

Angiología

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Síndrome de salida torácica arterial en una mujer de 20 años tratado mediante abordaje supraclavicular

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ABSTRACT

Introduction: thoracic Outlet Syndrome (TOS) is a pathology of the neurovascular bundle located in the upper extremities of the body comprising three main categories: neurogenic, venous and arterial etiologies. Its diagnosis is supported by imaging and physical findings.

Case report: we present a case of a 20-year-old female with a pure arterial variant of TOS first thought of as a neurological problem. We also discuss the importance of a structured diagnosis and surgical planning involved in managing arterial TOS. Computerized tomography with angiography (CT-angio) showed compression of the left subclavian artery upon abduction. Dynamic imaging and a physical exam confirmed the findings. A left first rib resection with anterior scalenectomy was done via a supraclavicular approach. The patient presented no cervical rib nor fibrosis in the surgical site. No complications were reported throughout hospitalization. The patient was discharged 48 hours post procedure with full range of motion and asymptomatic. One week follow-up showed no new alterations.

Discussion: this case report shows the importance of exhausting all possibilities in diagnosis of TOS origin and how different surgical approaches offer aids and disadvantages.

Keywords: Thoracic outlet syndrome (TOS). Arterial. Supraclavicular.

RESUMEN

Introducción: el síndrome de salida torácica (SST) es una patología del paquete neurovascular localizado en las extremidades superiores, que comprende tres categorías principales: neurogénica, venosa y arterial. Su diagnóstico se apoya en estudios de imagen y hallazgos en la exploración física.

Caso clínico: presentamos el caso de una mujer de 20 años con una variante puramente arterial de SST, inicialmente considerada como un problema neurológico. Asimismo, discutimos la

importancia de un diagnóstico estructurado y de la planificación quirúrgica en el manejo del SST arterial. La tomografía computarizada con angiografía (angio-TC) mostró compresión de la arteria subclavia izquierda durante la abducción. La imagen dinámica y la exploración física confirmaron los hallazgos. Se realizó resección de la primera costilla izquierda con escalenectomía anterior mediante un abordaje supraclavicular. La paciente no presentaba costilla cervical ni fibrosis en el sitio quirúrgico. No se reportaron complicaciones durante la hospitalización. Fue dada de alta a las 48 horas del procedimiento con rango completo de movimiento y asintomática. En el seguimiento a una semana no se observaron nuevas alteraciones.

Discusión: este reporte de caso demuestra la importancia de agotar todas las posibilidades en el diagnóstico del origen del SST y cómo los diferentes abordajes quirúrgicos ofrecen ventajas y desventajas.

Palabras clave: Síndrome de salida torácica (SST). Arterial. Supraclavicular.

INTRODUCTION

Thoracic Outlet Syndrome (TOS) encompasses multiple causes of neurovascular compression at a thoracic-axillary transition. TOS is classified into three categories: neurogenic (nTOS), venous (vTOS), and arterial (aTOS). More than 90 % of reported cases of TOS fall into the category of nTOS being the leading variant. Although TOS incidence is not well described in literature, an estimated 3-80 cases arise per 1000 inhabitants (1). The etiology of TOS includes congenital or anatomical variants, trauma (e.g., clavicle fractures), and repetitive strain injuries, particularly in athletes (1).

aTOS is the rarest variant of TOS; according to the literature, it accounts for approximately 1-2 % of all TOS cases (1). This vascular subtype is often linked to strenuous upper-limb activity, especially in athletes (2). Compression at the level of the subclavian artery in aTOS is generally attributed to congenital anomalies such as cervical ribs or an abnormal first rib. This compression can cause intimal arterial damage, turbulent flow, and vessel dilation, potentially

leading to arterial thrombosis with distal embolization and ischemia of the affected limb (1).

The clinical manifestations of aTOS may include (3):

- Claudication.
- Pallor.
- Pulselessness.
- Poikilothermy.
- Delayed capillary refill.
- Pain at rest in affected limb.
- Pain in the neck and shoulder region (less common compared to nTOS).

This case report has been written in accordance with the *2025 Surgical Case Report Guidelines (SCARE)* (4). Figure 1 shows the order of events from the patient's initial symptoms up to intervention and discharge.

