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CASE REPORT

When a subclavian artery is equivalent to STEMI of left main coronary artery: a case report

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Abstract
An 81-year-old man with known ischemic heart disease and coronary artery bypass graft (CABG) was admitted with cardiogenic shock and ST segment elevation myocardial infarction (STEMI) of the anterior and lateral wall. Coronary angiography showed a total occlusion of left main coronary artery and acute thrombotic proximal segmental occlusion of the left subclavian artery before the origin of left internal mammary artery (LIMA). Successful percutaneous intervention proximal to the LIMA origin led to immediate restoration of antegrade flow in the left internal mammary artery (LIMA) to the left coronary circulation, stabilizing hemodynamics, and relieving symptoms.

Keywords Subclavian artery stenosis, Myocardial infarction, Coronary artery bypass graft, Coronary subclavian steal syndrome, Case report

Introduction

Subclavian artery stenosis is detected in about 5% of patients referred for coronary artery bypass graft (CABG). The cause is typically atherosclerosis, the left subclavian artery is involved more often than the right, and this phenomenon increases the risk for cardiovascular events [1].

Most patients with subclavian artery stenosis are asymptomatic. When symptoms do exist, they are divided into arm ischemic symptoms such as claudication or finger necrosis from emboli and/or splinter hemorrhages versus neurological symptoms due to vertebro-basilar insufficiency such as vertigo, syncope, dysarthria, and diplopia, the distinction between which can be determined if the neurological symptoms happen with arm movement. Both upper extremity and neurological symptoms occur due to subclavian steal syndrome (SSS) [2]. In addition, cardiac ischemic symptoms can also occur, including myocardial infarction, if the internal mammary artery is used as a bypass for the supply of coronary arteries, causing coronary subclavian steal syndrome (CSSS) [3].

The internal mammary artery, a branch of the subclavian artery, is the most frequently utilized graft to restore coronary circulation because of its durability and longevity [4]. Symptomatic subclavian artery stenosis post-bypass is referred to as coronary subclavian steal syndrome post-CABG [3].

A diagnosis of subclavian artery stenosis can be suspected clinically if there is a systolic blood pressure difference of more than 20 mmHg in both arms. Doppler ultrasound can reveal elevated flow velocities, turbulent flow, and reversed flow in the vertebral artery. Computer

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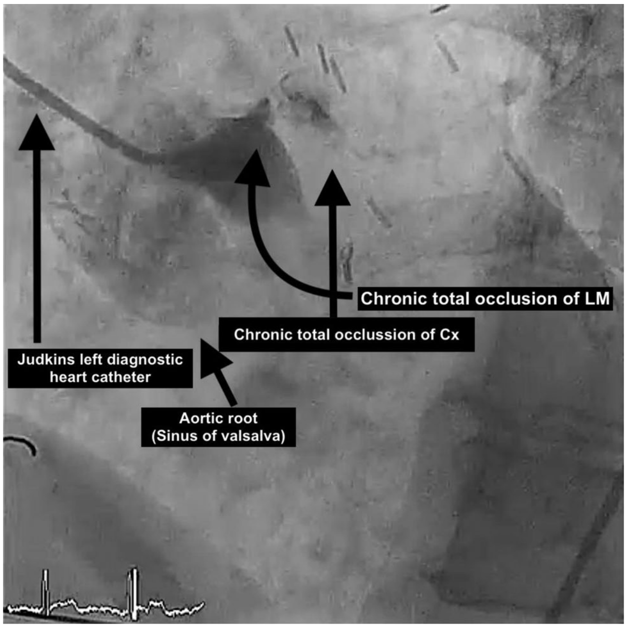

Fig. 1 Diagnostic heart catheterization in left anterior oblique caudal view showed a total occlusion of left main coronary artery

