



# Subclavian Steal Syndrome: A Retrograde Phenomenon

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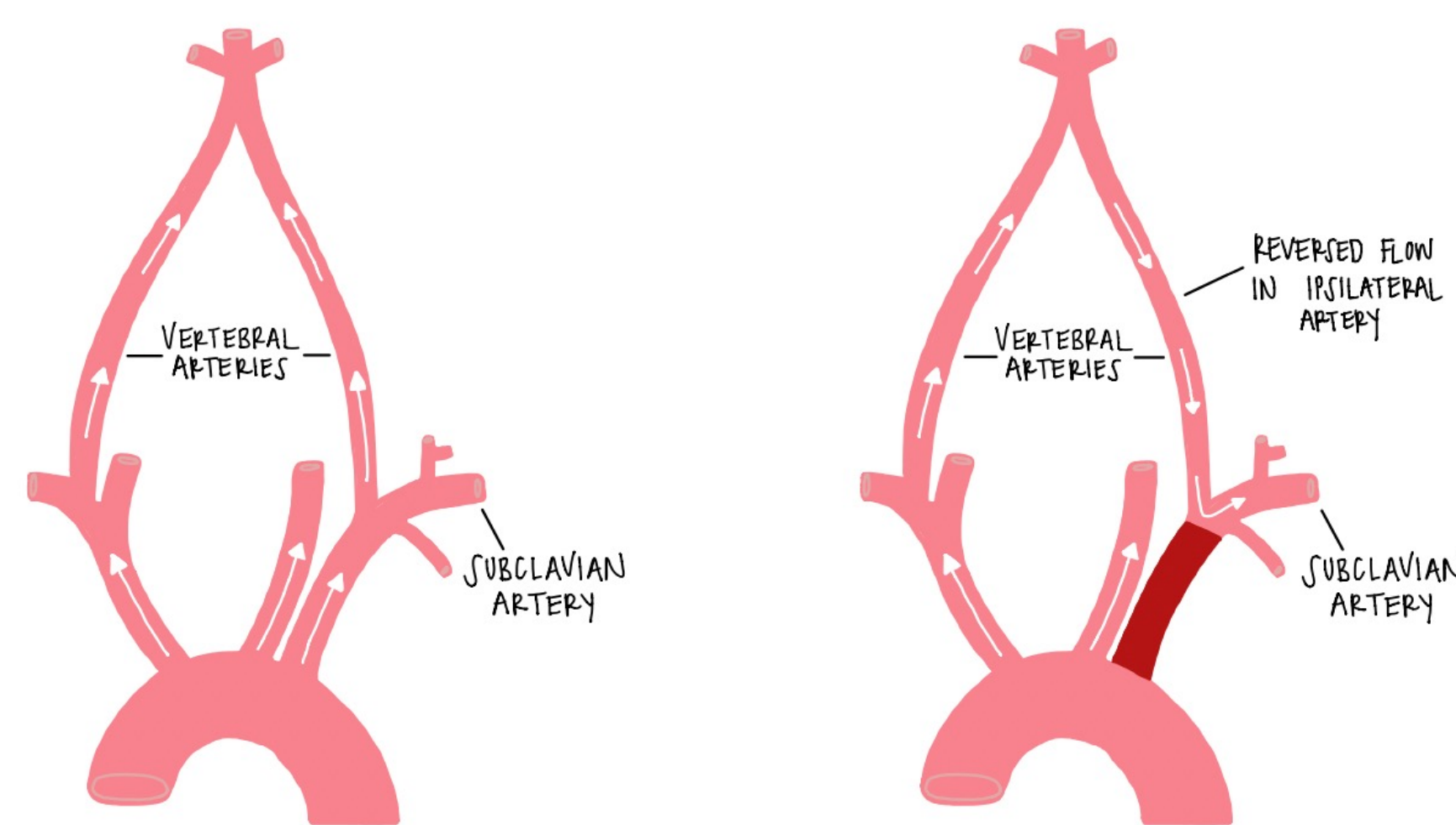


## INTRODUCTION

- Subclavian steal syndrome is a rare vascular phenomenon which describes retrograde flow in the vertebral artery associated with ipsilateral subclavian artery stenosis.<sup>1</sup>
- Affecting 2% of the population, with increased prevalence in patients with cardiovascular disease or coronary artery bypass graft.<sup>1</sup>
- Symptoms are secondary to the level of stenosis, as the retrograde flow can “steal” blood from the contralateral vertebral artery or circle of Willis arteries resulting in recurrent syncope, ‘tardus and parvus’, and weakness of upper extremities with physical activity.<sup>2</sup>
- Doppler ultrasound and angiography aid in identification of the stenosis.<sup>3</sup>
- While duplex ultrasound is frequently performed to assess the extent of atherosclerotic disease in the setting of TIA and stroke, the characteristic retrograde vertebral artery flow is an incidental finding.<sup>4</sup>
- The acute angle and relatively smaller diameter of the left subclavian artery compared with the right are potential explanations as to why more than 80% of cases are left-sided.<sup>5</sup>
- Percutaneous transluminal angiography (PTA) and stenting remain widely accepted as treatment modalities.<sup>5</sup>
- Once diagnosed, the clinical success rate of angioplasty as measured by bilateral upper extremity blood pressure, is 86.5% at 1 year follow-up.<sup>5</sup>

## DIFFERENTIAL DIAGNOSIS

- Transient ischemic attack/Stroke, posterior circulation
- Thoracic outlet syndrome
- Aortic stenosis
- Peripheral vascular disease
- Peripheral neuropathy
- Diabetic neuropathy
- Musculoskeletal injury



