Case Reports

Percutaneous Closure of a Coronary Artery-to-Vein Graft Anastomotic Pseudoaneurysm

Presenting as Acute Coronary Syndrome after Recent Coronary Artery Bypass Grafting

Ryan J. Maybrook, MD
Suresh Sharma, MD
Kamal Gupta, MD
Mark Wiley, MD
Deepak Parashara, MD

Pseudoaneurysm formation has been reported in degenerated coronary artery saphenous vein bypass grafts, as well as in native coronary arteries after interventional procedures or blunt trauma. In contrast, pseudoaneurysm formation arising from the anastomotic site of native coronary vessels soon after coronary artery bypass grafting is rare, and neither the clinical presentation of this phenomenon nor its treatment is well described.

We present the case of a 63-year-old man, a recent coronary artery bypass grafting patient, who presented with acute coronary syndrome due to a large and expanding pseudoaneurysm of the saphenous vein-to-ramus intermedius artery graft anastomosis. After several attempts, we successfully treated the pseudoaneurysm by means of percutaneous coil embolization. To our knowledge, this is the first report of acute coronary syndrome secondary to a pseudoaneurysm at the coronary artery–saphenous vein graft anastomosis. In addition, this appears to be the first report of the percutaneous treatment of such a pseudoaneurysm by means of coil embolization. ***(Tex Heart Inst J 2015;42(3):265-9)***

Key words: *Aneurysm, false/diagnosis/etiology/therapy; aneurysm, ruptured/prevention & control; coronary artery bypass/adverse effects; embolization, therapeutic/instrumentation/methods; graft occlusion, vascular/etiology; postoperative complications/diagnosis/therapy; saphenous vein; treatment outcome*

From: *Division of Cardiovascular Diseases (Drs. Gupta, Maybrook, Sharma, and Wiley), University of Kansas Medical Center, Kansas City, Kansas 66160; and Division of Cardiovascular Diseases (Dr. Parashara), Kansas City Veterans Affairs Medical Center, Kansas City, Missouri 64128*

Address for reprints: *Ryan J. Maybrook, MD, Division of Cardiovascular Diseases, Rm. 1001 Eaton, MS 3006, University of Kansas Medical Center, 3901 Rainbow Blvd., Kansas City, KS 66160*

E-mail: *rmaybrook@kumc.edu*

Pseudoaneurysms of degenerated saphenous vein grafts (SVGs) can form after coronary artery bypass grafting (CABG).[1] Pseudoaneurysm formation at the distal anastomotic site after CABG is very rare, and the clinical presentation and treatment of this phenomenon have not been well described. We present the case of a recent CABG patient whose pseudoaneurysm at the coronary artery–SVG anastomosis was treated by means of percutaneous coil embolization. In addition, we discuss other management options.

Case Report

In December 2012, a 63-year-old man presented at another hospital with syncope and a non-ST-segment-elevation myocardial infarction (NSTEMI), a peak troponin I level of 11.4 ng/mL, and associated new T-wave inversions in the inferior electrocardiographic leads. He had undergone 4-vessel, on-pump CABG 4 weeks earlier: a graft of the left internal mammary artery to the left anterior descending coronary artery, a saphenous vein graft to the right posterior descending artery, and a saphenous vein Y graft to a superior branch of the ramus intermedius (RI) and the first diagonal branch. A quantitative coronary angiogram showed a 1.7 × 1.5-cm pseudoaneurysm that appeared to arise from the SVG–RI anastomotic site (Fig. 1A). Even though the pseudoaneurysm filled after angiographic contrast-medium injection from both the left main coronary artery (LMCA) and the SVG, the filling was substantially more pronounced when injections were made from the SVG (Fig. 1B). The other bypass grafts were patent, and no new obstructive native coronary artery lesions were apparent. It was presumed that the patient's NSTEMI was secondary to the pseudoaneurysm—most likely from distal embolization of intraluminal thrombus from the pseudoaneurysm, even though no distal cutoff or other angiographic evidence of embolization was noted. Another possible mechanism by which the pseudoaneurysm could cause acute coronary syndrome (ACS) was mass effect; however, no compression of the adjacent vessels was seen. The patient was referred to our center for further

treatment. In light of his recent sternotomy, we decided to pursue percutaneous intervention first.