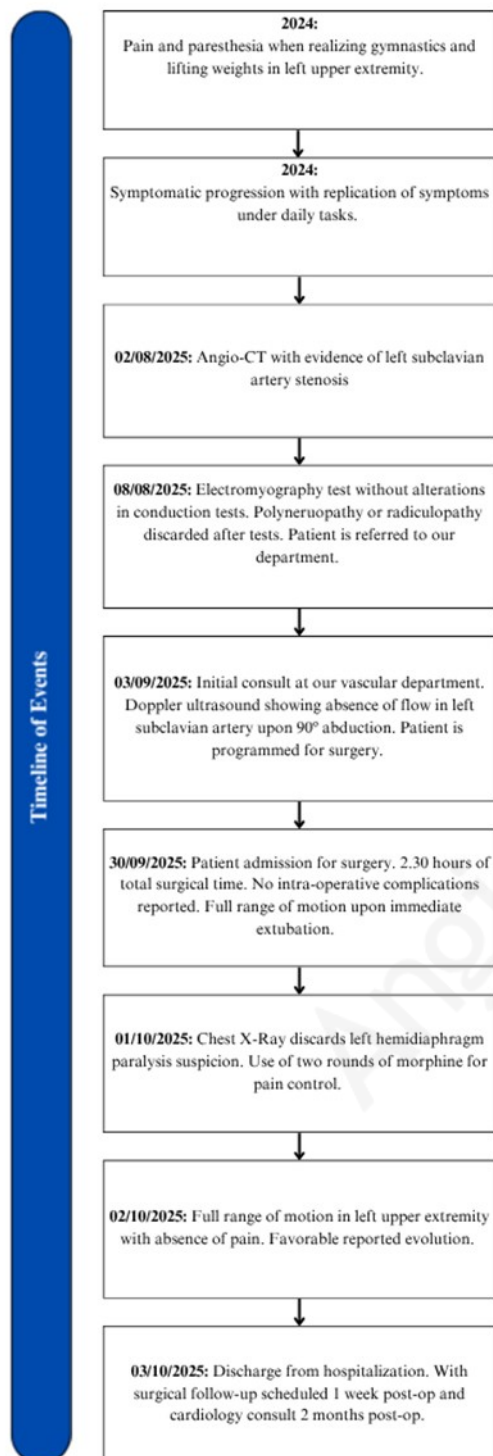


Figure 1. Timeline of events displayed in chronological order from top to bottom since patient's initial symptoms up to hospitalization and discharge. Date formatted in month/day/year (mm/dd/yyyy) where applicable.

CASE REPORT

A 20-year-old female was referred to our institution due to 1 year of pain and paresthesia in the left shoulder and neck region which began during weightlifting and gymnastics. She had to abandon her routine due to discomfort, however, the symptoms persisted and were replicated under less demanding tasks. The patient had no relevant personal medical or family history. She had an athletic complex, right-hand dominance and was a college student at presentation. She was first seen in another institution where a computerized tomography with angiography (CT-Angio) and electromyography (EMG) were done. Her initial presumptive diagnosis pointed out to a neurological problem but EMG discarded it; CT-Angio showed a stenosis in the left subclavian artery secondary to anterior scalene muscle hypertrophy with poor intravenous contrast flow in the distal third of the subclavian artery and proximal portion of axillary artery (Fig. 2). She was referred to our institution after discarding a neurological etiology.

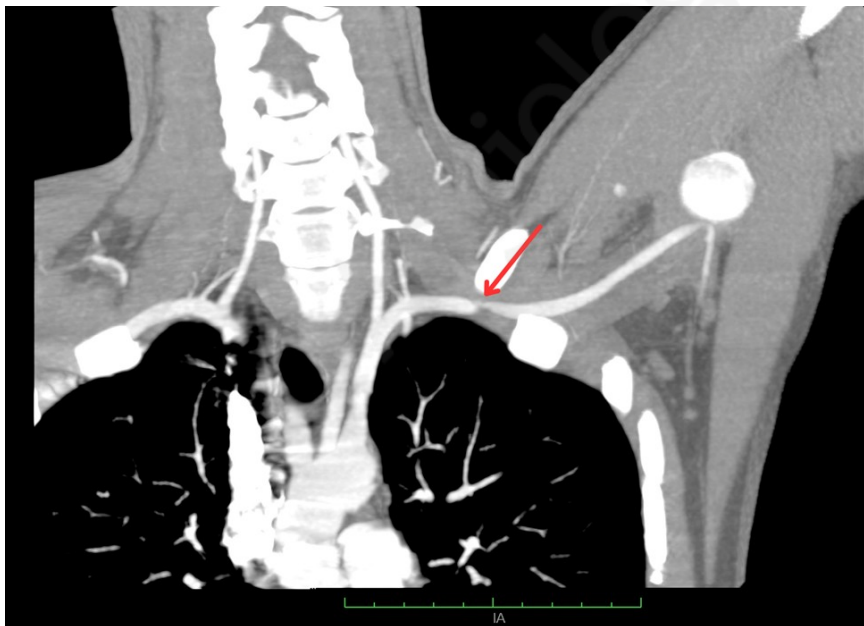


Figure 2. CT-Angio evidencing impingement of contrast flow when abducting left upper extremity to 90°. Compression seen in the distal third of the subclavian artery and near the proximal portion of the axillary artery (red arrow). CT-Angio, computerized tomography with angiography.