## CASE DESCRIPTION

- A 68 y.o. female with past medical history of acute MI, coronary atherosclerosis of native coronary artery, diabetes mellitus, essential hypertension, hypercholesterolemia, and atrial fibrillation presented with five-month history of non-exertional syncope, dizziness with positional changes, and left upper extremity weakness with increased physical activity

## HISTORY

- PSHx:
  - Cardiac catheterization (2016),
  - Coronary angioplasty with stent (2019)
  - Cryo ablation (2019)
- Medications:
  - Amlodipine 10mg QD
  - Clonidine 0.1mg QD
  - Furosemide 20mg QD
  - Losartan 100mg QD,
  - Metformin 750mg QD
  - Rivaroxaban 20mg QD
  - Rosuvastatin 20mg QD
- Allergies: Keflex (urticaria), sulfa (urticaria)
- FHx:
  - Mother, 79 y.o.; HTN, DM type 2
  - Father 69 y.o.; deceased
- Social hx:
  - Previous smoker, 1 PPD x 10 yrs, quit 20 yrs ago
  - No alcohol or illicit drug use

## PHYSICAL EXAM

- General:** No acute distress, nontoxic appearing
- Neurologic:** Alert and oriented to person, place, and time
- Neck:** Left carotid bruit, right normal. No JVD
- Cardiovascular:** Regular rate and rhythm

|       | Brachial | Radial |
|-------|----------|--------|
| Left  | 1+       | 0+     |
| Right | 2+       | 2+     |

- Pulmonary:** No accessory muscle use, clear without adventitious lung sounds
- Abdominal:** Soft, nontender, nondistended
- Musculoskeletal:** 1+ pitting edema bilateral lower extremities

## VITALS

- Temperature: 98.2<sup>o</sup>F
- Heart rate: 80 beats per minute
- Blood pressure:
  - Right 138/65 mmHg
  - Left 130/62 mmHg
- Respirations: 18 breaths per minute

## DIAGNOSTICS

### CTA Head & Neck:

**Right Carotid:** Soft atherosclerotic plaque causing approximately 50-70% narrowing, no evidence of dissection  
**Left Carotid:** Extensive atherosclerotic calcification involving carotid bulb extending into proximal ICA and causing significant narrowing of approximately 80%, no evidence of dissection  
**Impression:** No high-grade stenosis at circle of Willis. Moderate to severe multifocal segmental narrowing of left V4 segment. Mild focal segmental narrowing of left M1 segment

**Carotid Artery US b/I:** 50-79% right and left internal carotid artery stenoses, appropriate antegrade flow seen in the right vertebral artery, retrograde flow seen in left vertebral artery consistent with subclavian steal syndrome

**Pulse Volume Recordings Upper Extremity:** There is no evidence of right upper extremity arterial insufficiency. The left upper extremity PVR and wrist brachial index are moderately reduced, consistent with subclavian arterial disease

**Arterial Plethysmography:** Left upper extremity PVT and wrist brachial index are moderately reduced, consistent with subclavian arterial disease

## HOSPITAL COURSE

- Pre-operative diagnosis of left subclavian artery stenosis with steal syndrome
- Left brachial artery cutdown, aortic arch and left upper extremity angiography, angioplasty and stenting of the left proximal subclavian artery
- Exposed brachial artery was accessed, a guidewire and 4-French catheter was advanced to the mid subclavian artery
- Intraoperative diagnostic angiography demonstrated a calcified plaque at the origin of the proximal subclavian artery and in the aortic arch
- The occlusion was dilated with a 4 mm angioplasty balloon however, as the balloon reached burst pressure, residual stenosis and occlusion remained
- Boston Scientific Express 6 x 37 mm balloon-expandable stent was carefully positioned across the occlusion and inflated
- Final angiography demonstrated strong blood flow with no significant residual stenosis
- Physical exam revealed a palpable left radial pulse, representing improvement
- In the PACU, palpable left radial pulse and patient denied numbness or tingling
- Patient discharged home same day without complications



Figure 1: Intraoperative diagnostic angiography; guidewire



Figure 2: Intraoperative diagnostic angiography; vascular sheath



Figure 3: Intraoperative diagnostic angiography; catheter



Figure 4: Intraoperative diagnostic angiography post-stent

## DISCUSSION

### Case Outcome

- The angioplasty and stenting of the left proximal subclavian artery was successful as noted by the intraoperative diagnostic angiography after stent placement (Figure 4).
- Patient was discharged to continue adequate follow-up with cardiology for management of her predisposing conditions.
- Her known coronary artery disease has been stable with no known further anginal or syncopal symptoms.

### Recommended Treatment Guidelines for SSS

- Percutaneous transluminal angiography with stenting remains the treatment with the most favorable outcome.<sup>4</sup>
- Artery stenting can be used in patients predisposed to subclavian stenosis before and after left internal mammary artery bypass graft to prevent subclavian steal syndrome.<sup>6</sup>
- Bypass presents as an alternative to transluminal angioplasty if the lesions are nonamenable to angioplasty or stent.<sup>6</sup>

## CONCLUSION

- Subclavian steal syndrome is an under recognized pathology due to the variability of presenting symptoms.
- In reported cases, symptoms manifest as vertigo and syncope however, in the face of increasing occlusion, bloody supply to the ipsilateral arm may become completely impaired.
- Diagnosis must be considered in patients presenting with a difference in pulse and arterial pressure in the upper extremities.
- Imaging modalities such as CTA, carotid artery duplex ultrasound, MR angiography, and plethysmography provide adequate diagnostic information needed to make the diagnosis.

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