BRIEF COMMUNICATION

SUBCLAVIAN STEAL SYNDROME. ENDOVASCULAR AND OPEN MANAGEMENT. REPORT OF 2 CASES

ABSTRACT

The Subclavian Steal Syndrome is caused by stenosis or occlusion of the subclavian artery, which generates reversal flow in the vertebral artery in order to perfuse the ischemic upper limb. Most of the patients are asymptomatic, others consult for vertigo, syncope, transitory ischemic attacks in the vertebrobasilar territory, or ischemic symptoms in the upper limb. At physical examination there is a significant difference in blood pressure between both arms, and pulse deficits in the affected limb. The diagnosis is confirmed by plethysmography and arterial duplex scan. Symptomatic patients should be treated either by surgical or endovascular approach. Percutaneous balloon angioplasty and stenting is the procedure of choice when there is suitable anatomy. Surgical treatment may be accomplished by carotid-subclavian bypass or carotid transposition in cases of large calcified lesions with risk of embolization. We present 2 cases of subclavian steal syndrome managed by endovascular and surgical approach.

Keywords: Subclavian steal syndrome, subclavian artery stenosis.

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INTRODUCTION

The term "subclavian steal" refers to a phenomenon of reverse flow in the vertebral artery secondary to a hemodynamically significant stenosis or an occlusion of the ipsilateral subclavian artery.[1,2] In most cases, the occlusion of the subclavian artery is asymptomatic and does not require invasive studies or treatment. A prevalence between 0.6% - 6% of the population is estimated. The subclavian steal syndrome involves the presence of symptoms caused by arterial insufficiency in the brain (mainly, vertebrobasilar insufficiency), in the upper limb, which is irrigated by the subclavian artery,[1,2] or even in the heart if part of the coronary circulation is supplied by an internal mammary artery bypass.[1]

Below, the cases of two patients with upper limb and vertebrobasilar ischemic symptoms associated with stenosis and subclavian steal are

presented. Also, two different management strategies are shown revealing the treatment options for this syndrome with their specific indications.

Case 1: 77-year-old female patient, hypertensive, with coronary disease, clinical picture of 3-month right fronto-occipital headache radiating to the neck and shoulder on the same side associated with phosphenes, dizziness and gait instability, in addition to paresthesias and pain in the right upper limb. During physical examination, she presented right hemianopsia during the exercise and physical activity of the ipsilateral arm, suggesting subclavian steal. A duplex ultrasound and an angiotomography of the neck were conducted showing calcified and soft plaques with 70% significant stenosis of the right arterial brachiocephalic trunk. (Figure 1.) It was decided to perform a percutaneous endovascular procedure. An aortogram was conducted with insertion of a catheter into the right subclavian artery, revealing short stenosis of approximately 80%; continuing, a 10 mm x 30 mm stent was found in the brachiocephalic trunk, with proper recovery of distal flow at the obstruction. (Figure 2.) Her dizziness and visual and upper limb ischemic symptoms improved and she was released from hospital 2 days later with dual antiplatelet therapy and subsequent satisfactory evolution.

Case 2: 80-year-old male patient, diabetic, with coronary disease, who in the last 6 months presented syncope and several cerebral transient ischemic attacks associated with dizziness. At physical examination, an inter-arm blood pressure difference of 30 mm Hg was found, with no other remarkable findings. A duplex ultrasound of carotid vessels was conducted showing a large calcified atherosclerotic plaque at the origin of the right subclavian artery producing significant stenosis of more than 90%, which was confirmed by an angiotomography of the neck. (Figure 3.)

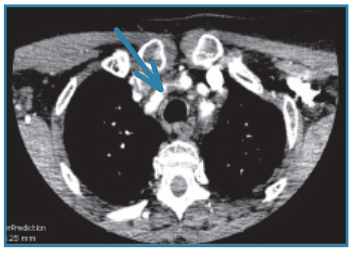

Figure 1. Angiotomografía cervical que muestra estenosis proximal del 70% del tronco braquiocefálico arterial.

Figure 2. Aortogram showing prosthesis in brachiocephalic trunk with proper subsequent distal flow.

It was considered that, given the anatomical characteristics, as it was a large calcified plaque, the best management strategy to treat this patient would be the surgical approach. A subclavian-carotid bypass with Dacron graft was performed without complications. (Figure 4.) With satisfactory clinical evolution, he was released from hospital 3 days later. Since then, his symptoms have improved.

