



Subclavian Steal Syndrome Presented with Recurrent Syncope: A Case Report



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Abstract

The Subclavian Steal Syndrome is a rare vascular disorder that results from the stenosis of the subclavian artery proximal to the origin of the vertebral artery. This obstruction causes the retrograde blood flow in the ipsilateral vertebral artery called “steal” because it steals blood from the cerebral circulation. We report a case of subclavian steal syndrome in a 57 yrs old male with HTN and CKD. The patient presented to the emergency department of a tertiary-level hospital with a one-week history of recurrent syncopal attack with an injury mark during his last episode. He had no known cardiac structural abnormality. Further clinical examination revealed absent radial and brachial pulse and non-recordable blood pressure in the left arm. Duplex study of the left upper limb arterial system showed left subclavian artery stenosis with the retrograde flow in the left vertebral artery (subclavian-vertebral steal). A coronary angiogram confirmed proximal stenosis of the subclavian artery. The condition was successfully treated with left subclavian stenting. [Journal of National Institute of Neurosciences Bangladesh, July 2023;9(2):161-167]

Keywords: Subclavian stenosis; subclavian steal syndrome; recurrent syncope

Introduction

Subclavian steal syndrome occurs when a proximally stenotic subclavian artery snips blood from the contralateral vertebrobasilar or carotid arterial systems into the low-pressure post-stenotic section of the ipsilateral diseased artery, resulting in transitory cerebral ischemic symptoms^{1,2,3}. This syndrome was first acknowledged in 1961 by Fischer CM⁴ (Figure.1). A negative pressure gradient develops over time between the vertebral-basilar and vertebral-subclavian artery junctions, causing changes in vascular hemodynamics. Because of the copious collateral circulation in the head and neck region, subclavian steal syndrome normally remains asymptomatic and is detected by ultrasonography or angiography by chance. However, when the blood pressure differential between the two arms surpasses 20 mmHg and the affected limb's pulse is inconsistent, early detection by clinical suspicion is possible⁵.

Subclavian steal syndrome primarily affects the left side

(up to 85% of all cases), with a 4:1 ratio between left and right-side subclavian steal. The postulated elucidation is that the left subclavian artery's sharp angle of origin enhances flow turbulence and stimulates atherosclerosis at the subclavian-aortic junction^{6,7}. Atherosclerotic plaque formation with subsequent stenosis or blockage of the proximal section of the SA prior to the origin of the vertebral artery is the most common cause of SSS. Vasculitis, trauma, dissection, and neoplastic tumor are some of the other causes of SSS^{7,8}. By around 2:1, males are more affected by atherosclerotic subclavian steal than females. Subclavian steal syndrome is more common in patients over the age of 50, which may be attributable to increased atherosclerosis in this age range. The theft from Takayasu arteritis, on the other hand, occurs much earlier (30 years in 90% of cases) and more frequently in women⁸.

Though most people with subclavian steal syndrome are asymptomatic, there are two basic types of symptoms:

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(a) vertebrobasilar insufficiency and (b) ischemia of the afflicted extremity. When too much blood is redirected away from cerebral tissues, vertebrobasilar insufficiency develops. The circulation in the posterior cerebral hemisphere is very poor. The circle of Willis provides collateral circulation to the posterior fossa, with the posterior communicating artery playing a major role^{8,9}. Vertebrobasilar symptoms are caused by a disruption in this circulation, which is frequently caused by extracranial carotid stenosis. The constellation of symptoms that may occur in this circumstance includes syncope, vertigo, ataxia, and disorientation. Ischemia of the affected extremity, weakness or arm claudication after exercise, and paresthesia or temperature fluctuations on the affected side, are all common symptoms. Both groups of symptoms have a distinct expression. They are classically reproducible when the patient adopts specific body postures that increase circulatory demand from the upper limb's distal subclavian artery or brachial artery^{9,10}.

The results of a physical examination, particularly the difference in systolic BABP between arms where lower blood pressure is on the affected side, are used to make an initial diagnosis of SSS¹⁰. Subclavian steal syndrome is diagnosed using a variety of imaging techniques. Duplex sonography of extracranial arteries, such as the vertebral and subclavian arteries, typically confirms SSS and provides the initial estimate of the severity of SA stenosis. For a preoperative examination of the degree of SA stenosis and a full evaluation of collaterals, congenital malformations, and other factors, MRA, CTA, and/or digital subtraction angiography (DSA) are employed. Angioplasty (with or without stent deployment) of the stenotic section of the SA, CCA-to-SA bypass, or innominate-to-SA bypass are surgical options for symptomatic SSS^{11,12}.