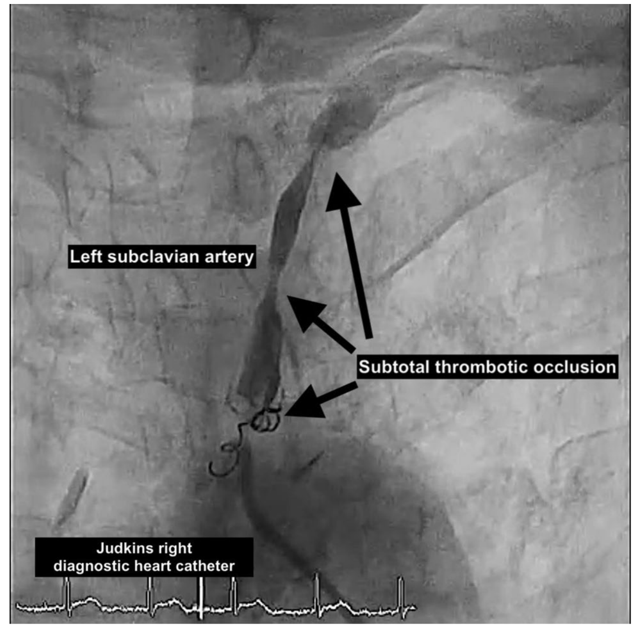

Fig. 2 Diagnostic heart catheterization in anterior posterior view showed a subtotal occlusion of left subclavian artery

tomography (CT) or magnetic resonance (MR)-angiography can be used in screening, to confirm the diagnosis, and help with management [3].

Management of subclavian artery stenosis is indicated in symptomatic patient experiencing cardiac ischemia and/or asymptomatic patient prior or after to the anastomoses of the left internal mammary artery (LIMA) to left anterior descending (LAD) artery in patient undergoing CABG.

Revascularization approaches include minimally invasive extra-thoracic bypass and endovascular management. Both have largely replaced traditional open endarterectomy [3].

AbuRahma et al. compared 121 patients underwent subclavian artery PTA/stenting to 51 patients with isolated subclavian artery occlusive disease treated with CSBG using polytetrafluoroethylene grafts. The 30-day patency rate was 100% for the bypass group and 97% (118/121) for the PTA/stent group. There were no significant differences in the survival rates between both groups at any time point.

Surgical approaches were superior to endovascular approach and associated with decreased restenosis rate and perioperative mortality; angioplasty has excellent short term success rates and relatively low risk but is associated with a higher restenosis rate (primary patency rates at 1, 3, and 5 years were 100%, 98%, and 96% for the carotid-subclavian bypass graft (CSBG) group versus 93%, 78%, and 70% for the stent group, respectively) [4]. Risk factors such as hypertension, smoking, and increased glycemic levels should be modified and managed.

Case report

An 81-year-old patient with hyperlipoproteinemia, arterial hypertension, and known ischemic heart disease with a history of CABG nine years prior (LIMA to LAD, left radial artery graft jump from LIMA to Cx and venous graft to RCA) presented to emergency wards with an acute coronary syndrome. The right upper extremity blood pressure was 90/65 mmHg while the left upper extremity blood pressure was 70/40 mm. An electrocardiogram (ECG) revealed sinus rhythm and three mV ST segment elevations of leads V1-6, I, and AVL.

Echocardiography revealed reduced left ventricular function with ejection fraction of 45%, apical hypokinesia, and grade I mitral insufficiency. Initially, the high-sensitivity troponin T value was 350 ng/l; two hours later, it was 35,000 ng/l, with CK 640 U/I and NT-Pro-BNP 25,000 pg/ml. An emergent cardiac catheterization through right femoral access showed patency of the RCA venous graft, total occlusion of the left main coronary artery (Fig. 1), and acute thrombotic proximal segmental occlusion of the left subclavian artery before the origin of the LIMA (Fig. 2). Percutaneous intervention of the left subclavian artery was performed through cannulation of the right femoral artery with a 7 F sheath. The lesion was crossed with a 0.035-inch guidewire and a pre-dilatation balloon angioplasty was performed (Figs. 3 and 4).

In this case, we had an emergent situation of non-expected extra cardiac cause of myocardial infarction.