DISCUSSION AND CONCLUSIONS

Atherosclerosis is the most common cause of the subclavian steal syndrome, which is more frequent on the left side possibly due to a more acute angle at the origin of the left subclavian artery, leading to atherosclerosis by an increased turbulent flow,[2] in addition to the known cardiovascular risk factors, including hypertension, diabetes, hypercholesterolemia, smoking.[3]

Other less common causes of subclavian artery stenosis are: Takayasu arteritis, compression of the artery at the thoracic outlet, post-radiotherapy fibrosis,[4] after the surgical correction of aortic coarctation,

tetralogy of Fallot (with Blalock-Taussig-type anastomosis),[1] and congenital anomalies such as the right aortic arch with isolation of the left subclavian artery.[1,2]

The syndrome occurs when a significant subclavian artery stenosis compromises the perfusion of the target organs mentioned above. As the degree of obstruction increases, the distal pressure to the stenosis site will fall at some point below the pressure transmitted by the contralateral vertebral artery (not compromised) via the basilar artery or the carotid artery through the circle of Willis.[1] The result of this pressure gradient favors a reverse blood flow in the ipsilateral vertebral artery in distal direction to the subclavian stenosis. A coronary-subclavian steal phenomenon has also been described in patients that previously underwent myocardial revascularization surgery, using the internal mammary artery (IMA).[1,2]

In about 80% of patients, the occlusive disease of the subclavian artery is asymptomatic and incidentally found when a discrepancy between the blood pressure of both arms is observed or when a duplex ultrasound is conducted in patients being tested for a coronary or carotid disease.[2] Symptomatic patients may present ipsilateral limb ischemia: claudication, fatigue, coldness, paresthesias, pain at rest.4 This occurs in one third of patients, whereas ischemic and trophic changes are rare.[2,3] The reverse flow of the vertebral artery is usually asymptomatic and, when not, causes in most cases vertebrobasilar ischemic transient attacks, which may manifest themselves as: dizziness, vertigo, ataxia, loss of balance, falls, diploplia, nystagmus, blurred vision, syncope, tinnitus, hearing loss, dysarthria.[2-4] In patients who underwent myocardial revascularization surgery with IMA graft, as the demand in another vascular bed such as the ipsilateral upper limb increases, angina and infarction may occur due to coronary-subclavian steal.[1,4,5]

In most cases, patients present significant systolic blood pressure difference between both arms (> 15 mm Hg).[2,4] In 1966, Toole stressed the importance of the bilateral arm sphygmomanometry, stating that, when the subclavian artery is stenotic or occluded, there should be a systolic blood pressure difference of more than 20 mm Hg or a diastolic blood pressure difference of more than 10 mm Hg for a reverse flow of the vertebral artery to occur.[2,4] Taking this into account, any person that know how to measure blood pressure may infer the diagnosis.6 It may also manifest itself with absent or severely diminished pulse (axillary, brachial, radial or ulnar) as compared to the contralateral arm; supraclavicular or cervical bruit.[4] Other physical examination findings are: ischemic changes such as finger ulcers, gangrenous skin lesions, blue fingers and subungual hemorrhages, secondary to atheromatous embolisms due to atherosclerotic lesions of the subclavian artery.[2-4]

Color duplex ultrasound is the non-invasive diagnostic option of choice to detect backflow.[4,7,8] Subclavian artery stenosis should be inferred in any patient with neurological symptoms of the vertebrobasilar territory, claudication of the arm or coronary ischemia,

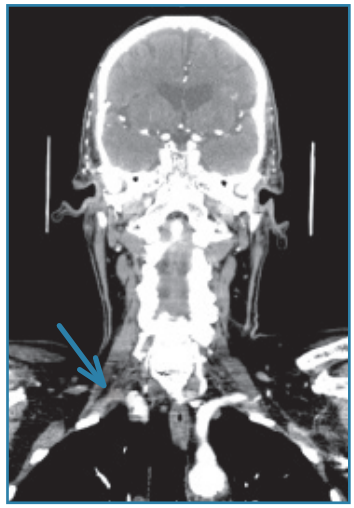

Figure 3. Cervical angiotomography showing a 90% stenotic area in the first section of the right subclavian artery.

