



## A rare case of non-ST-segment elevation myocardial infarction triggered by coronary subclavian steal syndrome

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Coronary subclavian steal syndrome (CSSS) has been recognized lately as an unusual clinical entity, giving rise to angina but rarely causing an acute coronary syndrome (ACS). The prerequisites for the appearance of CSSS are both a patent left internal mammary artery (LIMA) graft and severe stenosis of the left subclavian artery (LSA). However, LSA is often overlooked in the diagnostic evaluation of patients with angina, who have undergone coronary artery bypass grafting (CABG). We report an unusual case of non-ST-segment elevation myocardial infarction (NSTEMI) caused by subtotal occlusion of proximal LSA.

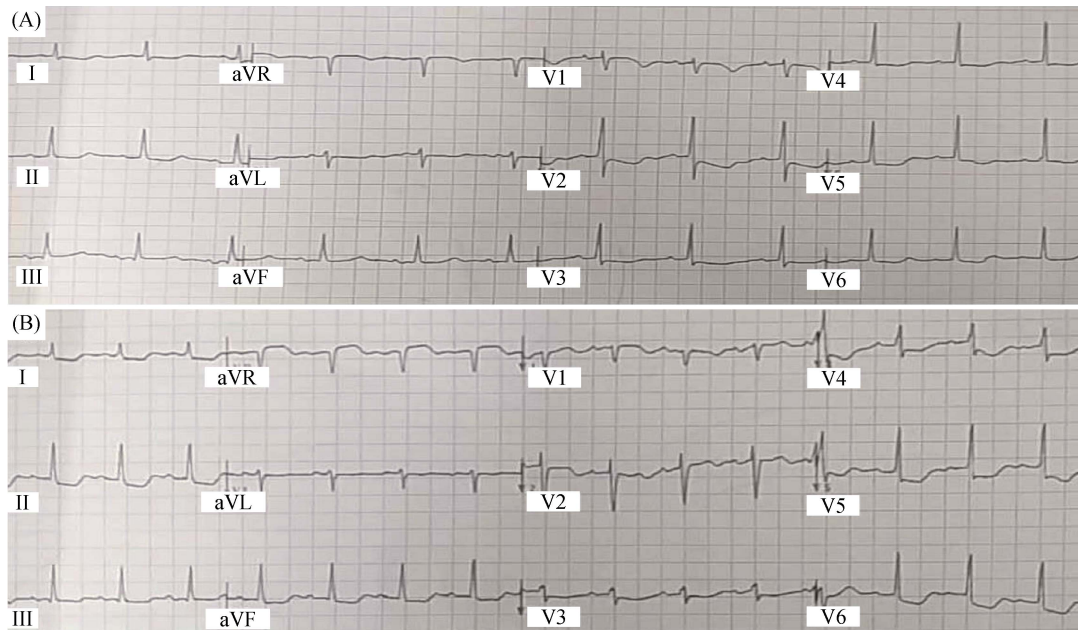
The patient was a 74-year-old female with hypertension, type 2 diabetes mellitus, hypothyroidism, stroke with remnant left hemiplegia, chronic kidney disease, Sjogren syndrome and peripheral artery disease with one stent implanted in left superficial femoral artery six months ago. The patient underwent CABG surgery 20 years ago, with LIMA grafted to the left anterior descending artery (LAD) and two venous grafts (target vessels unknown). In 2010, she was treated with percutaneous coronary intervention (PCI) on right coronary artery (RCA); with two stents implanted, due to exertional chest pain. Recently, the patient had recurrence of angina and dizziness even during mild activity, which exacerbated 10 days before admission. Physical examination showed signs of anemia, pulmonary infection, and a systolic blood pressure discrepancy of 40 mmHg between upper extremities. The left radial pulse was too weak to palpate, however, murmur was not detected in left subclavian region. Electrocardiogram (ECG) showed low and flat T waves in all leads during rest state (Figure

1A), whereas the ST-segment in aVR lead was significantly elevated during angina, with depression of ST-segments in V2-V6 and all other limb leads (Figure 1B). Echocardiography demonstrated reduced left ventricular ejection fraction (LVEF = 46%) with anterior wall hypokinesia. Serum levels of troponin T and creatine kinase were both elevated after admission, supporting the diagnosis of NSTEMI. The management of anemia, pulmonary infection and volume overload was prioritized. Then angiography was performed via right femoral access, showing patency of stents in RCA, severe stenosis in distal left main coronary artery, total occlusion of both proximal LAD and circumflex (Figures 2A&2B), and occlusion of both venous grafts. Interestingly, LSA was subtotally occluded with severe calcification, while LIMA was unaffected and smooth (Figure 2C). Competing flow was observed in left vertebral artery, suggesting a retrograde flow from the right side of vertebrobasilar system. The stenosis was crossed by using Run-through® wire in an antegrade fashion with the assistance of a Corsair® microcatheter, and was predilated gradually from small semi-compliant balloon to large non-compliant balloon. A 7.0 mm × 20.0 mm bare-metal stent was implanted followed by post-dilatation with the stent balloon. Post-stent angiography revealed recovered antegrade flow in the left vertebral artery, and excellent forward flow within the LIMA (Figure 2D). After the procedure, the patient was free of symptoms of angina or intermittent dizziness and there was no discrepancy of blood pressure between two arms. Three days later, LVEF was markedly improved at 57%. Additionally, the myodynamia of the patient's left upper extremity was also significantly improved.

