

SUBCLAVIAN STEAL SYNDROME

By

Magdy Haggag, M. D. and Mohammad Mostafa M. D.

Departments of Surgery and Diagnostic and Interventional Radiology
Faculty of Medicine, Cairo University

Subclavian steno-occlusive disease proximal to the vertebral artery is associated with reversal of flow that may lead to vertebrobasilar insufficiency. Usually asymptomatic, but may present with transient ischemic attacks, arm claudications, or both. Diagnosis is made incidentally during Doppler ultrasound examination of the carotid and vertebral arteries.

Study of 22 patients with diagnostic evidence of retrograde flow in the vertebral artery due to stenosis or occlusion of the ipsilateral subclavian artery. 15 males and 7 females with age range between 44-73 years were included in this study. Symptoms were arm claudication in 13 patients, syncope and dizziness in 3 and the remaining 6 patients were asymptomatic and discovered during duplex study for neck bruit duplex study. Treatment modalities used were Axillo-axillary bypass in 6 cases and carotid-subclavian bypass in 7 cases and angioplasty and stenting in the last 9 cases. Clinical results were compared and proper indications of each modality were defined.

In conclusion: subclavian steal syndrome is a rare clinical syndrome. The main etiology among our population is atherosclerosis. Patients usually present with arm claudications and rarely with transient ischemic attacks due to vertebrobasilar insufficiency. Investigation of neck bruit help in diagnosis of more cases. Surgical revascularization can be made with excellent outcome and long term patency rate. The new modality of angioplasty and stenting provides an excellent alternative to such patients with minimal rate of morbidity and mortality.

Keywords: subclavian steal syndrome-subclavian steal phenomenon-subclavian steno-occlusive disease.

INTRODUCTION

Subclavian steal syndrome (SSS) refers to subclavian artery steno-occlusive disease proximal to the origin of the vertebral artery and is associated with reversed flow in the vertebral artery. Contorni was the first to describe it⁽¹⁾. Reivich described associated neurologic symptoms⁽²⁾ and the combination of both was named subclavian steal syndrome (SSS) by Fisher⁽³⁾.

Classification of subclavian steal syndrome can be defined by territory from which blood is stolen. Volmer recognized four types: vertebro-vertebral, carotid-basilar, external carotid-vertebral, carotid-subclavian (occur only with brachiocephalic artery)⁽⁴⁾. Another classification by Brnchereau and colleagues is based on the hemodynamic abnormalities ranged from reduced antigrade flow (stage one), reversal of flow during active hyperemia of the arm

(stage two) and stage three correlates with the disease severity usually indicating subclavian artery occlusion⁽⁵⁾.

Angiographically the incidence of subclavian stenosis is 17% but angiographic steal occurs only in 2.5%, of these 80% had associated extracranial arterial obstruction and 5.3% had neurologic symptoms⁽⁶⁾. On Doppler examination for neck bruit; 6.4% was found to have subclavian steal syndrome.

The main etiology of the disease is atherosclerosis except in the Far East where Takayasu arteritis is more prevalent. In 2% of the population, vertebral artery arises directly from the aortic arch as proximal stenosis or occlusion of the subclavian artery would not reverse flow in the vertebral artery⁽⁷⁾.

Clinically, commonly asymptomatic and flow reversal is

diagnosed as an incidental finding during Doppler ultrasound examination. Symptoms occur (dizziness, unsteadiness, vertigo, visual changes) most typically related to vertebrobasilar and posterior cerebral circulation. Arm ischemia occurs as arm claudications or rest pain⁽⁸⁾.

Color Doppler ultrasound is the preferred examination and digital angiography is the traditional test for diagnosis and to verify the extracranial carotid disease.

Treatment modalities include Axillo-axillary bypass and carotid-subclavian bypass surgery^(9,10,11,12). Percutaneous revascularization by transluminal angioplasty with or without stenting provides an excellent patency rate⁽¹³⁾.