Case Presentation

A 57 yrs old man with diabetes mellitus, hypertension, left-handed person and a known case of CKD came to our emergency room for his recurrent syncopal episodes with injury marks during the last episode. The patient noticed frequent syncope, which was severe when suddenly rising from a seated position in an office or house. Severe spontaneous episodes manifested with certain upper limb positions, e.g. sudden lifting and prolonged manual work involving the left arm; the latter became more evident recently. The patient did not mention any chest pain, palpitations or symptoms of epilepsy prior to or following these episodes. He regained consciousness in a few seconds from these

episodes without any urinary or fecal incontinence or tongue bite. He did not have any auditory difficulties, ear infections, tinnitus, or any drug history causing postural drop and trauma.

The examination started with measuring brachial arterial blood pressure (BABP). The right arm's systolic blood pressure measured 110/80 mm Hg; the left arm's blood pressure was not recordable. A left supraclavicular bruit was also found. His left radial pulse and left brachial pulse were not palpable during the examination. Other general and systemic examination was found unremarkable except for xanthelasma over both eyelids and an injury mark left eyebrow.

After a rapid screening of routine investigation and settlement of the renal status, the duplex study of the left upper limb arterial system and carotid arteries revealed left subclavian artery stenosis with retrograde flow in the left vertebral artery (subclavian-vertebral steal) otherwise normal extracranial carotid and vertebral arteries. Further investigation with coronary angiogram demonstrated nearly 100.0% stenosis from the proximal part of the left subclavian artery with normal coronary arteries. Neurologic evaluation and brain computed tomography (CT) scan did not reveal focal ischemic brain lesions. No myocardial hypokinesia or structural valvular abnormality was seen in echo colour doppler. With a good ejection fraction of 60.0%, 24 hrs Holter monitoring showed no episodes of bradycardia, no episodes of supraventricular tachycardia, and no pauses more than 2000 ms were detected. Vasculitic screening with P-ANCA, C-ANCA, and ANA revealed no abnormality. After maintaining good hydration and repeated consultation with a nephrologist, DSA was finally done to see the status of carotid and vertebral arteries and found no stenosis or occlusion.

Discussion

The Circle of Willis comprises the basilar artery, which is produced from both vertebral arteries and connects to the anterior circulation via bilateral posterior connecting arteries. When the system is disrupted by vascular diseases, the Circle of Willis connects the anterior and posterior circulations, allowing collateral blood circulation to avoid ischemia¹².

The reversed blood flow in the ipsilateral vertebral artery generally acts as an excellent collateral channel for the injured limb, making subclavian steal syndrome a benign condition^{12,13}. Even in patients with complete

blockage of the proximal subclavian artery significant ischemia of the afflicted limb is rare. More blood flows down the vertebral artery than down the vertebrobasilar artery, resulting in symptoms such as syncope, vertigo, and neurologic impairments in the affected upper limb¹⁴.

Patients who acquire symptoms as a result of this occurrence, according to some experts, frequently have other vascular disease involving intracranial or extracranial vessels. However, some instances of chronic posterior circulation ischemia resulting from subclavian steal syndrome have been reported in people who had no severe stenosis in any other cervical or cerebral artery¹⁵⁻¹⁶.

Subclavian steal syndrome can cause various vertebro-basilar symptoms that are typically severe. A variety of elements are believed to be involved in the causes for the differences in presentation. The existence of reversed ipsilateral vertebral artery blood flow or the absence of a radiologic steal is not reliable predictor of any form of presenting symptoms in patients with haemodynamically substantial subclavian artery stenosis. The symptoms and existence of reversed flow in the vertebral artery are determined by the location of the extracranial vascular stenosis¹⁷. Several patients with no other substantial stenosis and non-hemispheric symptoms were determined to be exceptions¹⁷⁻¹⁸.

Similarity was found for the presenting case who presented with syncope as well injury mark over left eyebrow after the last episode having very minimum symptom of left arm claudication pain or weakness, clinically consistent with subclavian stenosis. We did investigations such as duplex study, Coronary angiogram, CT angiogram, and cerebral DSA and found no other stenotic disease except proximal stenosis of the left Subclavian artery.

