

Isolated Innominate Artery Aneurysm

An endovascular approach to treat this rare presentation.

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Isolated innominate artery aneurysms (IAAs) are uncommon, and causes may include trauma, infection, or atherosclerotic degeneration. Atherosclerosis generally causes occlusion of the brachiocephalic vessels in up to 4.8% of patients;¹ however, approximately 4% of all innominate artery surgeries are for aneurysmal disease.² The aneurysm is usually asymptomatic and is detected as an incidental finding of a mass on a chest x-ray. A large aneurysm may also present with symptoms of compression on mediastinal structures.³ The IAA may rupture, enlarge, thrombose, or embolize and should therefore be treated. Conventional treatment has largely been a surgical approach via a thoracotomy or median sternotomy with or without cardiopulmonary bypass;^{4,5} however, an open approach has a significant morbidity rate associated with the procedure. We report a case of a large, isolated IAA causing compression and probable erosion into the trachea, which we treated endovascularly.

CASE REPORT

A 77-year-old man presented with a cough, fever, and shortness of breath. A chest x-ray showed an elliptical densi-

ty in the right upper lobe. He was subsequently treated for presumed pneumonia. The patient began to develop worsening shortness of breath and hemoptysis. A computed tomography (CT) scan of the chest revealed an anterior mediastinal mass that we suspected could be a brachiocephalic artery aneurysm. A dedicated CT angiogram showed a multilobulated aneurysm measuring 5 X 5 cm arising from the lateral aspect of the innominate artery. The right common carotid and subclavian arteries were noted to arise from the aneurysm sac. The right vertebral artery was patent and came off 2 cm beyond the origin of the subclavian arteries (Figures 1 and 2). The aneurysm abutted the trachea, causing compression and left shift, which accounted for the patient's symptoms (Figure 3). An open repair was considered, but given the history of cardiomyopathy with an ejection fraction of 20% and pulmonary hypertension, the patient was deemed to be extremely high risk for an open procedure. Therefore, an endovascular approach was chosen.

The patient was taken to the surgical suite, and the right femoral artery was accessed percutaneously. An angiogram was obtained confirming the large aneurysm (Figure 4). The



Figure 1. A 5 X 5-cm aneurysm arising laterally off the innominate artery.



Figure 2. Reconstruction images of an IAA with the subclavian and carotid artery arising from the aneurysm sac.

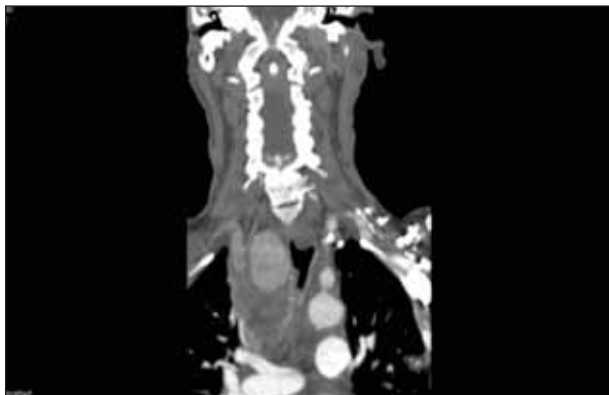


Figure 3. Left shift of the trachea and compression on the lumen by the large aneurysm.



Figure 4. Diagnostic angiogram confirming the IAA, with patent carotid and subclavian vessels both taking off from the aneurysm sac.

carotid and subclavian arteries were patent bilaterally. A VTK catheter (Cook Medical, Bloomington, IN) was then introduced into the aneurysm and advanced into the external carotid artery. A 9- X 59-mm iCast covered stent (Atrium Medical Corporation, Hudson, NH) was first placed into the common carotid artery, and then a 10- X 38-mm iCast covered stent was placed within the first stent, landing partially

into the aorta. The stent was balloon dilated to 12 mm (Figure 5), and the aneurysm was filled with coils through a right brachial artery approach (Figure 6). An endoleak was noted from the subclavian artery into the aneurysm sac. A plug was not readily available in the institution at the time. Therefore, coils were placed into the origin of the subclavian artery percutaneously via the brachial artery, and the

Indications for Use

The Medtronic Vascular Complete SE Vascular Stent System is indicated for improving luminal diameter in patients with iliac stenosis in previously unstented lesions with vessel reference diameters between 4.5 mm and 9.5 mm and lesion lengths up to 90 mm. The stent is intended as a permanent implant.

Contraindications

There are no known contraindications.