In this study 22 patients with subclavian steal syndrome were evaluated and treated by different modalities. The clinical presentation and the outcome of treatment will be discussed.

PATIENTS AND METHODS

22 patients 15 males and 7 females with age range between 44 to 73 years were included in this retrospective study between 1997 and 2002 at Kasr El Aini Hospitals. All patients had proximal subclavian artery steno-occlusive disease with duplex evidence of retrograde flow in the ipsilateral vertebral artery (Fig. 1).

Symptoms included arm claudications in 13 patients, syncope and vertigo in 3, and asymptomatic with neck bruit in 6 patients. Clinical examination, differential blood pressure, duplex study of the subclavian, vertebral, and carotid arteries were done. Angiography was done for all before therapeutic intervention to evaluate the condition of the arch vessels and the distal tree of the upper extremity (Fig. 2).

Treatment modalities included Axillo-axillary bypass in 6 cases (Fig. 3 a&b), carotid-subclavian bypass in 7 cases (Fig. 4 a&b) (Fig. 5). Percutaneous transluminal angioplasty with or without stenting in 9 cases (Fig. 6 a&b) (Fig. 7 a&b).

In the last 9 cases (2 right & 7 left subclavian steno-occlusive disease), PTA was tried in all cases through the femoral artery route. Axillary artery access was used in 3 cases with total occlusion one in the right side and two in the left side together with the femoral artery route.

0.35 gliding guidewire was used to bypass the lesion and 6 to 8 mm balloon was used for PTA. 8 mm 2cm stent was applied for each of the two cases with residual stenosis.

Results were analyzed to compare the clinical outcome of the three modalities used for revascularization. The parameters of successful revascularization include restoration of the flow in the subclavian artery, reversal of flow in the vertebral artery, disappearance of arm claudications and vertebrobasilar transient ischemic attacks. Patency of the grafts and the subclavian artery after angioplasty were evaluated by duplex and or angiography during follow up period of 9 months to 4 years.

RESULTS

Patients were classified into three groups according to the method of revascularization of the subclavian artery, group 1: Axillo-axillary bypass group (6 cases), group 2: carotid-subclavian bypass (7cases), and group3: angioplasty group (9cases). The mode of presentation and the clinical results are shown in (Table 1). All cases showed disappearance of symptoms except in one case with painful hand indicating another cause for pain other than ischemia (Cervical spondylosis). Postoperative duplex study showed absence of flow reversal in the ipsilateral vertebral artery and regaining the triphasic pattern of the subclavian artery after angioplasty. In two cases with subclavian occlusive disease, angioplasty and stenting failed due to long segment occlusion and technical failure and they preferred to continue on medical treatment.

There was no mortality in our study. Complications were minimal as wound hematoma in two patients and graft thrombosis in one case in carotid subclavian bypass group. The latter complication was managed by graft thrombectomy. There was no complications of endovascular intervention neither at the puncture site of the femoral artery nor at the site of angioplasty and stenting. There was no embolic phenomenon into the cerebral circulation or in the upper extremity.

Duplex and or angiography were done to evaluate the patency rate. All surgical grafts were patent in the early postoperative period (Fig. 5) except one carotid-subclavian bypass that became patent after secondary thrombectomy. For late patency, 9 out of 13 patients were followed for four years and were found patent. For the angioplasty group, all successful cases were found patent during follow up period of 8 to 18 months.

