Complete occlusion of the proximal subclavian artery post-CABG: Presentation and treatment

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Atherosclerotic disease of the proximal left subclavian artery is an uncommon cause of angina in the post-coronary artery bypass graft patient, and is termed coronary-subclavian steal syndrome. Typical manifestations include cardiac symptoms of angina and noncardiac symptoms of lightheadedness, left arm numbness or weakness, and a difference in blood pressure of more than 20 mmHg between both arms. A case of complete proximal occlusion of the subclavian artery is reported. The clinical picture, investigations and treatment are described. Historical treatments of occlusive disease include surgical bypass graft and, more recently, percutaneous transluminal angioplasty. The patient underwent percutaneous transluminal angioplasty with stenting by a retrograde approach, with an excellent short-term response, but ultimately required a carotid subclavian bypass due to restenosis.

Key Words: Angina; Angioplasty; Cerebrovascular disorders; Complications; Peripheral vascular disease; Surgery

The use of the left internal mammary artery (LIMA) during coronary artery bypass graft (CABG) surgery has become the gold standard for revascularization. However, stenosis within the proximal left subclavian artery may cause reduction, and even reversal, of flow within the LIMA and the vertebral artery (Figure 1). The physiology of this phenomenon parallels subclavian steal syndrome, and has been termed coronary-subclavian steal syndrome (CSSS). We report a case of complete proximal subclavian occlusion with cardiac and neurological manifestations that was treated with angioplasty and stenting.

CASE PRESENTATION

A 61-year-old Guyanese man who immigrated to Canada in 1996 experienced crescendo angina and a myocardial infarction in 2000. Coronary angiography demonstrated triple-vessel disease, and the patient underwent CABG surgery; a LIMA to left anterior descending artery (LAD) graft, and saphenous vein grafts to the first obtuse marginal (OM) and the right coronary artery (RCA) were used. He was asymptomatic following surgery.

Over the next five years, the patient noted a decreased exercise tolerance. Initially, he experienced a 'hot' feeling in his left upper chest progressing to left chest pressure on exertion, which radiated to the neck. He also complained of light headedness, left arm pain and numbness on exertion. He was able to walk one to two blocks (or one flight of stairs) before the onset of symptoms, which were relieved by rest.

He did not associate any of his symptoms with the movement of his left arm. However, he noted reduced sensation in his left arm compared with the right. He denied shortness of breath, paroxysmal nocturnal dyspnea or orthopnea. He had no syncopal episodes.

Coronary risk factors included type 2 diabetes mellitus, hypertension and hyperlipidemia. Medications included acetylsalicylic acid, atenolol, atorvastatin and metformin.

On examination, his heart rate was 54 beats/min in the right arm, with a nonpalpable pulse in the left arm. The blood pressure in his right arm was 140/80 mmHg and 76/40 mmHg in his left arm. Otherwise, he had a normal physical examination.

Une occlusion complète de l'artère sous-clavière après un pontage aortocoronarien : La présentation et le traitement

La maladie athéroscléreuse de l'artère sous-clavière gauche proximale est une cause peu courante d'angine après un pontage aortocoronarien. On la désigne syndrome du vol de la sous-clavière. Ses manifestations classiques sont les symptômes cardiaques d'angine et les symptômes non cardiaques de légers étourdissements, d'engourdissement ou de faiblesse du bras gauche et d'une différence de tension artérielle de plus de 20 mmHg entre les deux bras. Un cas d'occlusion proximale complète de l'artère sous-clavière est présenté. Le tableau clinique, les explorations et le traitement sont décrits. Les traitements habituels de maladie occlusive incluent le pontage aortocoronarien et, plus récemment, l'angioplastie transluminale percutanée. Le patient a subi une angioplastie transluminale avec endoprothèse par endoscopie rétrograde et a présenté une excellente réponse à court terme, mais a finalement dû subir un pontage carotido-sous-clavier en raison d'une resténose.

Figure 1) Complete occlusion of the proximal subclavian artery, leading to flow reversal (*) in the left internal mammary artery (LIMA) and the vertebral artery. LAD Left anterior descending artery

The patient underwent exercise testing with sestamibi perfusion imaging. He was able to exercise 4 min 12 s, at which time he developed chest pain and shortness of breath. He achieved a heart rate of 115 beats/min. An electrocardiogram showed ST depression to a maximum of 2.7 mm in the anterior leads, although imaging did not show perfusion defects.

