# Extrathoracic Surgical Treatment of Subclavian Steal Syndrome

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Twelve patients with" subclavian steal syndrome" were studied in 36 months period from June 2013 to June 2016. Their age ranged between 21-55 years with a mean age of 32 years. Female sex represented (7/12, 58.33%). All cases were subjected to complete history taking and clinical examination. They presented with drowsiness and, or fainting after left upper limb exercise. This was associated with manifestations of chronic left upper limb ischemia. Investigations were done for all cases including laboratory investigations, Duplex US, Angiography and CT Angiography. Surgical treatment was done for all cases (7 cases were treated by transcervical subclavian -subclavian bypass graft, 4 cases were treated by left common carotid to left subclavian artery bypass graft and one case by right subclavian to left axillary artery bypass graft). Ringed Gortex graft 8mm was used in all cases. The results of all surgical operations were successful and the symptoms of the brain and left upper limb ischemia disappeared. The graft in one case was occluded after 2½ years due to intimal hyperplasia (the case of right subclavian to left axillary artery bypass graft). Clearance of the graft was done by using Fogarty catheter. All grafts were functioning well and the results were excellent.

**Key Words:** Left upper limb ischemia, fainting, coma, subclavian steal syndrome,subclavian artery stenosis.

## Introduction

"Subclavian steal" means reversal of flow in a branch of the subclavian artery that is due to an ipsilateral hemodynamically significant lesion of the proximal subclavian artery.[1,2]

Subclavian stenoses however, are most often asymptomatic and therefore do not require specific therapy other than that directed at the underlying etiology. In some patients with "Subclavian steal syndrome" symptoms of arterial insufficiency affecting the brain and the upper extremity become manifested.[1-3]

Atherosclerosis is the most common cause of "subclavian steal syndrome" irrespective of the clinical manifestation, however, large artery vasculitis, thoracic outlet syndrome, and stenosis after surgical treatment of aortic coarctation are other possible causes.[2-4]

The phenomenon of reversed flow in the vertebral artery in the setting of proximal subclavian artery stenosis[5] is relatively rare and usually asymptomatic[6] due to adequate compensation by the circle of Willis and a rich brachiocephalic collateral circulation. However, symptoms can arise when these pathways are compromised by occlusive disease or anatomical variants[7,8] leading to vertebrobasilar or upper extremity ischemia or even myocardial ischemia from diminished flow through an internal mammary artery bypass graft.[7,9,10] In these circumstances, surgical or endovascular intervention is indicated.

Over the past decades, endovascular therapy (angioplasty and stenting) and a variety of extrathoracic surgical approaches [carotid-subclavian bypass (CSB), axilloaxillary bypass (AAB), and subclavian-to-carotid transposition] have been advocated to treat subclavian lesions and avoid transthoracic approaches because of their greater morbidity and mortality.[11-14]

## Aim of the work

This work aimed to evaluate the results of extra thoracic surgical treatment of "subclavian steal syndrome".

## Patients and methods

### Patients

This study included 12 patients with "subclavian steal syndrome" attending "the Vascular Unit, Department of Surgery, Faculty of Medicine, Alexandria University, Egypt". In the period from June 2013 to June 2016.

**Inclusion criteria:**

1. Brain ischemia.
2. Left upper limb ischemia

**Exclusion criteria:**

1. Intracranial tumor.
2. Intracranial thrombosis.
3. Left upper limb thrombosis.
4. Left upper limb ulceration or gangrene.

**Methods:**

After local ethical committee of "the Faculty of Medicine, Alexandria University" approval and obtaining fully informed patients' consent, the current study was conducted on all patients who

were subjected to the following:

1. Complete history taking
2. Thorough clinical examination
3. Investigations which included:
   - Laboratory investigations
   - Duplex ultrasound
   - Angiography:
     – Arch aortography
     – CT Angiography
4. Surgical treatment of 12 patients with "Subclavian steal syndrome":

All extra thoracic surgical bypass procedures were performed with 8 mm-diameter polytetrafluoroethylene (PTFE) grafts under general anaethesia.