Warnings/Precautions

The Complete SE Vascular Stent System is provided sterile for one procedure only. Do not re-sterilize. Use prior to the "Use By" date noted on the package. • Use of the Complete SE Vascular Stent System requires advanced iliac angioplasty technical skills. The following instructions provide technical guidance but do not obviate the need for adequate training prior to use of the device. • Do not use if the temperature indicator found on the inner pouch is changed from a gray square to a black square as this indicates the unconstrained stent diameter and stent release may be compromised. • Persons with known hypersensitivities to nitinol and/or its components (e.g. nickel, titanium) may suffer an allergic reaction to the Complete SE Vascular Stent. • Maintain the delivery system parallel to the patient and as straight as possible during the procedure to prevent delivery system catheter kinking. • Do not deploy the stent if it is not optimal or appropriate for the vessel. The stent cannot be repositioned once deployed. • Care should be taken when stenting near a bifurcation, aneurysm or bypass graft. • Prior to stent deployment, utilize fluoroscopy to verify the stent has not been damaged or dislodged during positioning. • If unable to initiate stent release, remove the entire system from the patient and advance a new, previously unopened stent delivery system. • Once deployment is initiated, the stent cannot be recovered by the sheath. In the event of partial delivery of the stent, remove the entire delivery system from the patient. This may result in damage to the vessel wall requiring surgical intervention. • Prior to completion of the procedure, utilize fluoroscopy to ensure proper positioning of the deployed stent. If the target lesion is not completely stented, use additional Complete SE Vascular Stents as necessary to adequately treat the lesion. • The Complete SE Vascular Stent System is intended for use by physicians familiar with iliac stenting techniques and the risks associated with stenting. • Thrombogenicity evaluations were conducted using a heparinized model. If your patient cannot be adequately anticoagulated, it is unknown whether thrombus formation may occur with this product. • The use of overlapping stents with the Complete SE Vascular Stent System has not been formally evaluated in a clinical trial. • Caution must be taken when crossing the stented area with ancillary equipment to avoid dislodgment of the stent.

Potential Adverse Events

The following complications may be associated with the use of iliac stenting devices or iliac angioplasty: abrupt stent closure; allergic reaction (contrast medium, drug, stent or filter

material); amputation/limb loss; aneurysm or pseudoaneurysm in vessel or at vascular access site; angina/ coronary ischemia; arrhythmia (including premature beats, bradycardia, atrial and/or ventricular tachycardia, atrial and/or ventricular fibrillation [VF]); asystole or bradycardia requiring placement of a temporary pacemaker; arteriovenous fistula; bleeding complications from anticoagulant or antiplatelet medication requiring transfusion or surgical intervention; death; detachment and/or implantation of a component of the system; emboli, distal (air, tissue, plaque, thrombotic material, stent); fever; hematoma at vascular access site, with or without surgical repair; hemorrhagic event, with or without transfusion; hypotension/hypertension; infection, local or systemic including bacteremia or septicemia; ischemia requiring intervention (bypass or amputation of toe, foot, or leg); myocardial infarction; pain (leg/foot); pain at catheter insertion site; pulmonary embolism; renal failure/ insufficiency secondary to contrast medium; stent malposition/ migration; stent strut fracture; stroke; vascular thrombosis/ occlusion at puncture site, treatment site, or remote site; vessel dissection, perforation or rupture; vessel spasm or recoil; worsened claudication/rest pain

Please reference appropriate product *Instructions for Use* for a more detailed list of indications, warnings, precautions and potential adverse events.

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Figure 5. Stent placed into the common carotid artery landing into the aortic orifice.

endoleak was subsequently resolved (Figures 7 and 8).

On postoperative day 3, the coils were noted to have migrated to the axillary artery, and the patient was taken back to the operating suite. An aortogram showed a patent subclavian and vertebral artery and flow in the axillary artery. A 12-mm Amplatzer plug (AGA Medical Corporation, Plymouth, MN) was then placed into the origin of the artery percutaneously via the brachial artery. This maintained the position of the previously placed coils and occluded the subclavian artery. A subsequent thoracic angiogram revealed a proximal leak around the covered stent; a 14-mm dilatation balloon angioplasty sealed the leak.

DISCUSSION

Isolated true IAAs are rare; they represent approximately 3% of all aneurysm incidents.³ Bower et al found only six cases in a retrospective survey of the Mayo Clinic records spanning 40 years.⁶ Traditionally, these aneurysms were encountered secondary to infection with syphilis (*Treponema pallidum*); however, with advances in medical treatment, syphilitic arthritis has virtually disappeared. The majority of IAAs encountered today are associated with a coexisting ascending or thoracoabdominal aortic aneurysm.⁷ Other causes include connective tissue disorders, vasculitis, or an associated trauma.⁸ An isolated IAA, as we presented here, is exceedingly rare.⁵ The clinical picture ranges from an incidental finding to a catastrophic event.