A multiacquisition gated scan revealed an ejection fraction of 62%. Echocardiography revealed normal left ventricular function, dimension and valves. A neck ultrasound with Doppler revealed less than 50% stenosis of the left internal carotid artery and retrograde blood flow in the left vertebral artery. Coronary angiography revealed retrograde flow up the LIMA, with distal subclavian filling (Figure 2). Angiography of the aorta revealed 100% stenosis at the left subclavian origin (Figure 3).

The patient underwent left subclavian artery stenting. The left brachial artery was punctured, and a 5 Fr sheath was introduced.

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Figure 2) A Left coronary angiography demonstrating reduced antegrade flow down the left anterior descending artery and retrograde filling of the left internal mammary artery (arrow). B Later stage of same injection showing filling of left subclavian from the left internal mammary artery (arrow)

Figure 3) Aortic angiography demonstrating total occlusion of left subclavian artery (arrow)

Subclavian angiography demonstrated occlusion of proximal subclavian artery and flow reversal in the vertebral artery and the LIMA. To better demonstrate this, contrast was injected into the LIMA, confirming flow reversal. Three thousand units of heparin were given intra-arterially. The occlusion was crossed in a retrograde fashion, and a 7 mm × 57 mm balloon-mounted stent was deployed across the occlusion. Post-stent angiography demonstrated good flow across the stent and forward flow within the LIMA (Figure 4). The distal tip of the stent was located at the origin of the LIMA, covering the left vertebral artery origin. The proximal end projected into the aorta.

After the procedure, the left radial pulse was noticeably stronger and subjectively of equal magnitude to the right radial pulse. The blood pressure in the left arm was 103/61 mmHg and 117/48 mmHg in the right arm. The patient underwent exercise treadmill testing and was able to exercise 6 min (reaching a heart rate of 90 beats/min) without changes on electrocardiogram or symptoms of angina. He was discharged on clopidogrel for one month. He was doing well from a cardiac perspective at six-month follow-up.

DISCUSSION

CSSS is thought to occur in 0.4% of post-CABG patients (1), and is usually diagnosed by a dramatic flow reversal in the LIMA during injection of the native LAD. In our patient, we observed reversal of flow in the left vertebral artery and the LIMA at rest, leading to symptoms of angina and light headedness on minimal exertion. We also noted instantaneous normalization of flow and resolution of symptoms following percutaneous transluminal angioplasty and stenting of the proximal subclavian artery using the left brachial approach.

Figure 4) Subclavian angiography after stent deployment showing antegrade flow down the left internal mammary artery (arrow)

Typical manifestations of CSSS include cardiac symptoms of angina and noncardiac symptoms of lightheadedness, left arm numbness or weakness, and a difference in blood pressure of more than 20 mmHg between both arms (2). It is important to note that exacerbation of symptoms with upper limb activity is not always present, as in our case.

Historically, the treatment of choice for CSSS was surgical carotid subclavian bypass grafting with a prosthetic conduit (2). This has been subsequently replaced by percutaneous transluminal angioplasty and stenting (3). Total occlusion of the subclavian artery presents a particular challenge for which experience is limited (4,5). Our case demonstrated that percutaneous transluminal angioplasty and stenting in a retrograde approach can be safe and effective, with excellent mid-term results, in patients with CSSS.

In summary, angina in patients post-LIMA grafting should raise clinical suspicion of CSSS, a condition that is treatable with percutaneous transluminal angioplasty and stenting.

Subsequent to submission, the patient developed recurrence of his original symptoms one year and a half post-stenting. On investigation, he was found to have restenosis of the subclavian stent. He underwent successful carotid to subclavian bypass in October 2007.

REFERENCES

1. Tyras DH, Barner HB. Coronary-subclavian steal. Arch Surg 1977;112:1125-7.
2. Marshall WG Jr, Miller EC, Kouchoukos NT, Kouchoukos NT. The coronary-subclavian steal syndrome: Report of a case and recommendations for prevention and management. Ann Thorac Surg 1988;46:93-6.
3. Marques KM, Ernst SM, Mast EG, Bal ET, Suttrop MJ, Plokker HW. Percutaneous transluminal angioplasty of the left subclavian artery to prevent or treat the coronary-subclavian steal syndrome. Am J Cardiol 1996;78:687-90.
4. Eggebrecht H, Naber CK, Oldenburg O, et al. Percutaneous transluminal laser guide wire recanalization of chronic subclavian artery occlusion in symptomatic coronary-subclavian steal syndrome. Catheter Cardiovasc Interv 2000;51:500-4.
5. Kang WC, Han SH, Ahn TH, Shin EK. Percutaneous transluminal angioplasty and stent implantation for coronary subclavian steal syndrome: Unusual approach. Int J Cardiol 2005;101:335-7.