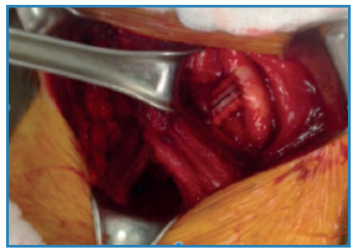

Figure 4. Subclavian-carotid bypassing with Dacron prosthesis. The right common carotid artery anastomosis is at the top right. Sternocleidomastoid muscle retracted to the left.

when the IMA has been used for myocardial revascularization.[1] Continuous Doppler and duplex ultrasound scans are easily accessible, low-cost and accurate if performed by a skilled operator. Findings suggesting significant obstruction include wave damping or monophasic changes; also, mosaics are observed in the color suggesting turbulent flow and increased flow rates on the site where there is suspected stenosis.[4,7] When there is severe stenosis (70% - 99%) of the proximal subclavian artery, 65% of patients will have permanent reverse flow in the ipsilateral vertebral artery and 30% will have intermittent reverse flow.[9] Other diagnostic tools include magnetic resonance angiography and computed angiotomography; however, they are most commonly used to quantify the degree of subclavian artery stenosis, the etiology of the obstruction or stenosis, and also when planning the therapeutic approach.[1,2]

Subclavian artery stenosis is a cardiovascular risk marker and identifies a population that will benefit from aggressive secondary prevention. Medical management includes lifestyle changes, glycemic control in diabetics (Hb1Ac < 7%), quitting smoking, anti-ischemic management; aspirin or clopidogrel, beta-blockers, angiotensin-converting enzyme inhibitors, and statins, which reduces long-term mortality.[1-4]

Usually, definitive management is not necessary in asymptomatic patients with subclavian artery obstruction or stenosis.[2] With the establishment of symptoms, surgical or endovascular management is needed. Management indications include disabling ischemia of the upper limb (claudication, pain in rest and digital embolization; vertebrobasilar insufficiency due to the steal phenomenon; anginal symptoms due to coronary steal by an IMA graft; lower limb claudication in axillofemoral bypass cases; to increase the flow in the affected upper limb before a myocardial revascularization surgery with an IMA graft) or when an arteriovenous fistula will be performed in the arm of the compromised subclavian artery.[4] The selection of the revascularization technique depends on the patient and the characteristics of the lesion.4

Surgical revascularization consists of performing a carotid-subclavian bypass, carotid transposition or an axillo-axillary bypass.[1,10] The first surgical reconstruction of a stenosis of the supra-aortic trunks (brachiocephalic trunk, subclavian artery and common carotid artery) was reported in 1951 by Shimizu and Sano; later, Diethrich et al and Crawford et al published results in which they observed a mortality decrease from 22% to 5.6% when an extra-anatomic cervical bypass was performed instead of using a transthoracic approach.[4] Surgical revascularization becomes necessary when endovascular treatment is not possible or when the anatomic conditions are not optimal and it is a more technically difficult procedure.[10] Carotid-subclavian bypassing surgery has favorable results proven by multiple studies showing low rates of mortality (0.8%) and postoperative complications (stroke: 0.5% - 5%) as well as favorable rates of medium- and long-term permeability (92% and 83% after 5 and 10 years, respectively).[4] Different materials may be used: a Dacron, PTFE or autologous vein

graft.[10-12] Although endoluminal therapy is considered safe and effective, open surgery continues to be an important option in low-risk patients due to greater durability and long-term permeability.[11,12] Symptomatic patients with failed endovascular management or with subsequent loss of permeability due to stent occlusion should be considered for surgical revascularization,[10,11] as well as patients with long, distal or very calcified lesions.[1]

The first cases of percutaneous angioplasty of aortic arch vessels were described in the 80's. Although balloon dilatation of these stenoses was effective and safe, reintervention was the main problem as long-term permeability was much lower than with surgery,4 which improved significantly with the use of stents.[12-13] In general, first an endovascular approach with angioplasty and stenting should be considered before open surgery, since it is a less invasive procedure with lower morbidity, shorter hospital stay and quicker recovery.[3,10,12-14] Several reports of angioplasty with stenting have described permeability rates over 90% after 5 years.[1,2,5] Balloon angioplasty with stenting may be performed in a safe way when there is little probability that the stent compromises vertebral artery circulation and when the patient has appropriate anatomic characteristics, as in the cases of stenoses or short occlusions at the origin of the subclavian artery.[1,2]

In conclusion, the subclavian steal syndrome is an entity that is primarily based on clinical suspicion and is not rare. In patients with upper limb and transient vertebrobasilar ischemic symptoms, the presence of this pathology should always be considered and blood pressure should be measured in both upper limbs; a blood pressure difference over 20 mm Hg means high probability of subclavian artery stenosis. It is important to take into account the overall context of the patient and to analyze carefully the anatomical alterations of the lesion in order to choose the best management strategy (endovascular or surgical) for the achievement of the best short- and long-term results with the lowest possible morbidity. ■

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