The severity of vertebral artery hemodynamic abnormalities is divided into three stages or grades: Reduced antegrade vertebral flow, Grade I (pre-subclavian steal). Alternating flow - antegrade flow in the diastolic phase and retrograde flow in the systolic phase, Grade II (intermittent/partial/latent): Persistent/advanced Stage III: permanent retrograde spinal flow¹⁹⁻²⁰. The use of arm BP difference as a predictor of the severity of the syndrome has been validated by certain writers. The greater the BP differential across arms, the more severe the symptoms²¹.

When presented at emergency, our patient's initial examination found an absent pulse in the left upper

limb and not recordable BP in the left arm without any skin changes. The brachial artery systolic pressure difference between the two arms was more than 100 mmHg. This medical condition is supported by the pieces of evidence already discussed.

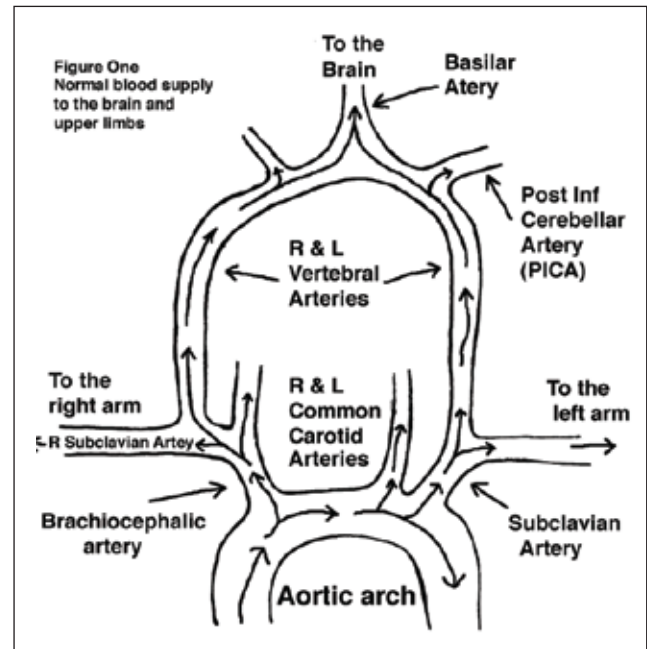


Figure 1.a

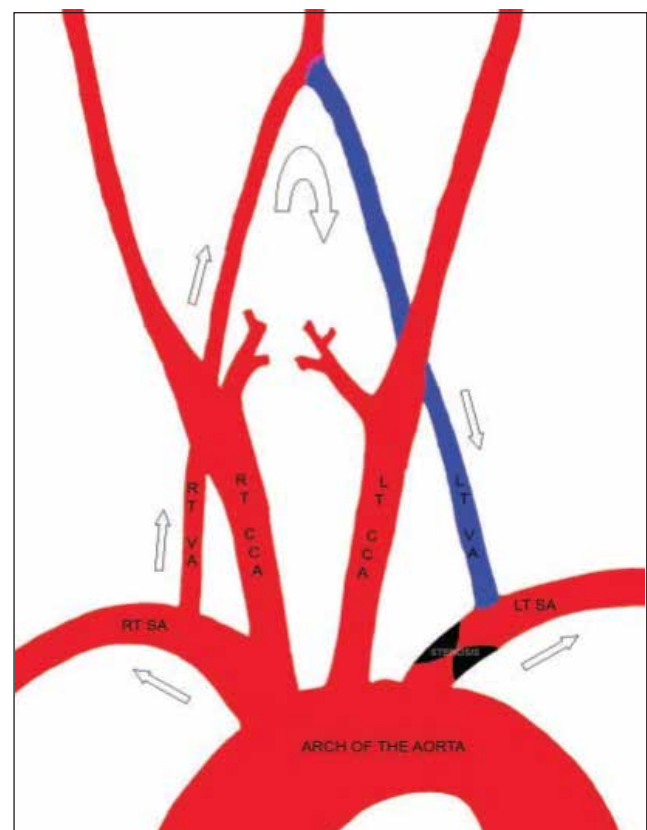


Figure 1.b

Figure I.a, I.b : Diagram of the hemodynamics of normal and SSS with high-grade stenosis of the left subclavian artery. The left SA steals blood from the right SA via a junction of two vertebral arteries at the origin of the basilar artery. The blue colour depicts the retrograde blood flow of the left vertebral artery into