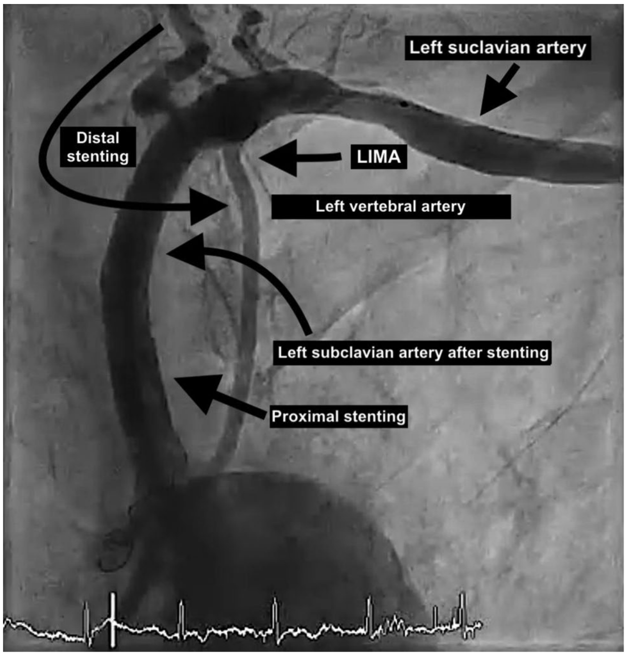

Fig. 3 Diagnostic heart catheterization in anterior posterior view showed a successful PCI with two stents of left subclavian artery

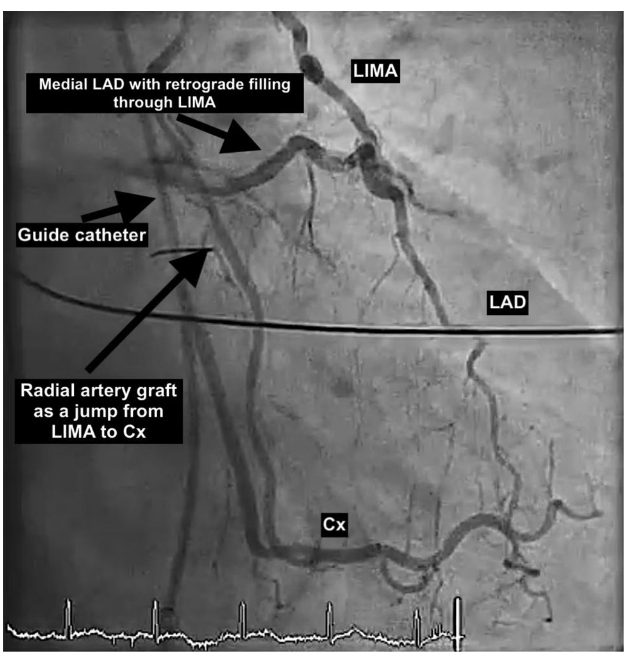

Fig. 4 Therapeutic heart catheterization in anterior posterior caudal view showed a restoration of TIMI Flow III after PCI of left subclavian artery

So, we started with a self-expanding stent as it is easier to deliver to the target lesion.

The size of the subclavian artery was determined via visual angiographic analysis and a pre-dilatation balloon and was based on the nominal diameter of the target vessel and the diameters proximal and distal to the lesion and its extension.

Further hospitalization was uneventful and after one week, the patient was discharged.

The discharge medications were acetylsalicylic acid, clopidogrel, statin, angiotensin-converting-enzyme inhibitor, and beta-blocker. The clinical and echocardiographic outcomes were favorable at three months and one year follow-up.

Discussion

We present a rare extra-cardiac cause of myocardial infarction. This highlights the peculiarity of CABG patients, who can develop cardiogenic shock and ST segment elevation myocardial infarction (STEMI) due to left main coronary subclavian steal syndrome. The culprit lies in the subclavian artery. The benefits of screening patients referred for CABG for subclavian artery stenosis (SAS) are not known, and current guidelines fail to provide guidance about screening high-risk patients for this phenomenon [5]. This case stresses the importance of early detection of SAS prior to or after CABG to reduce complications posed by post-mammary artery graft cardiac ischemia.

