**Subclavian Steal Syndrome Secondary to Atherosclerosis: A Case Report and Review of Literature**

Sunil Basukala,1 Bishnu Deep Pathak,1 Sabina Rijal,1 Bibek Karki,2 Narayan Thapa1

1Department of Surgery, Nepalese Army Institute of Health Sciences College of Medicine, Chhauni, Kathmandu, Nepal

2Department of Radiology, Nepalese Army Institute of Health Sciences College of Medicine, Chhauni, Kathmandu, Nepal

**Correspondence**

Bishnu Deep Pathak, Department of Surgery, Nepalese Army Institute of Health Sciences College of Medicine, Chhauni, Kathmandu, Nepal

Email: [bishnupathak433@gmail.com](mailto:bishnupathak433@gmail.com)

**KEY CLINICAL MESSAGE**

Subclavian Steal Syndrome (SSS) is mostly asymptomatic but may present with neurological and/or limb ischemia. Patients with difference in upper limb blood pressure and pulse amplitude should always be evaluated for SSS. Symptomatic cases require revascularization procedures.

**ABSTRACT**

Subclavian Steal Syndrome (SSS) is a rare vascular syndrome caused due to proximal occlusion or stenosis of subclavian or innominate artery. It is usually asymptomatic but occasionally may present with vertebrobasilar insufficiency and/or upper limb ischemia. Atherosclerosis is the most common cause.

**INTRODUCTION**

Subclavian Steal Syndrome (SSS) is a vascular phenomenon characterized by proximal occlusion or stenosis of subclavian or innominate artery resulting in decreased blood pressure in the distal part. This causes retrograde blood flow in the ipsilateral vertebral artery so as to compensate the perfusion of upper extremity. Thus, blood is siphoned away from the brain to the extremity of the affected side.1–3

Majority of the patients are asymptomatic due to adequate collateral circulation of the head and neck. A few may present as vertebro-basilar insufficiency and/or arm claudication, in the setting of physical exercise or arterio-venous fistula. Symptoms of vertebro-basilar ischemia includes dizziness, nystagmus, diplopia, hearing loss, tinnitus and rarely transient ischemic attacks as well.4 It is a rare disorder with prevalence ranging from 0.6% to 6.4%.5 Atherosclerosis is the most common cause followed by vasculitis, thoracic outlet syndrome and iatrogenic interventions. Congenital abnormalities like right sided aortic arch with an isolated left subclavian artery can also cause this disorder, especially in young patients.4 It is present mostly on left side with left to right ratio of 4:1. Atherosclerotic SSS is more common in males and age group above 50 years.5

Doppler ultrasound, Computerized Tomography (CT) or Magnetic Resonance (MR) Angiography are used for confirmation of diagnosis. Only symptomatic patients require revascularization procedures like bypass grafting or angioplasty and stenting.2,5

Here, we report a case of 57 year male of SSS who presented in Surgical Outpatient Department (SOPD) with vertigo, sense of imbalance, tingling, numbness and claudication of left upper extremity.

**CASE PRESENTATION**

A 57-year-old Ex-serviceman, a known hypertensive and diabetic on medication, was admitted for evaluation of numbness and claudication in the left hand of two months duration, with mild tingling sensation in his left arm. He also gave history of continuing vertigo and sense of imbalance for two months duration, blue discoloration and pain in the fingers of left hand for two weeks. There was no history of chest pain, palpitation, visual changes, aura, nausea, fever, upper respiratory and ear discharge. His medical history included long standing hypertension with hypercholesterolemia and was under regular medication as prescribed by his physician. On physical examination, his blood pressure (BP) was 140/90 mmHg (right arm), however the left radial pulse was feeble, following which BP was recorded in the left arm which was found to be markedly low at 80/44 mmHg. His laboratory investigations, Electrocardiogram and chest X-ray were unremarkable. With the clinical suspicion of Subclavian steal syndrome, the patient was referred for Doppler evaluation of the neck vessels.  Doppler study showed complete reversal of the blood flow in the left vertebral artery, both in systole and diastole (figure 1).

The findings were suggestive of Subclavian steal syndrome and Multidetector Computed Tomography (MDCT) angiography of the neck vessels was advised. It showed irregular concentric wall thickening of the left subclavian artery near origin causing partial luminal stenosis. Bilateral vertebral arteries and the left subclavian artery distal to the origin of the Left Vertebral artery showed normal luminal opacification with contrast (Figure 2), suggesting the feeding of distal left subclavian artery by the left vertebral artery.