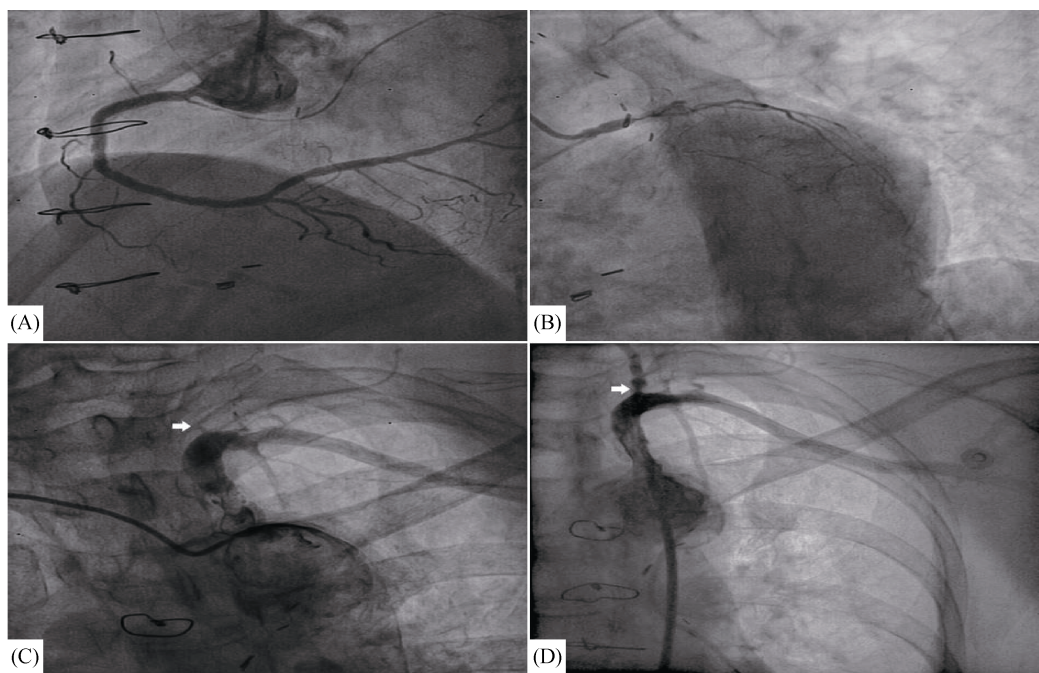
The diagnostic manifestation of a patient with recurrent angina after complete revascularization with CABG and

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**Figure 1. ECG changes during angina.** (A): ECG at rest state; (B): ECG during angina. ECG: electrocardiogram.



**Figure 2. Coronary angiography and percutaneous intervention of LSA.** (A) Patency of stents in RCA; (B) total occlusion of proximal LAD and proximal circumflex; (C) subtotal occlusion of LSA with competing flow in left vertebral artery (arrow head); (D) severe stenosis was resolved after stent implantation with regaining of antegrade flow in left vertebral artery (arrow head). LAD: left anterior descending artery; LSA: left subclavian artery; RCA: right coronary artery.

PCI is hard. Severe stenosis or occlusion of proximal LSA is often overlooked in everyday clinical practice because of the rarity. CSSS, defined by retrograde blood flow from the LIMA and left vertebral artery into ipsilateral upper extremity, usually occurs during left arm exertion and thus results

mainly in angina and rarely to ACS, or decompensated heart failure.<sup>[1-3]</sup> It has been estimated that the incidence of CSSS is from 0.2% to 7% after CABG and the rate continuously rises with the increasing use of LIMA graft.<sup>[4]</sup> Compromise of posterior neurologic perfusion presented with dizziness,

vertigo or imbalance may occur concomitantly due to retrograde flow from the left vertebral artery to left upper extremity. The recurrent angina with discrepancy of bilateral brachial blood pressure may give hints of suspected CSSS, so physicians need to keep in mind this rare entity and perform a full clinical estimation of the patient including definitely a check for upper extremities blood pressure discrepancies. Subclavian artery angiography remains the gold standard in diagnosis, while percutaneous stenting of LSA replaces surgical strategy as the first-line therapy owing to fewer complications and equal effectiveness.<sup>[5]</sup>

In our case, the patient underwent CABG surgery more than 20 years ago, and suffered recurrent angina recently, with discrepancy of upper extremities blood pressure at 40 mmHg. The diagnosis was more challenging because the patient had remnant left hemiplegia due to a stroke 11 years ago, concealing the symptoms of blood steal due to restraint activity of her left arm. The newly onset of infection and anemia disturbed such fragile balance, thus aggravating myocardial ischemia, even resulting in NSTEMI. Under such tough clinical circumstances, we chose to manage non cardiac issues (anemia, pulmonary infection) contributing to myocardial ischemia via optimal medical therapy first, and then performed angiography to reveal cause of NSTEMI. Regarding revascularization strategy of the subtotally occluded LSA, the treatment choice was endovascular therapy with angioplasty instead of surgical bypass surgery after considering comorbidities and the patient's preference. During the procedure, no distal embolic protection was im-

plemented because of the complicated settings and unclear benefits.<sup>[6]</sup> Fortunately, no distal embolization occurred and the patient recovered well.

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