- Subclavian- Subclavian bypass (SSB)
- Caratid- Subclavian bypass (CSB)
- Right Subclavian- left axillary bypass (SAB)

5. Follow up for 12 patients with "subclavian steal syndrome" through 3 years.

All operations were successful and symptoms disappeared except the case of right subclavian-left axillary graft which was occluded after 2½ years. This graft was revised and cleared using Fogarty catheter. All the 12 grafts were still functioning for 3 years of follow up.

## Results

- Twelve patients presented to the Vasclar Unit with" subclavian steal syndrome" in the period from June 2013 to June 2016.
- Their ages ranged between 21-55 years with a mean of 32 years.
- Female sex represented 7/12, (58.33%).

**Table 1: Clinical presentations of 12 patients with" subclavian steal syndrome"**

| Clinical presentations | NO | % |
|---|---|---|
| Chronic left Upper limb ischemia | 12 | 100 |
| Low or absent blood pressure in left Upper limb | 12 | 100 |
| Drowsiness after upper limb exercise | 12 | 100 |
| Ataxia | 10 | 83.33 |
| Vertigo | 10 | 83.33 |
| Bruit in the left Supraclavicular area | 8 | 66.67 |
| Visual disturbance | 8 | 66.67 |
| Syncopal attacks | 6 | 50 |

**Table 2: Surgical treatment of 12 patients with "subclavian steal syndrome ". All cases were treated by indirect extrathoracic approaches as follows:**

| Type of operations | NO | % |
|---|---|---|
| Subclavian – subclavian bypass graft | 7 | 58.33 |
| Left common carotid – subclavian bypass graft | 4 | 33.33 |
| Right subclavian – left axillary bypass graft | 1 | 8.33 |

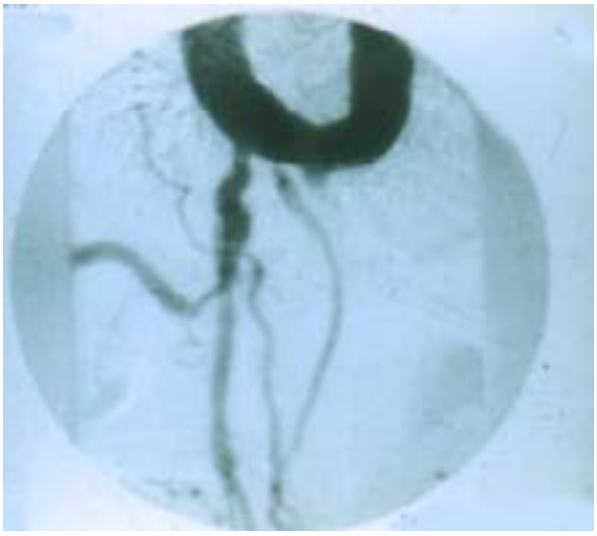

**Fig 1A: Arch aortography showed occlusion of the left subclavian artery, ostial stenosis and attenuated left common carotid artery.**

**Fig 1B: Ringed Gortex graft between both sub-clavian arteries.**

**Fig 1C: Post operative scar of both supraclavicular incisions.**

**Fig I (A, b,C): Subclavian – subclavian bypass graft.**

**Fig 2A: Arch aortography showed dilated brachio-cephalic artery and its two branches; the right common carotid and right subclavian artery. Narrowing of the left common carotid artery, occlusion of the left subclavian artery and the axillary artery was reconstituted at its distal half.**

**Fig 2 B1: Left upper limb ischaemia (Atrophy and pallor of the left upper limb).**

**Fig 2 B2: Three intra operative incisions and ringed Goretex graft passed through them from the right subclavian artery to the left distal axillary artery.**

**Fig 2 B3: Goretex graft was started in the right subclavian artery and was passed transcervical to the left subclavian artery then was passed behind the left clavicle to the left axilla and was anastomosed end to side to the axillary artery.**

**Fig 2 B4: Showed the scars of the three incisions.**
**The pallor of the left upper limb was improved (1 week after operation).**

**Fig 2C: Postoperative arch aortography showed functioning graft from the right subclavian artery to the left axillary artery.**

**Fig II (A, B1-4, C): Right subclavian – left axillary artery bypass graft.**

As regards the complications postoperatively; there were no brachial plexus injuries, no minor wound complications or graft infection. However, only one patient developed occluded right subclavian to left axillary artery graft after two and half years from operation and was revised using Fogarty catheter to clear the graft.

