Percutaneous Closure of the Aorto-Ostial Origin of a Coronary Artery Saphenous Bypass Graft with a Large Pseudoaneurysm Using the AMPLATZER Muscular Ventricular Septal Defect Occluder

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Abstract

Keywords

- pseudoaneurysm
- saphenous bypass graft
- AMPLATZER occluder
- ascending aorta
- aneurysm

We report the case of a 76-year-old male patient with a history of coronary artery bypass graft surgery presented with a large pseudoaneurysm emerging from a previously occluded saphenous bypass graft (SVG). A largely contained hematoma is seen in the mediastinum on computed tomography angiography (CTA) of the chest. Flow was seen from the ascending aorta into the pseudoaneurysm through the aorto-ostial opening of the bypass graft. Closure of the aorto-ostial origin of the graft was performed using the AMPLATZER muscular ventricular septal defect (VSD) occluder (St Jude's Medical, St. Paul, MN) with immediate interruption of flow into the graft and the pseudoaneurysm. A repeat CTA of the ascending aorta at 6 months postprocedure continued to confirm an optimal positioning of the occluder with no flow into the pseudoaneurysm. This case offers an endovascular alternative to close the aorto-ostial opening of a saphenous bypass graft in the setting of a rare but potentially life-threatening SVG pseudoaneurysm.

Pseudoaneurysms of bypass grafts following coronary artery bypass graft (CABG) occur very rarely.^{1–14} They are generally preceded by aneurysmal dilatation of the graft secondary to degenerative changes many years after CABG.¹² Ramirez et al¹² noted that 68.5% of the grafts that develop aneurysmal changes post CABG do so after 10 years of bypass surgery and 8.1% will eventually rupture. Other etiologies also include intervention on the graft,⁹ inflammatory disease,¹⁵ or infection.³ Treatment of vein graft pseudoaneurysm is generally surgical. However, endovascular techniques are now more frequently utilized including stent grafts or coil embolization.^{3,7,9,16,17} We report a case of an aneurysmal vein graft with subsequent rupture and formation of a large pseudoaneurysm. The AMPLATZER muscular VSD Occluder (St Jude's Medical, St. Paul, MN) was utilized successfully to occlude the aortic origin of the graft.

Case Report

The patient is a 76-year-old male with a history of CABG in December 1999. He returned in December 2004 with chest pain and was noted to have occluded bypass grafts to the right coronary artery and the second obtuse marginal. A first obtuse marginal bypass graft was stented. His ejection fraction was 10% and on February 15, 2005 he underwent placement of internal cardiac defibrillator. The patient underwent further treatment with stenting of his obtuse marginal graft on January 2010 and July 2013. His occluded right CABG was confirmed to be occluded but with an aneurysmal stump (►Fig. 1). He presented with chest pain in December 2014 and angiography was performed. This revealed severe left ventricular dysfunction (ejection fraction 15%) and severe three-vessel coronary artery disease. His left internal

Fig. 1 Angiogram of the right coronary artery bypass graft 4 years before the development of the pseudoaneurysm. The graft is occluded and appears aneurysmal.

Fig. 3 Intravascular ultrasound to the origin of the bypass graft.

mammary artery to the left anterior descending artery was patent with no obstructive disease. His previously stented obtuse marginal graft was patent with no restenosis. A second obtuse marginal graft was occluded. His vein graft to the right coronary artery was occluded with a large pseudoaneurysm surrounded by a giant hematoma compressing partially his right-sided chambers of the heart (**Fig. 2A, B**). His hemoglobin was 8.5 g/dL and he was transfused with two units of packed red blood cells. His history is significant for abdominal aortic aneurysm postendograft repair (2012) and carotid endarterectomy (2002). His cardiac risk factors included the history of smoking, family history of heart disease, hypertension, and hyperlipidemia. He has been on carvedilol, clopidog-

rel, baby aspirin, furosemide, potassium chloride supplement, and atorvastatin. He has been intolerant to angiotensin blockers. The patient was deemed to be a very high surgical risk for an open repair of his saphenous bypass graft pseudoaneurysm and an endovascular approach was planned.

After preparation and draping, and 1% xylocaine anesthesia, the left and right common femoral arteries are entered percutaneously by the Seldinger technique and 6F sheaths were advanced in the vessels over guidewires. A pre-Perclose device (Abbott Vascular, Abbott Park, IL) is advanced into the right femoral artery. A pigtail catheter is advanced through the left femoral artery introducer and ascending aortogram is completed in the left anterior oblique projection. A normal

Fig. 2 Pseudoaneurysm from the right coronary artery bypass graft with a large hematoma (dark long arrow) (A) (short dark arrow pointing to the orifice, a long white arrow pointing to dye extravasation into the pseudoaneurysm) partially compressing the right ventricle (dark arrow) (B). H, hematoma.

