Coronary Subclavian Steal Syndrome in a Post-Coronary Bypass Patient with Flow Reversal from Left Internal Mammary Artery Graft to Distal Subclavian Artery and Upper Limb with Arteriovenous Fistula

Jiunn-Cherng Lin[1,2,3,4], Tsun-Jui Liu[1,2], Yu-Wei Chen[1,2], Yu-Cheng Hsieh[2,3,4]

[1]Division of Cardiology, Department of Internal Medicine, Taichung Veterans General Hospital Chiayi Branch, Chiayi, Taiwan; [2]Cardiovascular Center, Taichung Veterans' General Hospital, Taichung, Taiwan; and Department of Internal Medicine, Faculty of Medicine, Institute of Clinical Medicine, Cardiovascular Research Center, National Yang-Ming University School of Medicine, Taipei, Taiwan; [3]Department of Financial Engineering and [4]Department of Data Science and Big Data Analytics, Providence University, Taichung, Taiwan

Abstract

Coronary steal syndrome is a rare disease which may result from various types of congenital and acquired diseases and conditions, such as coronary fistula to pulmonary arteries or coronary-ventricular fistulas. Coronary artery bypass surgery (CABG) establishes new arterial or venous grafts to native coronary arteries from other major arteries such as the aorta or subclavian artery, giving rise to opportunities to steal native coronary blood flow via these grafts. Here, we present the case of a post-CABG uremic patient who suffered angina every time he underwent hemodialysis. Coronary subclavian steal syndrome was diagnosed after coronary angiography, which showed blood flow reversal from the left anterior descending artery to the left subclavian artery. Left subclavian artery arteriography showed ostium stenosis. The patient's symptoms were resolved completely after percutaneous transluminal angioplasty (PTA) over the left subclavian artery.

Keywords: coronary steal syndrome, subclavian artery stenosis, left internal mammary artery (LIMA), coronary artery bypass graft (CABG), arterio-venous fistula

Introduction

Coronary subclavian steal syndrome after coronary artery bypass surgery (CABG) is rare.[1] However, important differential diagnosis can be applied in coronary subclavian steal syndrome. Here, we report a rare case of coronary subclavian steal syndrome in a post CABG patient with flow reversal from left internal mammary artery graft to distal subclavian artery and upper limb with arteriovenous fistula.

Address for correspondence: Jiunn-Cherng Lin, MD.
Division of Cardiology, Department of Internal Medicine, Taichung Veterans' General Hospital Chiayi Branch; No. 600, Sec. 2, Shixian Rd., West District, Chiayi City 60090, Taiwan
Tel: +886-5-2359630 ext 2516; Fax: +886-5-2840440; E-mail: horrisong@gmail.com

Case Report

A 63-year-old man had a history of type 2 diabetes mellitus, end-stage renal disease and coronary artery disease (CAD). He had previously received percutaneous transluminal coronary angioplasty (PTCA) with stenting over the left anterior descending artery (LAD) middle segment.The CAD continued to progress after several years, so he underwent coronary artery bypass surgery (CABG) around 3 years ago. His left internal mammary artery (LIMA) was anastomosed to the LAD distal segment and 1 saphenous vein graft (SVG) was anastomosed sequentially to the LAD first diagonal branch (LAD-D1) and left circumflex artery (LCX) obtuse marginal branch (OM). The patient visited our cardiovascular clinic due to chest tightness and resting dyspnea when he was undergoing hemodialysis. Recurrence of coronary artery disease such as graft occlusion was highly suspected by his nephrologist, who suggested re-evaluation of his cardiovascular condition. Physical examination revealed regular heart beat without heart murmurs. His arterio-venous graft (AVG) for hemodialysis was created over his left forearm and the thrill was strong. ECG showed sinus rhythm without significant ST-T changes. Chest X-ray showed nothing remarkable. Echocardiography also revealed nothing remarkable, with left ventricle (LV) systolic function preserved in resting condition. Nuclear cardiac stress test showed severe reversible ischemia over the anterior and anteroseptal walls of the LV myocardium (Figure 1). Under the impression of possible CAD recurrence, the