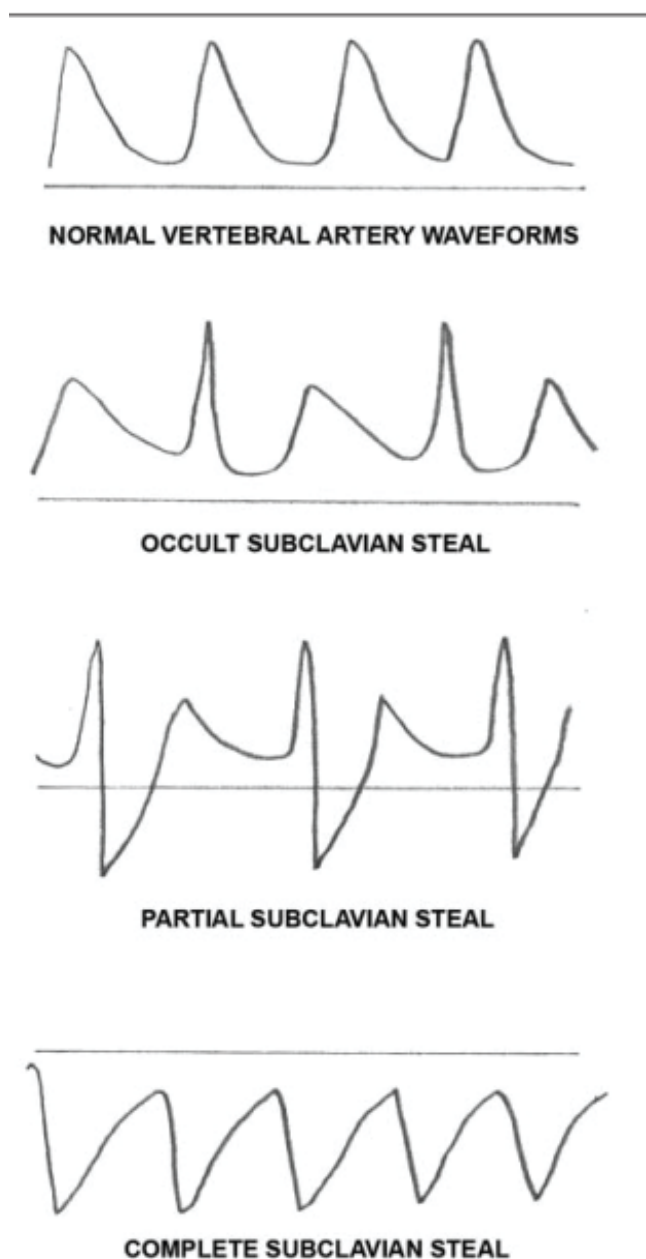


Figure II: Different variants of Doppler waveforms in the normal and affected vertebral artery occult subclavian steal corresponds to the milder form of hemodynamically significant subclavian artery stenosis, partial subclavian steal corresponds to the moderate form, and complete steal is observed in severe cases²²

post stenotic part of the left SA. Neurological symptoms (Syncope, dizziness, drop attack) occur at the expense of the basivertebral system^{3,4}.

In the detection of subclavian steal syndrome, doppler ultrasonography is the most sensitive and specific technology. To rule out further atherosclerotic lesions, a thorough examination of the complete extracranial vascular tree is required. There are different variations of aberrant doppler wave patterns in the afflicted VA that can be used to document the severity of SA stenosis²² (figure II).

Subclavian occult steal (the affected side's VA) Antegrade flow with a mid-systolic notch (the "bunny sign") correlates to a milder type of hemodynamically important SA stenosis, partial subclavian steal (alternating "to-and-fro" waveforms) to a moderate form, and total steal (retrograde flow in the VA) to a severe form. Factors impacting the hemodynamics between the subclavian and vertebral arteries, such as congenital abnormalities of the Willis circle, congenital hypoplasia and patency of the VA, development of collaterals, and the extension of atherosclerotic plaques, and so on, need this classification^{22,23}. The case discussed here is a severe form according to the classification, as a complete steal found in the Doppler waveform (Figure III).

The treatment aims to restore permanent antegrade blood flow to the affected vertebral artery, thus abolishing cerebral hypoperfusion and its associated symptoms. Treatment options are carotid-subclavian bypass, carotid subclavian transposition, PTA (Percutaneous transluminal angioplasty), axilla-axillary bypass, atherectomy, and stenting. Stent placement may also decrease the rate of embolic material by trapping it against the artery wall²⁴⁻²⁵. We treated our patient by percutaneous transluminal angioplasty with stent deployment to the stenotic portion of the left Subclavian Artery (Figure IV).