Signs and symptoms include supraclavicular pulsatile masses, chest pain, dysphagia, dyspnea, tracheal compression, and hoarseness.⁹ Although neurological manifestations due to embolism or thrombosis are by far the most frequent devastating events associated with these aneurysms, rupture has also been reported. For example, Kieffer et al reported such a case in the *Journal of Vascular Surgery*.⁵ IAA

rupture is more commonly seen in conjunction with post-traumatic aneurysms and in patients with hereditary connective tissue disease.⁵ Posttraumatic aneurysm may also present with thrombosis. An IAA is usually detected as an asymptomatic mass on chest x-ray, and CT scan or angiography can confirm the diagnosis.^{8,10}

Surgical treatment is always necessary in symptomatic cases and should be considered in asymptomatic patients to prevent complications, which include cerebral embolization if thrombus is noted lining the aneurysm wall.⁶ However, surgical treatment comes with considerable morbidity and mortality rates, and although these rates have improved, they remain significant. Hadjipetrou et al report rates of 3%, 2%, and 16% for death, stroke, and complications, respectively,¹¹ for patients undergoing surgery to treat IAAs. Kieffer et al reported a perioperative mortality rate of 11% in 27 patients who were treated for IAAs over 3 decades.⁵ Schumacher et al³ quote a mortality rate of 41.7% in 47 patients treated for nontraumatic IAAs. Endovascular treatment of IAAs is desirable because of the difficulty in approaching these aneurysms and the considerable mortality rates. Endovascular graft repair is also an option for patients who cannot tolerate general anesthesia due to severe pulmonary disease. Endografts can be delivered by either a femoral approach or via a brachial approach; however, it may be unusual to find IAAs with a proximal neck. Only aneurysms with an adequate proximal and distal neck (> 1 cm) are suitable for endografting.

If the patient is not a candidate for endovascular repair, a surgical approach through a median sternotomy and bypass grafting from the ascending aorta to the subclavian and carotid arteries can be performed and has good long-term patency.^{2,10} rates around 94% ± 3% and 88% ± 6% at 5 and 10 years, respectively.¹² Various surgical approaches have been devised to treat IAAs and include ligation alone,¹⁰ patch angioplasty, resection with end-to-end anastomosis, and bypass with either saphenous vein or prosthetic grafts.

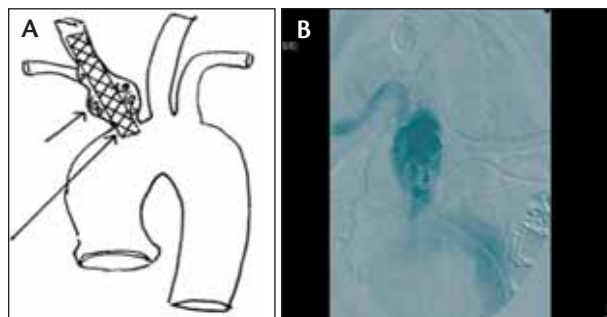


Figure 6. An aneurysm with embedded coils (short arrow) and a stent in the carotid artery landing into the aorta (long arrow) (A). Coils placed into the aneurysm partially filling the aneurysm sac (B).



Figure 7. Complete embolization of the aneurysm and subclavian artery. The carotid artery remained patent with the stent in place.

The surgical approach depends on the extent of the aneurysm, which is classified into three groups: group A does not involve the origin of the innominate artery; group B involves the origin but not the aorta; and group C involves the origin and the aorta and requires cardiopulmonary bypass for repair.⁵

Kieffer et al noted that patients with isolated asymptomatic aneurysms who are at high surgical risk should undergo surgery when the aneurysms are saccular or when their maximum transverse diameter is > 3 cm.⁵ In an elective setting, the mortality risk is 4% to 5% and increases up to 50% in cases of emergency surgery for a ruptured aneurysm.¹⁰

CONCLUSION

A surgical approach has largely been the conventional treatment via a thoracotomy or median sternotomy with or without cardiopulmonary bypass;^{4,5} however, an open approach has a significant morbidity rate associated with it. An endovascular approach offers the advantage of being minimally invasive and having a decreased morbidity rate, although long-term follow-up and evaluation of the durability are still to be determined. ■

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Figure 8. Postprocedure aortogram showing the stent in the common carotid artery and coils occluding the aneurysm and right subclavian artery.

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