Table (1):

<i>Case N0</i>	<i>Age years</i>	<i>Sex</i>	<i>Side</i>	<i>Symptoms</i>	<i>Clinical outcome</i>
1	62	M	Lt	Arm claudications	Improved
2	65	M	Lt	Arm claudications	Improved
3	58	F	Lt	Syncope and dizziness	Improved
4	44	F	Lt	Arm claudication	Improved
5	73	M	Rt	Arm claudications	Improved
6	70	M	Lt	Vertigo	Improved
7	59	M	Lt	Arm claudications	Improved
8	65	M	Lt	Arm claudications	Improved
9	49	F	LT	Arm claudications	Improved
10	58	M	Rt	Arm claudications	Improved
11	71	M	Lt	Syncope	Improved
12	64	M	Lt	Asymptomatic	Restored flow
13	55	F	Rt	Arm claudications	Improved
14	62	M	Lt	Arm claudications	Improved
15	57	F	Rt	Asymtomatic	Restored flow
16	67	M	Lt	Arm claudications	Improved
17	58	M	Lt	Asymptomatic	Restored flow
18	60	M	Lt	Asymtomatic	Restored flow
19	62	M	Lt	Asymtomatic	Restored flow
20	56	M	Lt	Asymptomatic	Restored flow
21	67	M	Rt	Arm claudications	Failed PTA
22	45	F	LT	Arm claudications	Fialed PTA

Group 1:Axilloaxillary bypass cases 1-6

Group 2:Carotid -subclavian bypass cases 7-13

Group 3:Percutaneous angioplasty with or without stenting cases 14-22

N B: Asymptomatic cases were discovered during investigations for neck bruit.

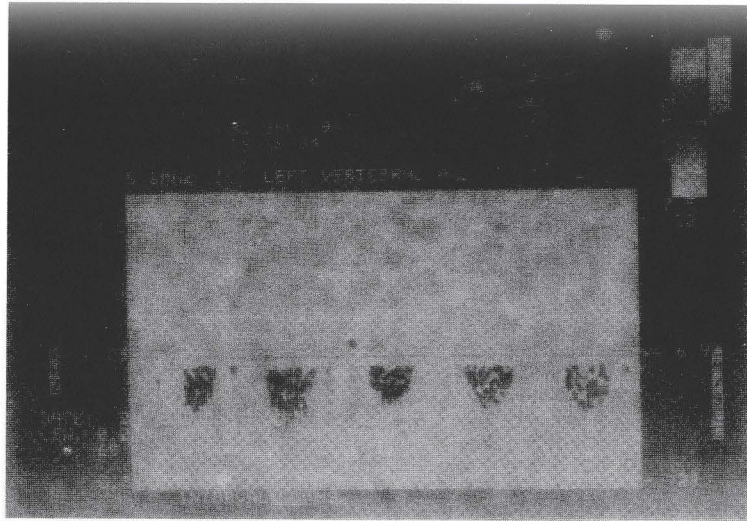


Fig.(1):Duplex study shows the reversal of flow in the vertebral artery due to subclavian steal syndrome.

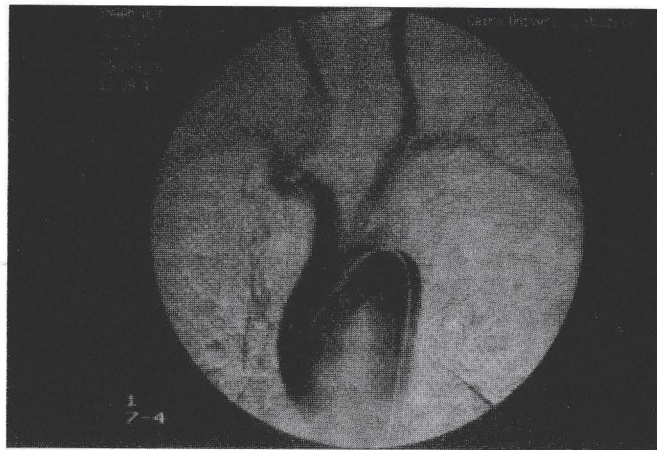


Fig.(2):Arch Aortography shows the subclavian stenosis and the condition of the arch vessels.