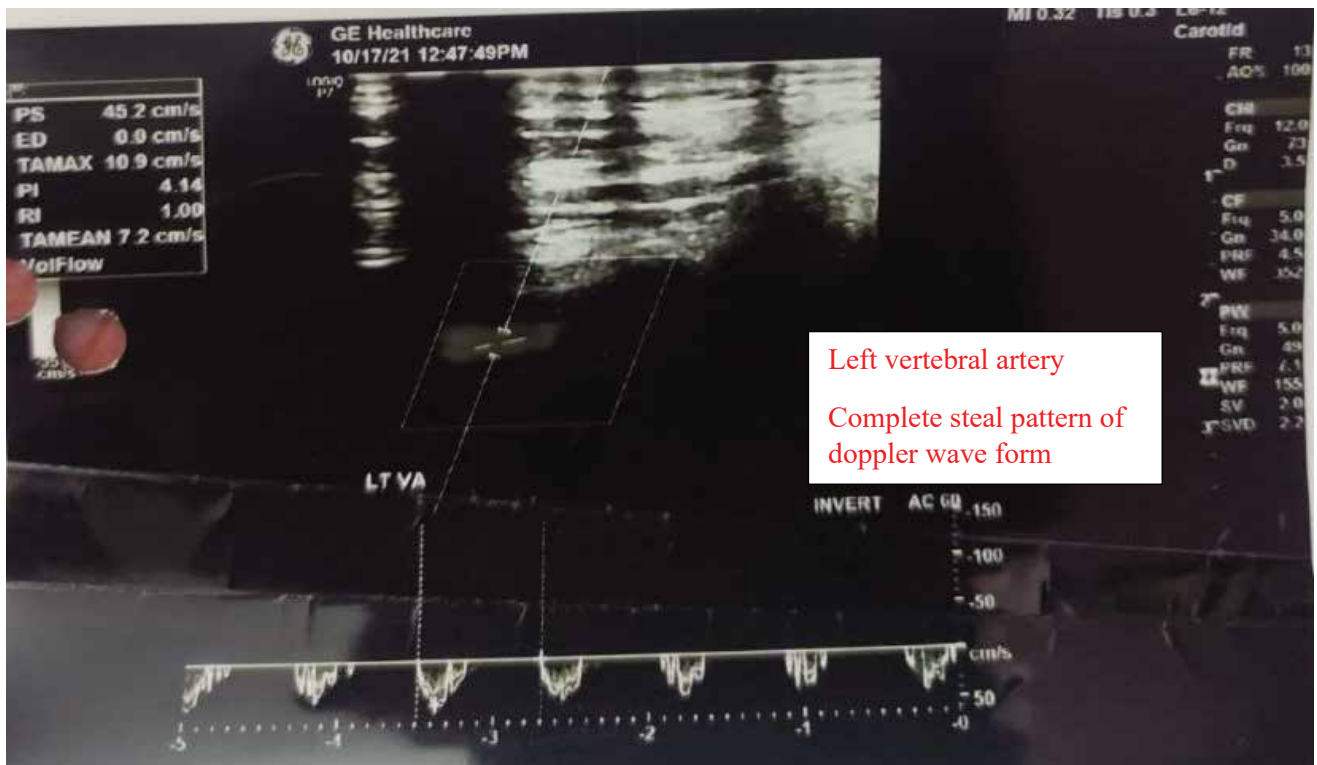


Figure III: Duplex sonography: A Complete Steal Pattern of Doppler Waveform (below the baseline) is in the Left Vertebral Artery (VA)





Figure IV: Before treatment and after treatment

Conclusion

To conclude, though subclavian steal syndrome is a relatively uncommon benign condition, but may create a dangerous situation like the presenting case. Bilateral brachial blood pressure measurement provides critical clinical data for SSS assessment and should be recorded in all patients. Doppler and dynamic imaging are paramount for the accurate detection of subclavian steal syndrome as well treatment with stenting is rewarding.

Acknowledgements

None

Conflict of interest

None

Financial Disclosure

Not Applicable

Contribution to authors

Rassel MA, Islam MA conceived and designed the study, managed the patient, analyzed the data, interpreted the results, and wrote up the draft manuscript. Elyas DM, Razzaque MA involved in the

manuscript review and editing. All authors read and approved the final manuscript.

Data Availability

Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

Written consent was taken from the legal guardian.

How to cite this article: Rassel MA, Islam MA, Elyas DM, Razzaque MA. Subclavian Steal Syndrome Presented with Recurrent Syncope: A Case Report. J Natl Inst Neurosci Bangladesh, 2023;9(2):161-167

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Article Info

Received on: 7 April 2023
 Accepted on: 24 May 2023
 Published on: 1 July 2023

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