan further confirmed the diagnosis of AAP (Figure 1, *A*). The patient was then referred to the department of cardiovascular surgery.

## Preoperative Evaluation

3D reconstruction of the aorta revealed a 4 × 3 × 2-cm isodensity mass arising from the ascending aorta, surrounded by a thick, low-density cyst. The patient was considered as a high-risk candidate for surgical excision of the pseudoaneurysm because of diffuse calcification of aorta (Figure 1, *B*). In addition, because of the complexity of the AAP, endovascular approaches for AAP repair may not be appropriate.[1] After balancing the risks and benefits of all approaches, we decided to perform transthoracic occlusion of the AAP with a custom occluder.

## Procedural Techniques

A 3D AAP model was reconstructed on the basis of preoperative CT data (Figure 1, *C*). Then an occluder was knitted on the model using NiTi alloy, and the final product is a self-expanding nitinol mesh occlusion device (Shanghai Shape Memory Alloy Ltd, Shanghai, China) (Figure 1, *D*), with some modifications from a patent ductus arteriosus occluder to fit the AAP.

With the patient under general anesthesia, a standard midsternal incision was made. The AAP was visualized, and a purse-string suture was made where the tremor was most obvious as the puncture point for the needle. A guidewire was then pierced into the AAP body and reached the lumen through the AAP neck, guided by the intraoperative TEE. The preknitted occluder was released through the catheter and deployed to separate the AAP from the ascending aorta (Figure 2, *A*). The occluder was fixed on the AAP by the purse-string suture for further reinforcement. The entire procedure lasted several minutes and caused minimal vessel injury and hemodynamic changes. The postoperative period was uneventful, and the patient recovered quickly. The device is a lifelong implant and does not necessarily need postoperative anticoagulation considering the hemodynamics in the ascending aorta. Follow-up CT scan at 2 weeks confirmed complete occlusion of the AAP (Figure 2, *B*).

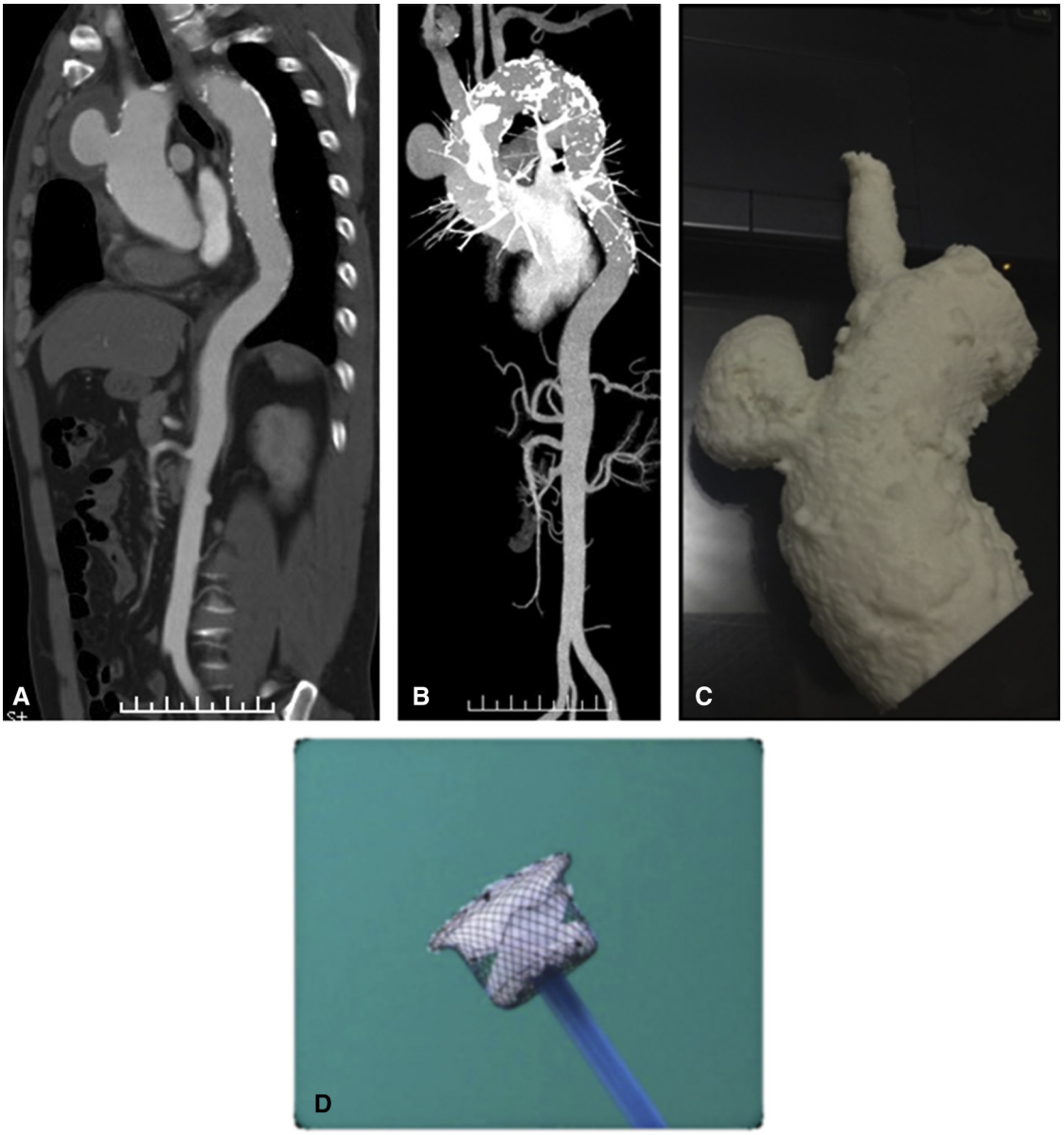


**FIGURE 1.** CT scan (A and B), 3D disease model (C), and a custom occluder (D) of an AAP.

## DISCUSSION

AAPs often result from aortic surgeries or surgeries that involve cannulation of the ascending aorta.[2] Trauma, inflammation, or infection also may predispose to the formation of pseudoaneurysms.[1] Although a variety of options are available to repair AAP, conventional surgery remains the standard therapy, which often requires cardiopulmonary bypass.[1] Endovascular repairs with stent grafts, coil embolization, thrombin injection, or occluder devices are used mainly in patients for whom major surgery is contraindicated.[1] However, several disadvantages associated with endovascular techniques prevent their wide application.[1,3,4] One of the noteworthy disadvantages is the mismatch between the deployed device and the pseudoaneurysm, which may result in dislocation of the occluder into the lumen or remnant shunt around the occluder.[3]

The techniques used in our case demonstrated several unique advantages. First, because the procedure was guided by intraoperative TEE, radiation exposure can be avoided. Second, the occluder was deployed through a transthoracic pathway, and vessel injury and hemodynamic disturbance can be minimized. Third, the better matching between the occluder and the AAP, as well as reinforcement by the purse-string suture, provides maximal fixation of the device. Last, the procedure can be performed with a minor