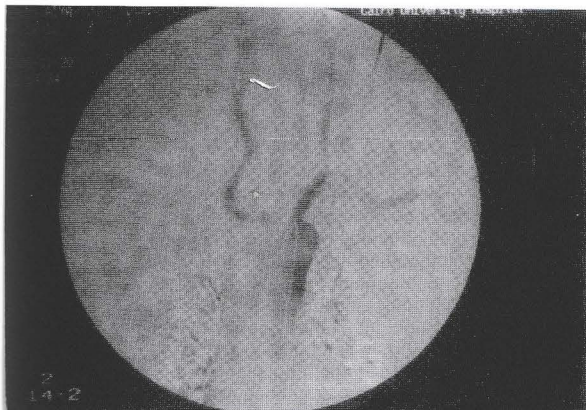
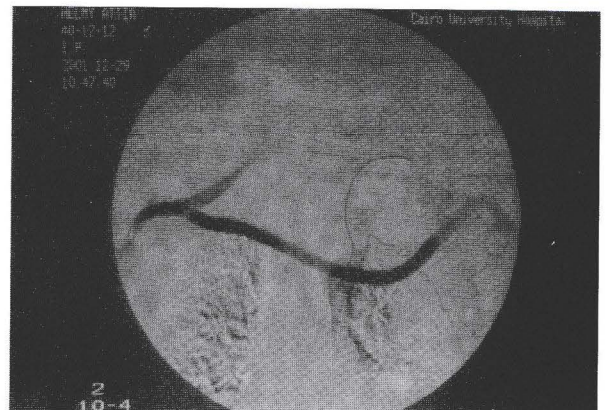


Fig. (3): A: Rt subclavian stenosis with subclavian steal syndrome



B: Axillo-axillary bypass with collagen coated dacron 8 mm graft

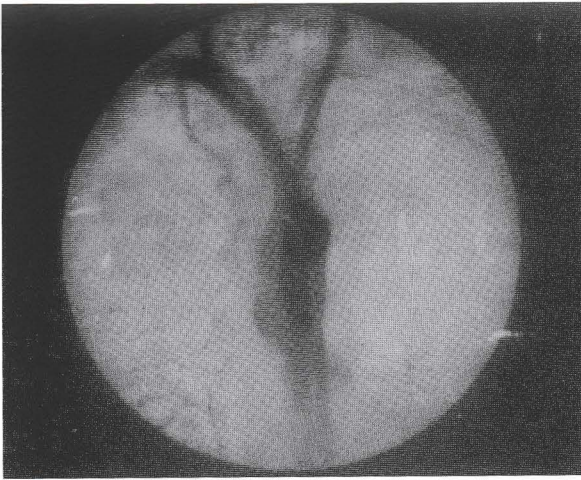
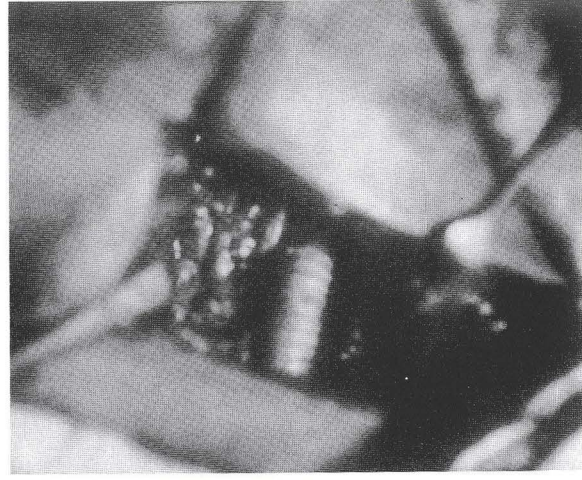


Fig.(4): A: Lt subclavian artery block with subclavian steal syndrome.



B: Carotid -subclavian bypass with collagen coated dacron 8 mm graft(operative veiw) . Duplex study shows the normal flow within the graft.