The left internal jugular vein thrombosis was also demonstrated in 3D Volume rendered angiographic images showing stenosis of left subclavian artery proximal to the origin of left vertebral artery (Figure 3). The findings were conclusive of SSS secondary to occlusion of proximal left subclavian artery due to atherosclerosis. The patient underwent endovascular subclavian stenting (8mm × 37mm) in Cardiothoracic and Vascular Surgery (CTVS) department. He improved significantly after the intervention and was followed up for six months where his symptoms did not recur.

**DISCUSSION**

The term ‘Subclavian Steal Syndrome’ was coined by Fisher in 1961 and the first case was reported by Contorni.5,6 It is a rare cerebrovascular insufficiency syndrome in which occlusion or narrowing of the first portion of subclavian artery (i.e. proximal to the origin of vertebral artery) leads to decreased pressure in distal segment. This pressure difference causes reversal of blood flow in ipsilateral vertebral artery. In this way, blood from basilar territory is diverted into the subclavian artery to compensate for decreased brachial perfusion. It is more common in age group above 55 years. Male to female ratio is 2:1. Most of the patients are asymptomatic because of enough collateral circulation of head and neck. However, excess compensatory blood flow to ipsilateral arm may result in neurological symptoms from vertebrobasilar ischemia. Major collateral supply maintained by posterior communicating artery of Circle of Willis may become inadequate due to concomitant carotid obstructive pathology. Likewise, SSS may present with features of coronary insufficiency in patients with internal mammary bypass graft.1,2,7

Clinical features if present can be broadly divided into two categories: neurological and brachial. The former include diplopia, vertigo, syncope, ataxia, headache, dysarthria, convulsions, mental changes, tinnitus and dysphasia. Limb symptoms include paresis, intermittent claudication, paresthesia and gangrene of fingers.8 Physical examination shows blood pressure difference of more than 15 mm Hg on bilateral upper extremities, feeble pulse on affected side, bruits over the supraclavicular region and atrophic changes in ipsilateral extremity.4 Different diagnostic modalities can be employed for confirmation like Doppler ultrasound, Magnetic Resonance Angiography or CT-Angiography. Subtraction Angiography can be used therapeutically during the procedure.9 Diagnostic criteria include occlusion or marked stenosis of subclavian or innominate artery, retrograde vertebral blood flow, and patency of both vertebral and basilar arteries.8

Mildly symptomatic cases can be managed with medical therapy and observation. Aspirin, Statins, Beta-blockers and Angiotensin Converting Enzyme (ACE) Inhibitors are recommended. Patients with severe symptoms require some form of revascularization. Increased blood pressure difference of more than 40-50 mmHg in both arms also need interventions. Surgical interventions include Carotid-subclavian bypass, axillo-axillary bypass and carotid transposition. Among these, Carotid-subclavian bypass is most preferred due to its lower operative risk and long term satisfactory results. This can be done in asymptomatic patients to prevent the evolution of symptoms of vertebro-basilar insufficiency. Balloon angioplasty with proper stenting is the minimally invasive technique employed in modern times. Side by side, appropriate management of risk factors like hypertension, diabetes mellitus and tobacco use is equally important.2,4,6

Though SSS due to left sided subclavian artery stenosis/occlusion is more common, right sided artery occlusion has been reported.10 Budincevic H et al3 and Aseem WM et al11 reported bilateral SSS, the former without significant symptoms. In our case, left sided pathology is present with atherosclerosis as the underlying cause. Similarly, ocular and auditory symptoms were present in cases reported by Lum CF et al12 and Psillas G et al2 respectively, which are not present in our case. Likewise, abnormal saccades and nystagmus were also seen in some studies.2,3 In a case study by Komatsubara I et al,13 syncope and arm weakness were present. Moreover, nausea and vomiting were also seen in one case study.10 One unique symptom present in our case is cyanosis of fingers of the affected arm.

Therefore, any patient who presents with difference in pulse and blood pressure in bilateral limbs should be evaluated for SSS. This disorder may present with any of the features. Unilateral upper limb pain, paresis, paresthesia and cyanosis of fingers should not be ignored. In the same way, isolated neurological symptoms like vertigo, dizziness, ataxia, hearing loss, tinnitus, blurring of vision, can be alarming, especially in patients with co-morbidities like hypertension and diabetes mellitus. For symptomatic patients, immediate intervention is necessary.

There are certain limitations associated with our study to be mentioned. Since CTVS facility was not available in our center, the patient was referred outside. So, we could not study much about the process of interventions done in this case. Moreover, we could not follow up beyond six months and are not aware of his present condition.

**ACKNOWLEDGEMENTS**

No acknowledgements.

**CONFLICT OF INTEREST**

None declared.

**AUTHOR CONTRIBUTIONS**

SB: Conceptualization. All authors SB, BDP, SR, BK and NT have contributed in writing, editing and preparation of manuscript and have reviewed it before submission.