At the start of the procedure, we gave the patient bivalirudin to achieve optimal anticoagulation, in accordance with protocol. He was already on a regimen of aspirin and clopidogrel. Bilateral access was attained in both common femoral arteries. A 7F extra back-up (EBU) 4 guiding catheter (Medtronic, Inc.; Minneapolis, Minn) was advanced into the LMCA, and a 7F hockey-stick guiding catheter (Cordis, a Johnson & Johnson company; Somerville, NJ) was advanced into the SVG to the RI. Multiple attempts to advance a coronary guidewire into the pseudoaneurysm through the SVG were unsuccessful, indicating that the pseudoaneurysm was probably arising from the native RI (Fig. 2). We then attempted to advance the wire into the pseudoaneurysm by using the native coronary approach. However, this too was initially unsuccessful, most likely because of acute angulation at the neck of the pseudoaneurysm. At this point, we decided to place a covered coronary stent to cover the neck. First, we stented a severe lesion in the proximal segment of the RI with use of a 2.5 × 15-mm XIENCE PRIME™ Everolimus-Eluting Coronary Stent (Abbott Vascular, part of Abbott Laboratories; Abbott Park, Ill), to facilitate wire movement and improve torque. We were unable to advance the covered stent to the opening of the neck, which was at the mid-distal segment of the RI branch. We then stented across the anastomosis (where the neck of the pseudoaneurysm was located) with use of a XIENCE PRIME stent (2.25 × 23 mm, postdilated with a 2.5-mm balloon), in the hope that the plaque shift would close the opening into the pseudoaneurysm. Regardless, the pseudoaneurysm continued to fill. Eventually, we passed a 0.014-in ASAHI Fielder FC hydrophilic coronary guidewire (Abbott Vascular) into the pseudoaneurysm through the struts of the stent. However, we were unable to advance any over-the-wire balloon or microcatheter into the pseudoaneurysm, and coiling could not be achieved. The catheter manipulation led