Both balloon-expandable stents and self-expandable stents can be implanted in the subclavian artery depending on the angiographic characteristics. A self-expanding stent is easier to deliver to the target lesions but is difficult to deploy at an exact position. On the other hand, a balloon-expandable stent facilitates precise deployment and stronger radial force but is difficult to deliver through a tortuous lesion [2]. Therefore, it is preferred for lesions where accurate positioning is necessary, such as ostial lesions, lesions close to the orifice of the vertebral artery, and lesions in the right subclavian artery to avoid any obstruction of the right common carotid artery while covering the lesion completely. Post-dilation of the stent should be performed if residual stenosis was > 50% [2].

To minimize the risk of distal embolization, some operators use a distal embolic protection device in the ipsilateral vertebral or carotid artery [2]. Of note, there are no randomized clinical trials have evaluated the outcome differences between endovascular and open repair in managing subclavian artery thrombotic stenosis [6].

The following stepwise management has been recommended in a case report to manage severe thrombotic left proximal subclavian artery stenosis:

- Placing a long guiding sheath.
- Placing an antiembolic filter into the left brachial artery (recommended for distal protection).
- Inflating a blood pressure cuff over the left brachial artery. The cuff should be inflated for pressures above the maximum systolic arterial blood pressure for 10 min.

- Inflating a coronary balloon catheter specifically along the 1st segment of the vertebral artery to ensure its protection, at the origin of the left subclavian artery's origin.
- Placing a peripheral stent with partial inflation parallel to the balloon, dilated distal to the subclavian stenosis.
- Deflating the jailed balloon, blood pressure cuff, and post dilation balloon in stent sequentially.
- Performing control angiography after jailed balloon catheter retrieval [7].

Extra-thoracic carotid–subclavian and axillary–axillary bypasses through a small incision from the base of the neck to the sternal notch should be considered if percutaneous intervention fails. Dacron or polytetrafluoroethylene (PTFE) prosthetic grafts are often anastomosed in end-to-side fashion [5].

A multidisciplinary management approach in chronic disease is essential to assess the operative risk and patient`s comorbidity, to address the multimodal imaging approach for accurate definition of the underling pathology, and to discuss the possibility and success rate of surgical as well as endovascular approach [6].

Appropriate tools are essential and required in the cardiac catheterization laboratory to tackle unexpected scenarios and complications of usual percutaneous coronary intervention (PCI) such as in these cases. We stress the importance of interdisciplinary teamwork in diagnosis and treatment strategies.

We hope to raise awareness among cardiologists and vascular and cardiac surgeons of this unsual STEMI presenation in CABG patients. Further studies are required to evaluate SAS screening for patients at high risk.

Conclusion

In CABG patients presenting with myocardial ischemia, there should be a low index of suspicion for CSSS as a possible etiology. SAS screening prior to CABG could improve management outcomes in high-risk patients.

Appropriate tools are essential and required in the cardiac catheterization laboratory to tackle unexpected scenarios and complications of usual PCI.

Patient perspective

- In CABG patients presenting with myocardial ischemia, there should be a low index of suspicion for CSSS as a possible etiology.
- SAS imaging screening could improve management outcomes in high-risk patients.
- Appropriate tools are essential and required in the cardiac catheterization laboratory to tackle unexpected scenarios and complications of usual PCI.

Abbreviations

CABG Coronary artery bypass graft
CSBG Carotid-subclavian bypass graft
CSSS Coronary subclavian steal syndrome
CT Computer tomography
ECG Electrocardiogram
LIMA Left internal mammary artery
MRA Magnetic resonance angiography
PCI Percutaneous coronary intervention
PTFE Dacron or polytetrafluoroethylene
SAS Subclavian artery stenosis
SSS Subclavian steal syndrome
STEMI ST segment elevation myocardial infarction

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

Author contributions

AB writing the main draft, ME made the english editing, DF and MS supervision and validation.

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Data availability

All data related to the case are available on request. However, data is provided within the manuscript or supplementary information files.

Declarations

Ethical approval and consent to participate

The is obtained.

Consent for publication

Written informed consent was obtained from the patient in line with COPE for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests

The authors declare no competing interests.

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