At our institution, a physical exam showed symptoms reported by the patient with abduction of the left upper extremity at 90°. The following findings were reported after the change of position: loss of the left radial pulse, decreased pulse intensity, and reduced pulse oximetry waveform. A duplex ultrasound was done showing changes in the left subclavian artery in the middle third portion upon abduction as seen in figures 3A and 3B. Similar results were found when focusing on venous vasculature in the region represented by figures 3C and 4D.

After dynamic imaging findings and physical evaluation, the patient was programmed for a left first rib resection with anterior scalenectomy.

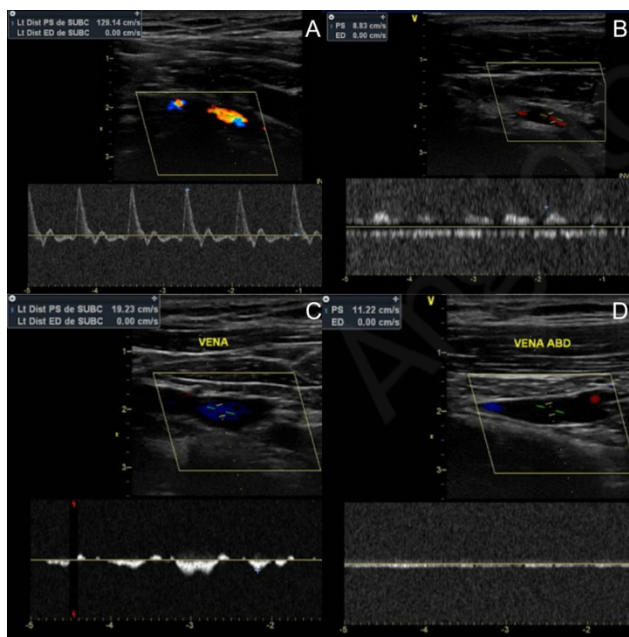


Figure 3. (A) Flow of left subclavian artery with arm relaxed. (B) Flow of left subclavian artery with abduction at 90°. (C) Flow of left subclavian vein with arm relaxed. (D) Flow of left subclavian vein with abduction at 90°.

On surgical day, per-op vitals were all within normal range. Lab values discarded: an active inflammatory process, kidney compromise, altered lipid parameters and coagulation times. No previous thrombolysis was indicated prior to surgery. General anesthesia was applied.

With the patient in decubitus supine position and neck extended to the right-hand side, the procedure started with a transverse cut approximately 2 cm over the left clavicle. Dissection by planes was performed until identifying the anterior scalene muscle and the phrenic nerve (Fig. 4A). Lymphatic tissue was also identified and separated from the surgical field prior to the scalenectomy of the anterior scalene muscle. Separation was done starting from the left subclavian artery in its origin (Fig. 4B) towards the left internal mammary artery and left vertebral artery until the left external mammalian artery. No visible compressible segment was seen during this first approach nor the presence of fibrosis throughout surgical field exposure. Further manipulation was done until reaching the left axillary artery where, under a replicated abduction movement with direct tactile feel over the area, a compression caused by the first left rib was confirmed. Separation of venous vascular counterparts was done prior to the resection of a fragment of approximately 5 cm in longitude of the first left rib (Fig. 5). A secondary abduction test was done after resection confirming disappearance of outlet compression. Hemostatic control with a saline air-leak test for pleural integrity was done before closure to discard any lesion. A drain was not left due to the absence of hemorrhage or lymphorrhagia intraoperatively. Complete gauze and compress count was reported with 50 ml reported in blood loss. Total surgical time was reported at around 2.30 hours.