Postoperatively, the success rate and the graft patency was 100%, the patency was confirmed by Doppler ultrasound. After an average of 3 years follow up, there was no mortality.

## Discussion

Patients with subclavian steal are relatively rare and usually asymptomatic[6] because of the rich collateral compensation.[15,16] Thus, it is generally a benign hemodynamic phenomenon.[17-20] However, clinical ischemic symptoms develop when the collateral circulation to the upper extremity is unable to compensate for a decrease in blood supply as a result of anatomical variation or occlusive disease in the carotid, vertebral, or circle of Willis arteries.[7,8] In these circumstances, surgical or endovascular treatment of subclavian artery lesion is indicated.

Carotid-subclavian bypass, axilloaxillary bypass and subclavian–subclavian bypass (SSB) were the most common extrathoracic surgical techniques used to treat subclavian steal, and all have excellent long-term outcomes.[21-24] However, in patients with concomitant carotid lesions, graft failure is more frequent in the CSB group. Usually perform CSB in patients without concomitant ipsilateral carotid diseases and AAB in patients with concomitant carotid artery diseases, especially ipsilateral,[25]

The age, sex, causes and symptoms of the ”subclavian steal syndrome” in our study were matched with those mentioned in the literature, as Osiro et al[17] mentioned that the vertebrobasilar symptoms include paroxysmal vertigo, dizziness, diplopia, ataxia, dysarthria and syncopal attacks. Ischemia to the hand often manifests as arm weakness, claudication, paresthesias or coldness in the arm.

The complication postoperatively was temporary mild numbness in three fingers of the left hand in one patient operated on with right subclavian to left axillary bypass and disappeared after two weeks. Later on, this patient developed occlusion in the right subclavian to left axillary bypass graft after two and half years from the time of the operation. The lumen of the graft was cleared by Fogarty catheter.

No infection occurred in any graft and no motor dysfunction occurred. All the grafts were still functioning up till now and all symptoms disappeared.

Carotid–subclavian bypass surgery has been used successfully in patients who have isolated steno-occlusive subclavian disease. Patency rates have been reported as high as 95% at 10 years.[21,22,26] The widely cited retrospective study by AbuRahma and colleagues[22] of the results of 51 carotid-subclavian bypass surgeries showed no mortality after almost 8 years of follow-up, with symptoms recurring in only four of the patients. Also, Qi et al.[27] have reported a series of operations with a success rate of up to 98.11% (52 out of 53 cases). Only one complication of thrombogenesis occurred at an anastomotic site, after an average of 24.5 months of follow-up. There was no mortality and the postoperative graft patency rate, confirmed by Doppler ultrasound, was 100%. All the vertebrobasilar and arm ischemic symptoms had also disappeared. This revascularization technique is therefore still regarded as a low-risk procedure for symptomatic patients whose donor carotid arteries lack significant atherosclerotic disease.

In the present study, the success rate was 100%. After an average of 36 months follow up, there was no mortality and the postoperative graft patency rate was confirmed by Doppler ultrasound. Those results were matched with the results of the previous studies done by AbuRahma and colleagues,[22] Uurto et al[26] and Qi et al.[27]

Today, many authers select subclavian artery stenting first for "subclavian steal syndrome". When endovascular therapy is unsuccessful initially or fails due to in-stent stenosis/ occlusion during follow-up, surgical revascularization with a CSB or AAB or SSB using a PTFE graft can provide an effective and durable treatment option.

**Conclusions**

Our results showed that extra thoracic surgical bypass using PTFE grafts are safe, easily done and effective for treating "subclavian steal syndrome".

Extrathoracic surgical bypasses are more durable in the long term.

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