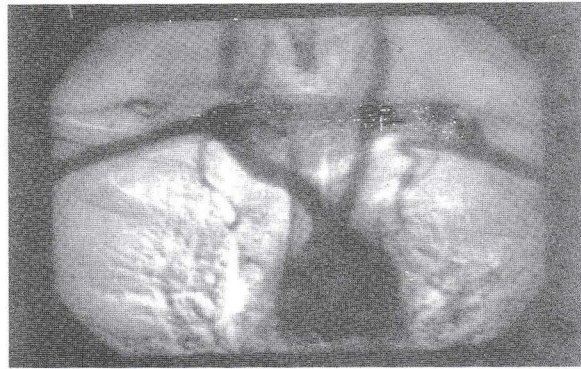


Fig. 5 Postoperative angiography shows patent carotid- subclavian by pass

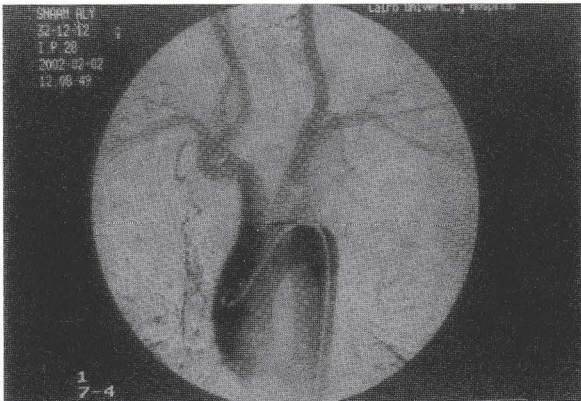


Fig. (6): A: Lt subclavian stenosis with sunclavian steal syndrome



B: Percutaneous angioplasty through the femoral route and 8mm balloon used for angioplasty-Post angioplasty angiography shows patent subclavian artery

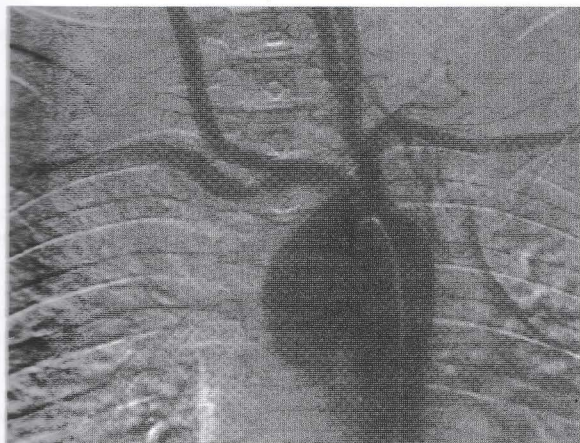
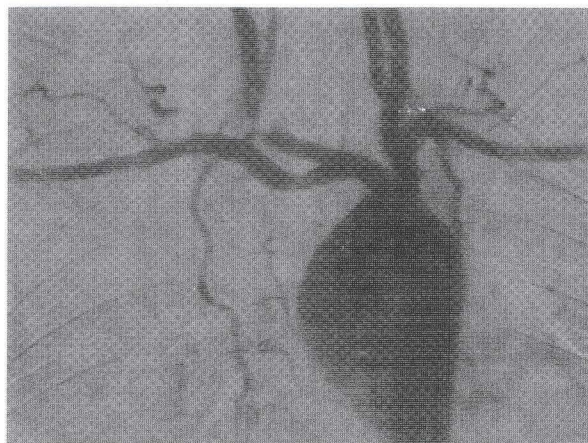


Fig.(7): A: Rt subclavian artery occlusion with subclavian steal syndrome



B: Percutaneous angioplasty of the stenosed subclavian artery

DISCUSSION

Subclavian steal refers to proximal subclavian artery steno-occlusive disease with flow reversal in the ipsilateral vertebrbasilar artery. Neurologic symptoms are produced when the compensatory flow to subclavian artery from the vertebral artery diverts much flow toward the arm and away from the intracranial structures. The quality of collateral blood supply and the capacity to increase the collateral flow to the intracranial circulation is the principle determinant as to which patient develops neurologic symptoms⁽¹⁴⁾. Hereby the presence of extracranial arterial disease is a prerequisite to development of symptoms⁽¹⁵⁾.

