Coronary Subclavian Steal Syndrome Evaluated with Multimodality Imaging

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Abstract

In patients with mammary coronary bypass grafts, the presence of a subclavian artery stenosis proximal to the internal mammary artery may result in a condition termed coronary-subclavian steal syndrome of which the incidence varies between 0.07-3.4% among those requiring coronary grafts. We reported a patient with a history of the coronary artery bypass graft who presented with typical angina pectoris at rest that was exacerbated by selective exercise of the left upper extremity in whom occlusion of the left subclavian artery was demonstrated in this patient by 3D reconstruction of computed tomography angiography, a reversal blood flow in the left internal mammary artery-left anterior descending artery graft by Doppler ultrasonography, and a coronary angiography.

Key words: coronary steal syndrome, imaging, intervention

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Case Report

A 70-year-old man was being followed regularly in the cardiology outpatient clinic. He presented with typical angina pectoris at rest exacerbated by selective exercise of the left upper extremity for two months. On his electrocardiogram, there was an inversion of the T waves in the lateral leads while his cardiac enzymes were within normal limits. His medical history was significant for coronary artery disease, type 2 diabetes mellitus, hypertension, smoking, and peripheral vascular disease. In addition, ten years prior, he had undergone coronary artery bypass grafting (CABG); the left internal mammary artery (LIMA) was grafted to the left anterior descending artery (LAD) and saphenous vein conduits were grafted to the diagonal branch of the LAD and to the circumflex artery.

The patient’s physical examination showed weak left radial and brachial pulses and a significant discrepancy in blood pressure between the right (135/85 mmHg) and left (80/45 mmHg) arms. He had normal heart sounds and his lung fields were clear. A neurological examination showed normal muscle power and coordination and no sensory loss. Doppler ultrasonography of the LIMA-LAD graft revealed a waveform highly suggestive of abnormal function in systolic reversal flow (Fig. 1A). The Doppler waveform of the ungrafted right mammary artery was evaluated to serve as a control to compare the direction of the blood flow (Fig. 1B). The left vertebral artery Doppler ultrasonography showed no reverse flow under basal conditions, despite the undeniable signs of the coronary-subclavian steal (Fig. 1C). An ultrasound evaluation of the left subclavian artery (LSA) origin from the suprasternal projection was not feasible. In the end, symptomatic coronary-subclavian steal syndrome (CSSS) was diagnosed for the patient.

Angiography of the patient’s left coronary artery showed an injection of the contrast dye into the left coronary artery, which revealed a non-stenotic left main coronary artery, severe stenosis of proximal LAD (70-80% d.s.), ostial circumflex (90% d.s.), and a retrograde flow in the normal LIMA-LAD graft (Fig. 2A, B). The right coronary artery was normal and two saphenous vein conduits were occluded. A subclavian artery angiography revealed ostial LSA occlusion.

Computed tomography (CT) angiography was performed, which revealed aortic branch stenosis, especially a subclavian artery morphology to help select the optimal treatment strategy.

Coronary CT angiography revealed that the LSA was to-
Figure 1. A Doppler ultrasound showing the systolic reversal flow of a LIMA graft (A) and a normal arterial retrograde waveform of RIMA (B) and LVA (C), contrasting with the opposite systolic direction of the flow in the LIMA graft.

tally occluded 1.5 cm from its origin (Fig. 2C). A 3D reconstruction of the CT angiography images showed clearly the anatomy of the subclavian artery and the occluded portion; the emergence of the left vertebral artery and LIMA-LAD graft were also visible (Fig. 2D).

Percutaneous revascularization could not be performed due to technical problems (total occlusion and inability to pass the guide wire) and stenting of the LSA was considered hazardous due to the risk of occlusion of the adjacent vertebral artery. It was thus decided to opt for bypass surgery.

Discussion

In patients with mammary-coronary bypass grafts, the presence of subclavian artery stenosis proximal to the internal mammary artery may result in a condition called CSSS. This syndrome may cause a reversal of flow through the grafts from the coronary to the subclavian circulation. Diversion of blood from the coronary circulation may result in angina and rarely, acute myocardial infarction.

First reported by Harjola and Valle in 1974 (1), CSSS is an unusual complication of coronary artery bypass using LIMA, with an incidence varying between 0.07-3.4% in those requiring coronary grafts (2). Although occasionally asymptomatic, CSSS usually presents as recurrent angina after selective exercise of the left upper extremity but can also manifest with silent ischemia or myocardial infarction (3). Symptoms have been reported to occur between 2-31 years following surgery. Symptoms presenting within a year of CABG usually suggest a subclavian stenotic lesion that was overlooked during surgery.

There are several diagnostic modalities used to detect subclavian artery stenosis, such as aortography, computed tomography angiography, magnetic resonance angiography, or duplex ultrasound imaging. A diagnosis of CSSS with LIMA function and reversal flow detection can be detected with the modalities of conventional angiography, phase-contrast velocity mapping, MRI (4), and Doppler ultrasound. Transthoracic Doppler ultrasound is a well-established non-invasive bedside method for internal mammary artery graft function evaluation (5).

Although, when planning LSA revascularization and during the postprocedural follow-up 3D reconstruction of the
CT angiography or MRI angiography which offer an “anatomic view” with precise information on lesion morphology, length and location, screening with Doppler ultrasound usually precedes angio-CT/MRI, as it is a less expensive and more widely available option (6, 7).

We herein report the case of a patient with a history of CABG who presented with typical angina pectoris at rest exacerbated by selective exercise of the left upper extremity. He presented with an occlusion of the LSA, which was demonstrated by 3D reconstruction of the CT angiography, reversal blood flow in the LIMA-LAD graft by Doppler ultrasonography, and coronary angiography. In our present case, the percutaneous revascularization could not be performed due to technical problems (a total occlusion and the inability to pass the guide wire) and the stenting of the LSA was considered hazardous due to the risk of occlusion of the adjacent vertebral artery. The patient was referred to undergo left common carotid to subclavian artery bypass. This case underlines the importance of a complete clinical evaluation in all patients undergoing coronary bypass surgery. Patients who have symptoms suggestive of coronary subclavian steal syndrome and a significant blood pressure difference between left and right arms should have a Doppler ultrasonography to confirm the possible diagnosis of CSSS.

The authors state that they have no Conflict of Interest (COI).

References


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