**ETHICAL APPROVAL**

Written informed consent was obtained from the patient for publication of case report and associated images. Since this report involves no experiments, the ethical approval is waived.

**INFORMED CONSENT**

A copy of written consent is available for review by editors of this journal on request.

**REFERENCES**

1. A New Vascular Syndrome — The Subclavian Steal. http://dx.doi.org/101056/NEJM196111022651812 [Internet]. 2010 Jan 13 [cited 2021 Jul 17];265(18):912–3. Available from: https://www.nejm.org/doi/full/10.1056/NEJM196111022651812

2. Psillas G, Kekes G, Constantinidis J, Triaridis S, Vital V. Subclavian steal syndrome: neurotological manifestations. Acta Otorhinolaryngol Ital [Internet]. 2007 [cited 2021 Jul 17];27(1):33. Available from: /pmc/articles/PMC2640015/

3. H B, L F, N T-K, N M, T S, I B. Bilateral subclavian steal syndrome in an intensive care unit. A case report. Med Ultrason [Internet]. 2014 [cited 2021 Jul 17];16(3):264–7. Available from: https://pubmed.ncbi.nlm.nih.gov/25110770/

4. BJ P, DS P. Subclavian steal syndrome. Circulation [Internet]. 2014 Jun 3 [cited 2021 Jul 17];129(22):2320–3. Available from: https://pubmed.ncbi.nlm.nih.gov/24891625/

5. Osiro S, Zurada A, Gielecki J, Shoja MM, Tubbs RS, Loukas M. A review of subclavian steal syndrome with clinical correlation. Med Sci Monit [Internet]. 2012 [cited 2021 Jul 17];18(5):RA57. Available from: /pmc/articles/PMC3560638/

6. Labropoulos N, Nandivada P, Bekelis K. Prevalence and impact of the subclavian steal syndrome. Ann Surg [Internet]. 2010 Jul [cited 2021 Jul 17];252(1):166–70. Available from: https://journals.lww.com/annalsofsurgery/Fulltext/2010/07000/Prevalence\_and\_Impact\_of\_the\_Subclavian\_Steal.26.aspx

7. Kargiotis O, Siahos S, Safouris A, Feleskouras A, Magoufis G, Tsivgoulis G. Subclavian Steal Syndrome with or without Arterial Stenosis: A Review. J Neuroimaging. 2016 Sep 1;26(5):473–80.

8. Fields WS, Lemak NA. Joint Study of Extracranial Arterial Occlusion: VII. Subclavian Steal—A Review of 168 Cases. JAMA J Am Med Assoc. 1972 Nov 27;222(9):1139–43.

9. G S, G V, K P, A L, I K, A T, et al. Primary Stenting of Right-Sided Subclavian Artery Stenosis Presenting as Subclavian Steal Syndrome: Report of 3 Cases and Literature Review. Ann Vasc Surg [Internet]. 2018 Apr 1 [cited 2021 Jul 17];48:254.e1-254.e5. Available from: https://pubmed.ncbi.nlm.nih.gov/29421416/

10. PARROTT JC. The Subclavian Steal Syndrome. Arch Surg [Internet]. 1964 Apr 1 [cited 2021 Jul 17];88(4):661–5. Available from: https://jamanetwork.com/journals/jamasurgery/fullarticle/562117

11. WM A, MS M. Bilateral subclavian steal syndrome through different paths and from different sites--a case report. Angiology [Internet]. 1999 [cited 2021 Jul 17];50(2):149–52. Available from: https://pubmed.ncbi.nlm.nih.gov/10063946/

12. CF L, PF I, B K. Subclavian steal syndrome. Optometry [Internet]. 2004 [cited 2021 Jul 17];75(3):147–60. Available from: https://pubmed.ncbi.nlm.nih.gov/15058696/

13. I K, J K, M A, H T, K N, S U, et al. Subclavian steal syndrome: a case report and review of advances in diagnostic and treatment approaches. Cardiovasc Revasc Med [Internet]. 2016 Jan 1 [cited 2021 Jul 17];17(1):54–8. Available from: https://pubmed.ncbi.nlm.nih.gov/26698195/

**FIGURE LEGENDS:**

Figure 1. Doppler study showing complete reversal of the blood flow in the left vertebral artery.

(A: Right vertebral artery, B: Left vertebral artery)

Figure 2. MDCT (Multidetector Computed Tomography) angiography of the neck vessels showing partial obstruction of left subclavian artery (red arrow) proximal to the origin of Left Vertebral artery.

Figure 3. 3D Volume rendered angiographic images showing stenosis of left subclavian artery (Red arrow) proximal to the origin of left vertebral artery.