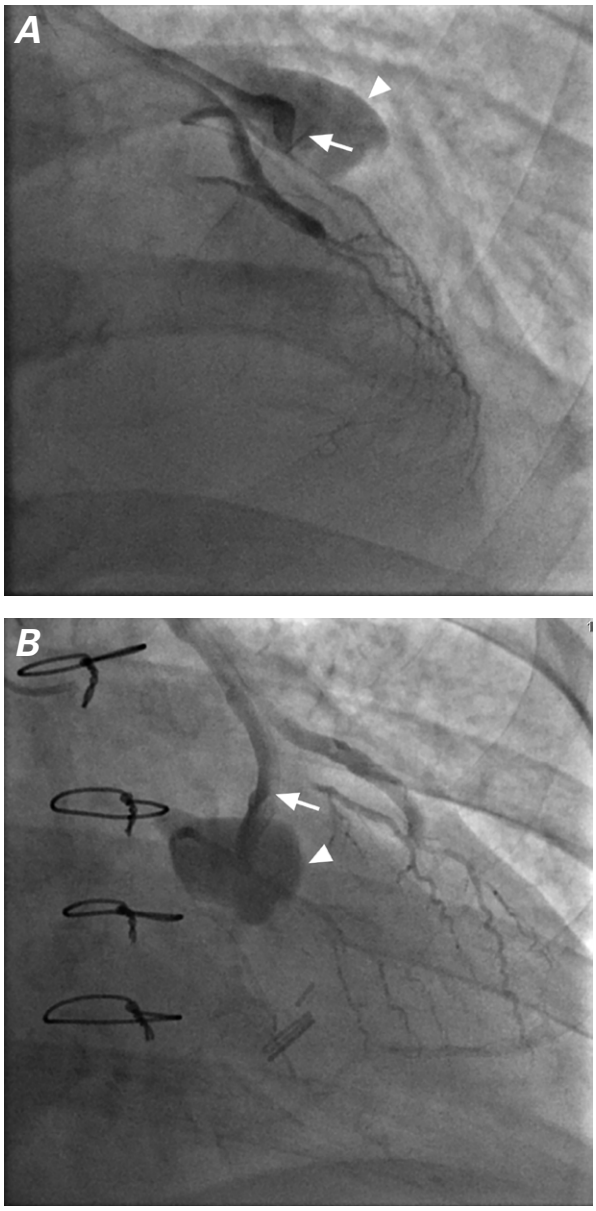

Fig. 1 *Coronary angiograms.* ***A****) The shallow left anterior oblique cranial view reveals a pseudoaneurysm (arrowhead) of the ramus intermedius at the site of anastomosis with the saphenous vein graft. The arrow points to a jet of contrast extravasation.* ***B****) The right anterior oblique view reveals the large pseudoaneurysm (arrowhead) and the saphenous vein to ramus intermedius (arrow).*

Supplemental motion image is available for Figure 1A.

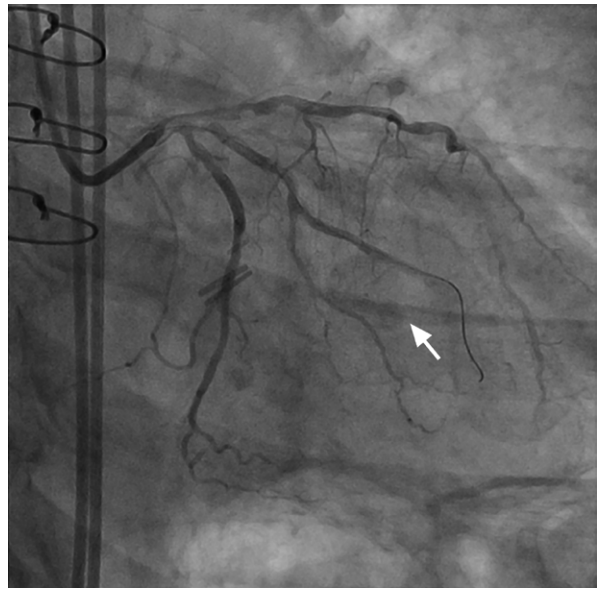

Fig. 2 *Coronary angiogram (shallow right anterior oblique caudal view) shows a guidewire in the superior branch of the ramus intermedius, and faint filling of the pseudoaneurysm (arrow) from this branch after contrast injection of the left main coronary artery.*

to clot formation in the lumen of the distal stent, and we promptly aspirated the clot with use of an aspiration catheter. An angiogram showed that the thrombus had resolved from the coronary lumen, but that the flow in the pseudoaneurysm was sluggish and diminished. We concluded that thrombus had been pushed into the pseudoaneurysm through its neck, and that new thrombus had probably also formed there after the wire manipulation (Fig. 3). At this time, we terminated our attempts. The patient was discharged from the hospital in stable condition after 2 days and was instructed to take aspirin and clopidogrel for 12 months.

Approximately 4 weeks later, the patient underwent coronary computed tomographic angiography (CTA). The pseudoaneurysm was persistent and was 2 × 1.6 × 2 cm in size. A subsequent coronary angiogram confirmed the pseudoaneurysm's persistence and substantial growth, suggesting its unstable nature (Fig. 4).