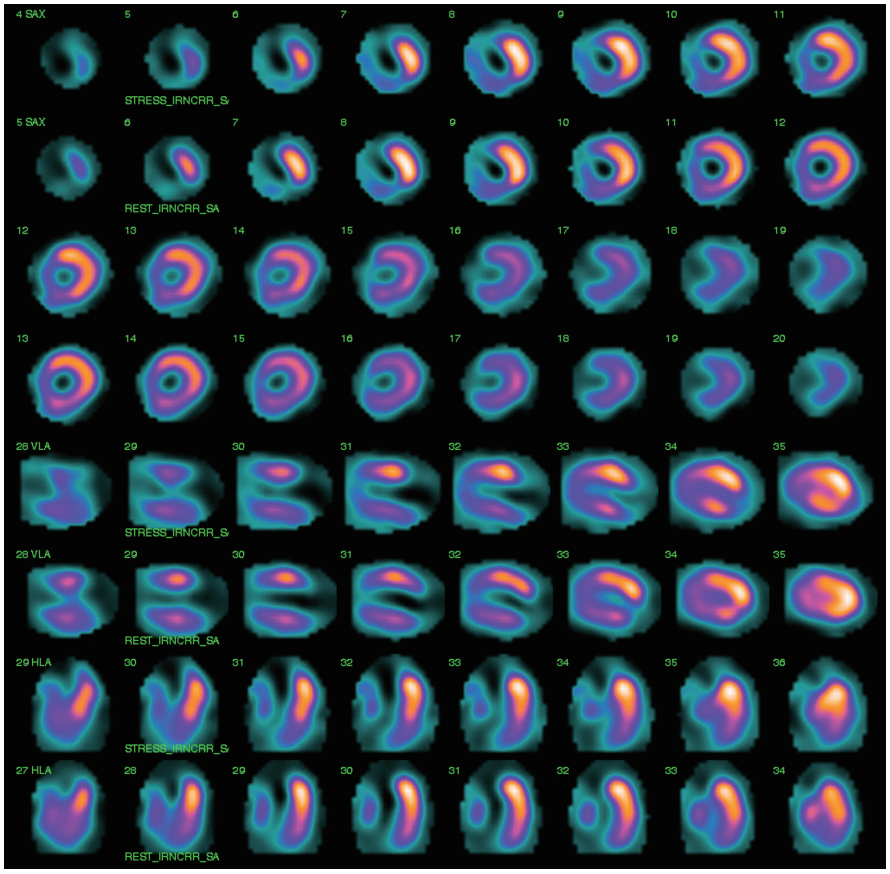

Figure 1. Nuclear cardiac stress test shows reversible ischemia over the anterior and anteroseptal walls of the left ventricular myocardium.

patient later received coronary angiography.

The selective left coronary angiography showed left main (LM) trunk 50% stenosis and distal segment 70% stenosis, LAD ostium 70% stenosis and middle in-stent segment 80% stenosis, and LCX proximal segment 80% stenosis. However, coronary flow reversal was found from LAD to LIMA (Figure 2). The selective right coronary angiography showed non-dominant diffuse atherosclerosis. Selective angiography of SVG showed patency from aorta to LAD-D1 to LCX-OM. Selective angiography of LIMA showed patency but strong competing flow from LAD to left subclavian artery. Since these angiography results couldn't explain the patient's condition, left subclavian arteriography was performed which revealed critical stenosis of the proximal segment (Figure 3). The pressure gradient before and after the stenotic segment exceeded 60 mmHg. Coronary subclavian steal syndrome was diagnosed.

To resolve this problem, percutaneous transluminal angioplasty (PTA) was performed with an Admiral Xtreme PTA balloon catheter, 5 x 80 mm (Medtronic. Minneapolis, MN, USA). Further stenting was performed with an Express LD stent, 8 x 27 mm (Boston Scientific, Natick, MA, USA). The pressure gradient dropped to less than 5 mmHg after the procedure. Repeat selective left coronary angiography showed there was no more flow reversal. The patient's angina and dyspnea symptoms resolved completely. After six months, follow-upcomputed tomography angiography (CTA) showed stent patency without restenosis.

Discussion

Here we have presented an uncommon cause of angina in a post-CABG patient whose symptoms were related to proximal subclavian artery stenosis, which impaired the normal perfusion from LIMA to LAD. Moreover, in this case, the LIMA "stole" the LAD blood flow to perfuse the left distal subclavian artery and left upper limb, a condition proven by the retrograde flow from LAD to LIMA revealed by the left coronary angiography. Even rarer, an arterio-venous access was created over the patient's left upper limb, which exacerbated the stolen condition when the patient underwent hemodialysis. This could explain why the patient's

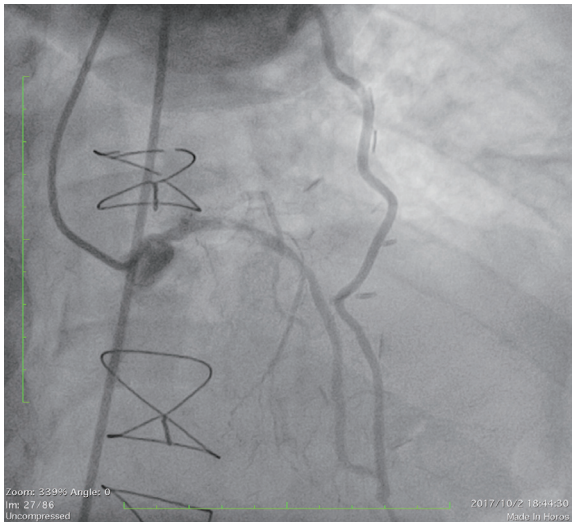

Figure 2. Selective left coronary angiography reveals flow reversal from LAD to subclavian artery via LIMA graft.