Fig. 4 Deployment of the first disc of the AMPLAZER muscular VSD occluder (St Jude's Medical, St. Paul, MN) (A) followed by deployment of the second disc in the aorta (B) (white arrow pointing to AMPLAZER occluder in position, a dark arrow pointing to coils in the pseudoaneurysm). Aortography (C) shows no to minimal leak within the pseudoaneurysm postoccluder deployment. At 6-month follow-up by CTA, the occluder remains stable in its position and no leak into the pseudoaneurysm is seen (arrow pointing to occluder position at the pseudoaneurysm) (D). CTA, computed tomography angiography; VSD, ventricular septal defect.

size ascending aorta is noted with wall calcification seen. A 9F multipurpose guiding catheter is positioned in the right CABG and angiography is completed. This revealed a totally occluded graft with a large right pseudoaneurysm. Intravascular ultrasound (Volcano, San Diego, CA) was then completed in the right CABG. Measurements are made at the aortotomy site (9.3×10.1 mm) (►Fig. 3). A 10-mm AMPLAZER muscular VSD occluder (St. Jude Medical Inc., St Paul, MN) was then prepared. Delivery through the 9F guiding catheter was not possible and the catheter was withdrawn with the Wholey guidewire (Covidien, Plymouth, MN) in the bypass graft. The AMPLAZER delivery sheath (9F) was then advanced to the right coronary artery graft origin over the guidewire. Initially, coil deployment is achieved in the pseudoaneurysm which included 5-3 mm and 4-3 mm Tornado coils (Cook Medical Inc., Bloomington, IN) to accelerate thrombosis following anticipated closure with the VSD occluder. The 10-mm VSD occluder was then advanced through the introducing sheath and partially deployed in the right CABG (►Fig. 4A). The plug

and sheath were then withdrawn as one unit until the graft portion of the plug reached the aortotomy site and the remainder of the plug is then positioned on the arterial site of the aortotomy (►Fig. 4B). An ascending aortogram is repeated. The AMPLAZER plug was then completely released and another aortogram performed confirming good position and a marked reduction of flow through the pseudoaneurysm (►Fig. 4C). At 6 months follow-up, a computed tomography angiography (CTA) was performed. The plug was in its position and no flow was seen in the pseudoaneurysm (►Fig. 4D).

Discussion

Several case reports and small series have described the occurrence of aneurysmal changes in SVG, generally seen on long-term follow-up after bypass surgery.¹² Spontaneous pseudoaneurysms of SVG are however very rare and potentially fatal and may be preceded by aneurysmal changes. Other etiologies include iatrogenic trauma from catheters or

stents,⁹ infections,³ or inflammatory conditions.¹⁵ The traditional treatment has been surgical and is generally associated with high morbidity and mortality. Surgery is reserved for patients who are an acceptable surgical candidate and with less comorbidities. Percutaneous closure of the pseudoaneurysm, however, carries the distinct advantage of being a lower risk technique than open surgery and likely requires shorter hospitalization. Therapeutic options such as coil embolization or closure with a stent graft have been reported.^{3,7,9,16,17} However, coil embolization is likely to be effective in a small pseudoaneurysm, and stent graft is best applied in a patent graft supplying a viable myocardium where graft closure can lead to significant ischemia. Closure of an aortic pseudoaneurysm with an AMPLATZER plug has also been described and its application in the setting of a vein graft pseudoaneurysm is exceedingly rare. This technique, however, cannot be applied to a viable functional graft.

The AMPLATZER muscular VSD occluder has been described in few case reports to successfully treat aortic pseudoaneurysms or to close aortic arteriotomies at the site of catheter punctures such as during transaortic valve replacement with a transcaval approach.^{13,18–21} We present the case of a symptomatic giant SVG pseudoaneurysm occluded by deployment of a proximal VSD AMPLATZER occluder. The antegrade flow into the pseudoaneurysm has been successfully obliterated. Distal retrograde flow from the native artery was not of concern as this graft has been previously known to be occluded. This approach was selected given the high risk of the patient for cardiothoracic surgery. Our patient had a reduced ejection fraction and had multiple comorbidities including the calcified aorta, lung disease, and extensive history of vascular disease. Only rare cases in the literature described the use of the VSD AMPLATZER for treating pseudoaneurysms of SVG by obliterating their aorto-ostial origin.^{13,19} We believe this technique can be applied safely in the high-risk surgical patients and with trained operators in the delivery of these devices when the anatomy is feasible.

The technique involved access from both femoral arteries and a 9F AMPLATZER delivery sheath was needed. To guide the AMPLATZER sheath into the pseudoaneurysm, a multi-purpose catheter initially was needed to engage the origin of the graft, followed by a Wholey Wire (Medtronic, Minneapolis, MN) placed into the pseudoaneurysm to serve as a rail to guide the AMPLATZER sheath. Also, appropriate sizing of the origin of the graft by intravascular ultrasound was needed to confirm the size of the occluder. In addition, the deployment of the occluder is done under fluoroscopic guidance and contrast dye injection from the pigtail catheter. Our patient was not a candidate for stent graft closure (graft had been occluded) and coils were ineffective given the large size of the pseudoaneurysm. Furthermore, occluding the graft origin was feasible as this graft was known to be occluded and was not essential for supplying blood flow to the myocardium. If this graft was still patent, a stent graft option may have been preferred. Finally, the complete closure of the pseudoaneurysm was not immediate but did occur at 1-month follow-up by CTA likely because of endothelial coverage of the AMPLATZER plug.

In summary, the use of the VSD AMPLATZER occluder to obliterate the aortic origin of an aneurysmal/pseudoaneurysmal vein graft is feasible and can be accomplished in the cardiac catheterization laboratory. In patients with high risk for open repair, this may prove to be a lifesaving procedure.

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