We decided to attempt coil embolization again. A 7F EBU 3.75 guiding catheter (Medtronic) was used to engage the ostium of the LMCA. After multiple attempts, we advanced a hydrophilic, 0.014-in PT2® moderate-support guidewire (Boston Scientific Scimed, Inc.; Maple Grove, Minn) into the aneurysmal sac. A 6F Judkins Right-4 guiding catheter (Medtronic) was placed into the ostium of the SVG–RI for dual access. Balloon angioplasty was performed with use of a 1.5-mm and then a 2-mm balloon through the previously placed stent struts at the anastomotic site, to gain better access into the pseudoaneurysm. A 0.21-mm Progreat® microcatheter (Terumo Medical Corporation; Somerville, NJ) was then inserted into the sac, and 6 coils were deployed in the following order: two 14-mm × 34-cm Azur® detachable coils (Terumo); a 10-mm × 20-cm Azur detachable coil; a 10-mm × 14-cm and an 8-mm × 14-cm Nester® embolization coil (Cook Medical Inc.; Indianapolis, Ind); and an 8 × 4 × 9.5-cm Tornado® microcoil (Cook Medical). The coils occluded the pseudoaneurysm. A coronary angiogram showed antegrade Thrombolysis in Myocardial Infarction-3 flow of the native RI and the SVG (Fig. 5), with no filling of the pseudoaneurysm. Follow-up coronary CTA 5 weeks later revealed no opacification of the aneurysmal sac, indicating successful coil embolization.

The patient was asymptomatic and free of recurrent ischemic events at his outpatient follow-up evaluation in February 2014, and in August 2014 he reported that he was doing well.

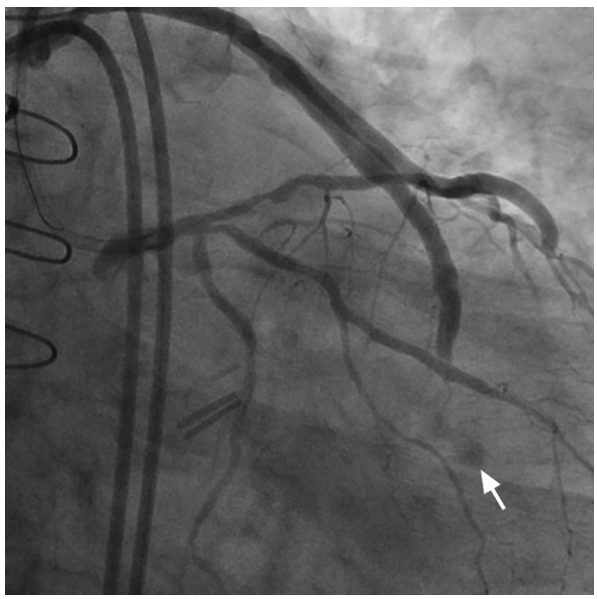

Fig. 3 *Coronary angiogram (shallow right anterior oblique caudal view) shows spontaneous, near-complete closure of the pseudoaneurysm of the ramus intermedius. There is only a hint of filling on simultaneous contrast injection of the left main coronary artery and the saphenous vein graft to the ramus intermedius. The arrow points to the former site of the pseudoaneurysm.*

Supplemental motion image is available for Figure 3.

Discussion

Venous-graft pseudoaneurysms form after CABG in less than 1% of cases and are almost always seen in degenerating grafts years after the CABG. Rarely, they form early in the postoperative course.[1-3] In 1975, Riahi and colleagues[2] first described the phenomenon of aneurysm formation in a saphenous vein-to-coronary artery graft after CABG. A pseudoaneurysm is defined as a defect in the arterial wall that causes extravasation of blood into a contained extraluminal space, whereas

Fig. 4 *Eight weeks after the first embolization attempt, a coronary angiogram (shallow left anterior oblique cranial view) shows a persistent, notably larger pseudoaneurysm of the ramus intermedius (arrow) after contrast injection of the left main coronary artery.*