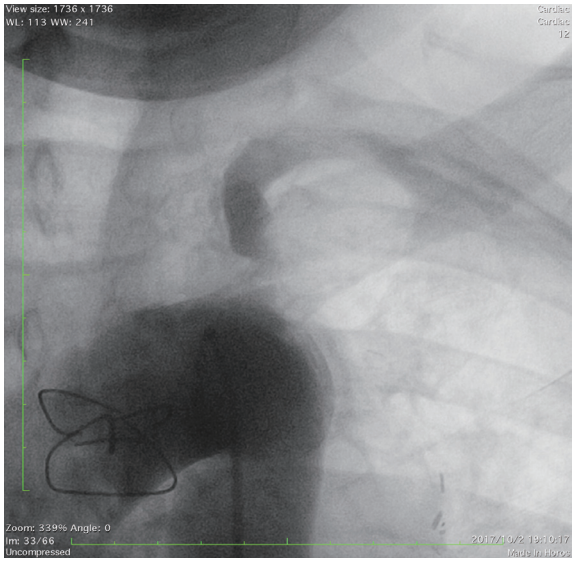

Figure 3. Aortography reveals ostial to proximal segment of left subclavian artery stenosis with pressure gradient > 60 mmHg.

angina always occurred during hemodialysis. There are only a few case reports of such patients, with the first case having been reported in 2002.[1] Crowleyet al. reported a post-CABG patient whose arterio-venous fistula had been created over the left upper limb and also stole the blood flow. Selective left coronary angiography revealed blood flow reversal from LAD to subclavian artery. When they occluded the arteriovenous fistula with manual extrinsic compression pressure the subclavian artery blood pressure increased and the patient's chest pain resolved. When the AV fistula was released, the subclavian artery blood pressure decreased and the patient's angina symptoms recurred. Our case is more complicated because of the presence of proximal subclavian artery stenosis.

Coronary subclavian steal syndrome in post-CABG patientsis uncommon but careful differential diagnosis is needed. In this case, the etiology included native subclavian artery stenosis which may have been missed before the CABG or was newly developed atherosclerosis after the CABG, radiation arteritis,[2] or Takayasu arteritis,[3] etc. This situation should be kept in mind, whereby detailed history review including the CABG surgery record is essential for differential diagnosis, since there are no specific non-invasive diagnostic tools. The blood pressure difference between the upper limbs is not a reliable indicator because of the possibility of segmental stenosis and multiple vessel disease.[4] Computed tomography angiography (CTA) or magnetic resonance angiography (MRA) could provide clues but dynamic coronary angiography is necessary for definite diagnosis. Duplex ultrasonography may be helpful to detect the flow reversal in the ipsilateral vertebral artery, which is a sign of proximal subclavian artery stenosis.

The mainstream therapy for subclavian artery stenosis is endovascular intervention. A trans-femoral or trans-brachial artery approach could both be chosen. Given the many advantages, percutaneous transluminal angioplasty (PTA) over the stenotic segment with scaffolding of peripheral stents is recommended.[5] These advantages include small puncture wound and minimally invasive procedure, only local anesthesia required with no need for general anesthesia, short hospitalization period at lower cost, and high safety. Qureshi et al. showed significant improvement of life quality.[5] Shortcomings of the procedure include restenosis of the intra-stent area and longer learning curve for experts on account of case rarity. The procedure success rate is more than 90% except in circumstances of subclavian artery occlusion. The in-stent restenosis rate was around 12% over a mean follow-up period of 5 years.[6] In unsuccessful PTA cases or subclavian occlusion cases, bypass surgery plays an important role, including carotid-subclavian, carotid-axillary, axillo-axillary, and aorta-subclavian bypass. The bypass surgery risk is acceptable in selected patients.[7] Skilled surgeons and an experienced team are required.

Conclusion

Although rare, left subclavian artery stenosis may induce myocardial ischemia in post-CABG combined uremia patients with left upper extremity arteriovenous fistula while undergoing hemodialysis. Careful history taking and knowledge of any coronary bypass grafts and arterio-venous access may help to identify this rare condition. Percutaneous transluminal angioplasty with or without stenting is the treatment of choice, with low complication rates and good long term prognosis.

Disclosures

None.

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