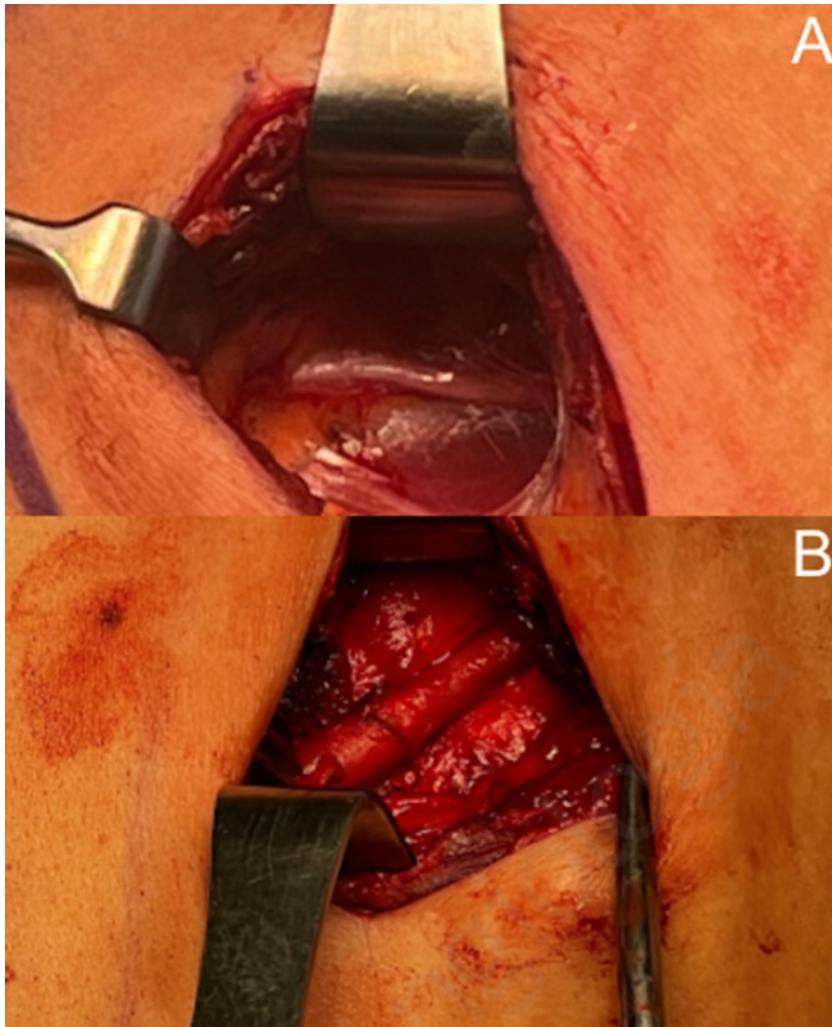


Figure 4. A. Left phrenic nerve. B Left subclavian artery.



Figure 5. First rib segment from resection with an approximate 5 cm in length.

Upon extubating, a physical examination was performed with the patient alert and oriented, with full range of motion, reporting only mild discomfort in the left shoulder region. Immediate post-op indications included: pain medication with 2.5 mg of intravenous morphine as a rescue drug, an antiplatelet regimen with 100 mg of oral aspirin once per day, free-roam with supervision in room, and unrestricted diet. The surgery was performed by the chief of the vascular department in a private institution; he reported no deviation from the original plan. The institute reports an estimated 8 cases of TOS with no distinction from aTOS, vTOS or nTOS. The procedure was done solely by the vascular surgery department.

A chest X-ray was done 12 hours post-op to discard left hemidiaphragm paralysis due to close proximity of manipulation to the phrenic nerve and patient reported discomfort in the immediate post-op. Morphine use was only reported twice during the first 12 hours post-op with complete absence of pain past the 24 hour mark. The patient was discharged 48 hours after procedure by joint orders with cardiology department prescribing a multivitamin supplement (350 mg ferrous fumarate, 1 mg folic acid, 25 g vitamin B₁₂, 600 mg vitamin C, 25.83 mg vitamin E) to be taken oral once daily for 2 months due to bordering iron deficiency anemia found on final lab report. She was scheduled for follow-up consult 1 week post-op where the original operating surgeon reported a fully healed surgical site, full range of motion

in left upper extremity and asymptomatic at time of evaluation. At time of article submission, she was scheduled for a consult to the cardiology department 2 months after surgery for the anemia. No further interventions nor hospitalizations were reported in a 30-day span since discharge.

DISCUSSION

Diagnosing aTOS is a challenge, as early stages may be confused with Raynaud's phenomenon. In a patient suspected of Raynaud's whose symptoms do not improve after treatment with calcium channel blockers, suspicion for aTOS should be raised.² A characteristic finding is a discrepancy in blood pressure between the upper extremities, where a difference greater than 20 mmHg is highly suggestive (1).