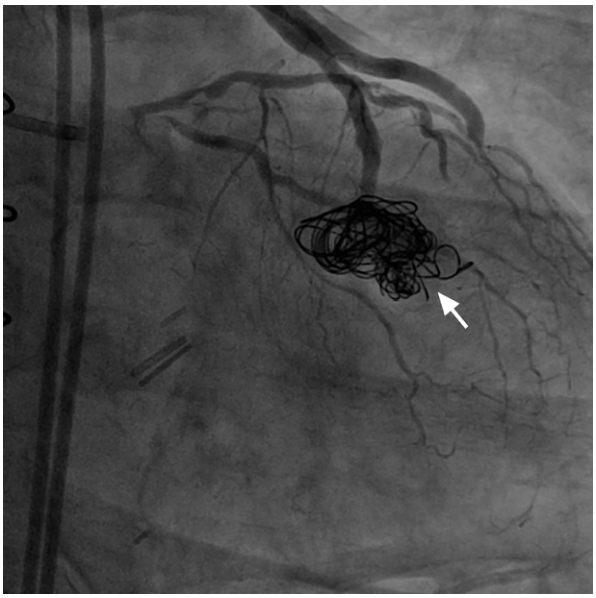

Fig. 5 *Coronary angiogram (anteroposterior caudal view) shows successful embolization of the pseudoaneurysm (arrow) after 6 coils were deployed. Thrombolysis in Myocardial Infarction-3 flow is present in the ramus intermedius past the former site of the pseudoaneurysm.*

Supplemental motion image is available for Figure 5.

a true aneurysm is dilation of the entire circumference of the vessel. Numerous sequelae—including fistula formation, myocardial infarction caused by mass effect or intraluminal thrombus, rupture leading to tamponade or hemothorax, and death—have been reported after the aneurysmal dilation of these conduits.[4-6] In venous grafts that are not old or degenerated, proposed mechanisms for pseudoaneurysm formation include weakness in the veins at branch locations or valves, accidental damage to the graft during the initial surgery, infection, and wall disruption related to stent placement in the SVG after CABG.[5] The mechanism for pseudoaneurysm formation early in the postoperative course (such as in our patient) most likely pertains to technical factors of the surgical procedure at the anastomotic site.

To our knowledge, this is the first report of a pseudoaneurysm at the distal anastomosis of a coronary artery-to-SVG. This case also involves an apparently unique cause of ACS after recent CABG. Most cases of ACS are secondary to early graft occlusion or failure, incomplete revascularization, or progressive native coronary artery disease.[7] Pseudoaneurysms of venous bypass grafts, of the aorta, and of the native coronary arteries after interventional procedures or blunt trauma have been described, but pseudoaneurysm formation arising from the anastomotic site of native coronary vessels after CABG is extremely rare.

Recommendations have not yet been defined for the management of coronary artery pseudoaneurysms arising after percutaneous coronary intervention, or in the case of more complex lesions such as those described herein. No trial investigators have compared surgical treatment with medical therapy for coronary artery pseudoaneurysms, probably because of the low prevalence of such sequelae. Currently, the medical literature supporting the percutaneous repair of pseudoaneurysms consists of small case series and case reports of degenerated SVG pseudoaneurysms. Although surgical repair is an option if a pseudoaneurysm arises after CABG, percutaneous repair with use of a PTFE-covered stent, an AMPLATZER™ vascular plug (St. Jude Medical, Inc.; St. Paul, Minn), or coil embolization might be preferable, to avoid repeat sternotomy.[8-12] Careful postprocedural monitoring with imaging such as coronary CTA is especially important in cases of percutaneous pseudoaneurysm closure, because these patients are taking dual antiplatelet medications, and recanalization of flow into the pseudoaneurysm is theoretically possible.