It is commonly asymptomatic and is diagnosed as an incidental finding during Doppler ultrasound examination of the carotid and vertebral arteries or examination for neck bruit⁽¹⁶⁾. Angiography revealed 23% incidence of proximal subclavian artery disease or occlusion with 6% showing reversed vertebral flow.

Despite low risk of stroke, 50% of patients showed spontaneous remittance of vertebrobasilar symptoms. Only 15% of the initially asymptomatic patients experienced transient ischemic attacks during follow up of at least 2 years⁽¹⁷⁾.

In our study only 3/22 patients experienced vertebrobasilar symptoms while 13/22 presented mainly with arm claudications. More important, 6/22 were completely asymptomatic and discovered only during investigations of neck bruit. None of them developed stroke due to subclavian steal.

Treatment modalities include Axillo-axillary bypass

which is considered by some as the best modality of treatment. It is simple, safe, excellent long-term patency and superior to transthoracic correction⁽¹⁸⁾. In our study 6 patients had axillo-axillary bypass grafts that were successful in relieving symptoms and help in revascularization of the distal subclavian artery. The grafts were all patent during a follow up period of four years.

On the other hand, carotid-subclavian bypass is another alternative to axillo-axillary bypass, more simple, easier and can be done under local anesthesia⁽¹⁹⁾. The only prerequisite is the presence of non-diseased ipsilateral carotid artery. In spite of early thrombosis in a single case, after thrombectomy, all grafts remain patent during the same follow up period.

Percutaneous transluminal angioplasty (PTA) is a well established treatment for patients with subclavian stenosis⁽²⁰⁾. Its value is well documented also in cases with total occlusion without any major or minor complications⁽²¹⁾. Angioplasty alone if technically well done carries an intermediate and a long term patency rate better than angioplasty and stenting. As in-stent restenosis frequently occurs in the long run. However, stenting provides better primary technical success especially for total occlusion and long segment stenosis. One year patency in unstented arteries was 76% and 68% after 4 years. While similar patency in stented arteries was 95% after one year and 59% after four years. This is mainly due to better primary technical success and late in-stent restenosis⁽²²⁾.

In our study angioplasty was done for 5 cases and angioplasty and stenting in 2 cases with subclavian artery stenosis. During a follow up period for 8 months to 18 months, duplex study showed patency of the subclavian

arteries with triphasic pattern of flow. However, a longer follow up is recommended in such cases for better evaluation of the technique. In two cases with subclavian occlusion, angioplasty and stenting failed to recanalize the artery due to technical failure and they continued on medical treatment.

In conclusion: Subclavian steal syndrome is rare but still present among our patients. Atherosclerosis is the main etiology and minority of cases are due to arteritis mainly Takayasu arteritis. The main mode of presentation is arm claudications and very rarely with vertebrobasilar transient ischemic attacks. More important is the asymptomatic cases that are discovered during duplex study of the neck vessels and investigations for neck bruit.

Treatment modalities include surgical revascularization by axillo-axillary bypass, carotid-subclavian bypass with a very good patency rate. These procedures are easy, simple and avoiding major or minor complications that are associated with transthoracic axial repair. Axillo-axillary bypass is recommended when there is an ipsilateral carotid artery disease when carotid-subclavian bypass is contraindicated. Meanwhile, arch aortography is essential to evaluate the arch vessels before having this bypasses done.

Percutaneous transluminal angioplasty become a very good alternative to surgical revascularization. It is simple, easy and with low complication rate. There is no fear of embolic phenomenon as the flow in the ipsilateral vertebral artery is reversed and consequently prevent cerebral embolization. It has a good short term patency rate. In spite of some technical difficulties especially with complete occlusion, better results will be achieved with increasing learning curve and endovascular experience. Further study and longer follow up are recommended for better evaluation of this promising technique.

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