The diagnostic approach to aTOS is structured to confirm arterial involvement, characterize the underlying etiology, and guide management. Initial noninvasive testing typically includes duplex ultrasound with provocative maneuvers (e.g., arm abduction), which can detect dynamic changes in subclavian artery flow velocities. A greater than 50 % change in flow velocity with arm abduction is considered diagnostic for hemodynamically significant compression (5,6). Duplex ultrasound is highly sensitive for ruling out aTOS, and when combined with arterial hemodynamic assessment (e.g., pulse-volume recording, Doppler pressure measurement), its sensitivity and negative predictive value are further improved, making it an effective screening tool to determine the need for advanced imaging (5).

Imaging to define the underlying arterial etiology and anatomical site of compression is essential for surgical planning. Static imaging modalities such as computed tomography or magnetic resonance imaging can yield false negatives, particularly when performed solely at rest. Therefore, the use of dynamic CT-Angio or magnetic resonance angiography in both neutral and provocative positions is recommended. These modalities can identify the degree and site of stenosis, aneurysm formation, mural thrombus, or distal emboli, and can delineate predisposing anatomical factors such as cervical ribs, anomalous first ribs, scalene muscle variants, or fibromuscular bands (7). Dynamic CTA in particular correlates the severity of

vascular stenosis with symptoms and localizes the site of compression (e.g., interscalene triangle, costoclavicular space), which is critical for determining the underlying etiology (7).

For aTOS, surgical management is recommended as first-line treatment, unlike nTOS, where surgery is typically reserved for patients who fail therapeutic goals after 4 to 6 months of conservative therapy (1). First rib resection remains the gold standard for decompression, with three classical surgical approaches: supraclavicular, trans axillary, and infraclavicular (2).

The supraclavicular approach offers advantages such as ease of performing scalenectomy and rib resection, good visualization of the brachial plexus and subclavian artery, and suitability for arterial reconstruction. However, it has a less favorable cosmetic outcome and carries risks of injury to the brachial plexus, phrenic nerve, or long thoracic nerve (8). The trans axillary approach provides the best cosmetic result due to minimal dissection, but the limited surgical field hinders vascular repair and still carries a risk of brachial plexus injury (8). Literature reports a success rate of up to 77 % for supraclavicular rib resection with scalenectomy, compared to an approximate success rate of 76 % in trans axillary in symptom relief (8). The infraclavicular approach has the lowest risk of neurological injury and offers good access to anterior structures for vascular reconstruction, though it is more challenging for posterior manipulation (8). Another important consideration is the lesion's etiology—whether fibrosis or a cervical rib—since it influences surgical approach (1,8). In this case, neither a cervical rib nor fibrotic tissue were present.

In regards to complications, literature states a risk of pneumothorax, with rates of 19 % for the supraclavicular, 14 % for the trans axillary, and 7 % for the infraclavicular approach (8). This risk was considered, and special attention was paid during rib resection. Although no air leak was observed, a seal test was performed intraoperatively to assess for air bubbles. Manipulation of the nerve bundle, particularly the brachial plexus and phrenic nerve has also been reported stating a 3 % incidence of nerve injury with supraclavicular rib resection, 5 % with trans axillary, and nearly 0 % with infraclavicular approaches (8). In our case, a chest X-ray was requested due to manipulation near the left phrenic nerve and mild postoperative discomfort reported 12 hours after surgery. The absence of left hemidiaphragm paralysis and the resolution of symptoms ruled out this complication (8).

In recent years, however, surgical management has evolved toward minimally invasive techniques. Robotic-assisted thoracoscopic surgery (RATS) and video-assisted thoracoscopic surgery (VATS) have been shown to provide superior visualization, precise dissection, and reduced perioperative morbidity compared to traditional open approaches (9). Robotic approaches facilitate meticulous exposure of the neurovascular bundle and allow in bloc resection of compressive structures, which can be especially advantageous in cases with complex anatomy or cervical ribs (10).

CONCLUSION

In this case report, the combination of dynamic imaging and positional testing was essential in clarifying the source of the patient's symptoms and guiding the treatment strategy. The surgical plan was tailored to the patient's specific anatomy and pattern of compression, emphasizing the importance of selecting an approach that provides adequate exposure and safe manipulation of the involved structures. The main strength of this case lies in the methodical diagnostic sequence that helped identify a condition that initially appeared unrelated to its final etiology. A limitation found in this case was the lack of information regarding symptom evolution during the early course of the patient's complaint. Having a detailed evolution prior to symptom exacerbation could prove beneficial for future references in aTOS management.

Patient perspective

The patient reported anxiousness prior to the procedure with resolution after careful explanation and risk appraisal by the surgical team. After the procedure, she felt discouraged to move her left upper extremity due to the pain felt during the first hours post-op. Limb motion and usage improved throughout hospitalization related to pain cessation and adherence to medical indications.

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