Although percutaneous repair is less invasive than surgery, the associated risks warrant careful evaluation and thorough discussion with the patient before any percutaneous procedure is undertaken. As is the case with percutaneous repair of other vascular aneurysms, coronary aneurysm rupture is potentially devastating, and extreme caution should be exercised while manipulating microcatheters and coils within the aneurysmal sac.[13] In stent-assisted coil embolization, another consideration is the risk of in-stent restenosis or thrombosis and subsequent coronary ischemia.[14] Watchful waiting is generally not advisable in cases such as the one that we have described, because of the acute presentation and the growth of the pseudoaneurysm. We think that the risks associated with aneurysms at a coronary artery-to-SVG anastomotic site are similar to those of other aneurysms, and that at least equal caution should be exercised during percutaneous repair.

Pseudoaneurysms can rapidly increase in size and thus are unstable; therefore, early treatment is recommended. This case illustrates that percutaneous coil embolization can be a feasible and successful alternative to surgical repair, especially because repeat sternotomy soon after CABG is preferably avoided.

References

1. Abbasi M, Soltani G, Shomali A, Javan H. A large saphenous vein graft aneurysm one year after coronary artery bypass graft surgery presenting as a left lung mass. Interact Cardiovasc Thorac Surg 2009;8(6):691-3.
2. Riahi M, Vasu CM, Tomatis LA, Schlosser RJ, Zimmerman G. Aneurysm of saphenous vein bypass graft to coronary artery. J Thorac Cardiovasc Surg 1975;70(2):358-9.
3. Sareyyupoglu B, Schaff HV, Ucar I, Sundt TM 3rd, Dearani JA, Park SJ. Surgical treatment of saphenous vein graft aneurysms after coronary artery revascularization. Ann Thorac Surg 2009;88(6):1801-5.
4. Almanaseer Y, Rosman HS, Kazmouz G, Giraldo AA, Martin J. Severe dilatation of saphenous vein grafts: a late compli-

cation of coronary surgery in which the diagnosis is suggested by chest x-ray. Cardiology 2005;104(3):150-5.
5. Le Breton H, Pavin D, Langanay T, Roland Y, Leclercq C, Beliard JM, et al. Aneurysms and pseudoaneurysms of saphenous vein coronary artery bypass grafts. Heart 1998;79(5):505-8.
6. Nishimura K, Nakamura Y, Harada S, Saiki M, Marumoto A, Kanaoka Y, Nishimura M. Saphenous vein graft aneurysm after coronary artery bypass grafting. Ann Thorac Cardiovasc Surg 2009;15(1):61-3.
7. Wann S, Balkhy H. Evaluation of patients after coronary artery bypass grafting. Cardiol Rev 2009;17(4):176-80.
8. Ramirez FD, Hibbert B, Simard T, Pourdjabbar A, Wilson KR, Hibbert R, et al. Natural history and management of aortocoronary saphenous vein graft aneurysms: a systematic review of published cases. Circulation 2012;126(18):2248-56.
9. Johnson NP, Dasgupta A, Appel D, Beohar N. Post-intervention coronary pseudoaneurysm treated with a covered stent. Tex Heart Inst J 2012;39(3):448-9.
10. Jamshidi P, Resink T, Erne P. Staged stenting of a long aneurysm of a saphenous vein coronary artery bypass graft. J Invasive Cardiol 2008;20(1):E1-5.
11. Goel P. Coil embolization of left coronary artery pseudoaneurysm arising as a complication of percutaneous coronary intervention. Catheter Cardiovasc Interv 2013;82(3):426.
12. Kumar A, Santana D, Jenkins LA. Closure of a giant saphenous vein graft aneurysm with embolization coil. Cardiol Res Pract 2009;2009:748272.
13. Sacca S, Pacchioni A, Nikas D. Coil embolization for distal left main aneurysm: a new approach to coronary artery aneurysm treatment. Catheter Cardiovasc Interv 2012;79(6):1000-3.
14. Terasawa A, Yokoi T, Kondo K. Stent-assisted coil embolization of coronary artery aneurysm. J Invasive Cardiol 2013;25(8):E175-7.`