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Cervical Rib Causing Thoracic Outlet Syndrome with Left Subclavian Artery and Vein Occlusion, Presenting in 38 Years Old Male: A Clinical Case Report and Its Literature Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Case Report

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ABSTRACT

Background: Thoracic outlet syndrome is a rare condition secondary to compression of neurovascular bundle in. Being physically active led to better prognosis. Literature shows a strong link between the thoracic and the thoracic area.
Introduction: TOS can present with arm pain and swelling, arm fatigue, paresthesia, weakness, and discoloration of the hand. TOS can be classified as neurogenic, arterial, or venous based on the compressed structure(s).
Methodology: This is a case presentation of our patient presented to us and was diagnosed with TOS, and then we have written its literature review article on the presentation and management of TOS discussed in PubMed indexed articles.
Results and Conclusion: Our patient was timely diagnosed and after managing the acute complication of TOS, such as pain and thrombosis, it was treated with surgical excision of extra rib, since then the patient is asymptomatic. Muscle hypertrophy is recognized as can induce vascular or neurogenic compression outlet syndrome and certain sports. Neurogenic manifestation is most common, presenting with Pain, numbness, tingling, weakness, and vasomotor changes of upper limb. Vascular complications of thoracic outlet syndrome are uncommon including thromboembolic phenomena and swelling. Both surgical and non-surgical Treatment whereas some non-surgical Treatment appears to be effective in some patients.
Despite advances, substantial controversy regarding the diagnosis remains. This is evidenced by the lack of objective findings surrounding TOS, the most common and widely disputed form of TOS. The challenges associated with diagnosis complicate the selection of the appropriate treatment option. In some cases, e.g., acute vascular insufficiency or progressive neurologic dysfunction, surgical decompression is clearly indicated. Prompt recognition and treatment of TOS provide the greatest opportunity for optimal recovery. Unfortunately, the multitude of nonspecific symptoms and challenges in diagnosis can delay treatment and increase the risk of complications. Surgical intervention for TOS syndrome is reserved for patients who have failed conservative management. Conservative treatment including physical therapy need be trialed for at least 4–6 months prior to consideration of surgical intervention.

Keywords: Thoracic outlet syndrome; extra cervical rib; pancoast tumor; rib pain; orthopedics.

1. INTRODUCTION

Thoracic outlet syndrome (TOS) encompasses a variety of conditions that causes the compression of neurovascular bundle as it exits the thoracic outlet. This outlet is an anatomical region located at the base of the neck, defined by three distinct spaces between the collarbone and the first rib, which include the scalene triangle, costoclavicular space, and sub coracoid space. These spaces allow critical neurovascular structures to pass through. The Structures include the brachial plexus, subclavian artery and subclavian vein. When this area is compressed, it leads to a variety of symptoms, such as upper limb pallor. Tingling sensations, weakness, muscle wasting and pain and swelling [1].

TOS is classified based on the underlying causes of symptoms, with the main subtypes being neurogenic, venous and arterial and mixed. Each of these categories can result from congenital factors, trauma, or functional changes acquired over time [2].

The diagnosis of TOS involves a detailed physical exam, focusing on the upper limbs and cervical spine and comparing the affected side to the unaffected one. Specific findings can vary depending on the type of: Thoracic outlet syndrome (TOS) encompasses a variety of conditions that causes the compression of the neurovascular bundle as it exits the thoracic outlet. This outlet is an anatomical region located at the base of the neck, defined by three distinct spaces between the collarbone and the first rib, which include the scalene triangle,

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TOS is classified based on the underlying causes of symptoms, with the main subtypes being neurogenic (ntos), venous (vtos) and arterial (atos) and mixed (mtos). Each of these categories can result from congenital factors, trauma, or functional changes acquired over time [4].

The diagnosis of TOS involves a detailed physical exam, focusing on the upper limbs and cervical spine and comparing the affected side to the unaffected one. Specific findings can vary depending on the type of tos .Arterial TOS might show significant differences in blood pressure between arms. While there can be swelling, discoloration and chest wall varicosities in chronic cases. Severe neurogenic TOS can cause muscle atrophy of the hand and forearm. ATOS v TOS can be diagnosed with CT scan mri and duplex by showing arterial or venous narrowing or clot. For suspected nTOS nerve conduction and electromyography studies can be conducted .Angiography is used to assess blood flow in suspected vascular TOS cases [5].

Managing tos involves a comprehensive approach, with treatment options varying based on the specific subtype. Physical therapy is often the primary focus in conservative treatment strategies but it also involves lifestyle changes, pain management and anticoagulant therapy. Injection therapy can temporarily alleviate symptoms and is considered a positive indicator for successful surgery. Surgery is generally recommended for patients who remain symptomatic after 4-6 weeks of conservative treatment or for those with vascular forms of TOS [6]. Arterial TOS might show significant differences in blood pressure between arms. While there can be swelling, discoloration and chest wall varicosities in chronic cases. Severe neurogenic TOS can cause muscle atrophy of hand and forearm. ATOS v TOS can be diagnosed with CT scan mri and duplex by showing arterial or venous narrowing or clot. For suspected nTOS nerve conduction and electromyography studies can be conducted. Angiography are used to assess blood flow in suspected vascular TOS cases [7].

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Epidemiology: Cervical ribs were found in 2.0% (67/3404) of the population. Of the 67 patients with cervical ribs, 27 (40.3%) had bilateral ribs. The prevalence of cervical ribs in women was twice that in men, 2.8% (39/1414) versus 1.4% (28/1990). Although African Americans accounted for 50.1% (1706/3404) and whites, 41.2% (1402/3404) of the patient population, African Americans were 70.1% (47/67) of patients with cervical ribs, whereas whites were 26.9% (18/67). Radiologists commented on 25.5% (24/94) of the cervical ribs in 25.4% (27/67) of patients.

Its incidence is 95% in neurogenic outlet syndrome and venous and arterial is 1% and 3% respectively. Venous thoracic outlet syndrome is associated with mechanical compression from repetitively overhead movements. Its range in the USA is 3-80 cases per 1000 population.

Sex and age related demographics: It's more common in women particularly with poor muscular development, poor posture, or both. Onset of symptoms typically occurs in persons aged 20-50 ears. Its uncommon in children [9].

2. CASE PRESENTATION

A patient of 38 years old presented to old for he complaint of bluish discoloration of left hand I it worsens on exposure to cold, itching, and relieved on warmth. he has no known premorbid conditions such as no diabetes Mellitus, no hypertension, no asthma no B mom smoker's patient Was in a usual state of health 7-8 das back when he developed bluish discoloration of fingers of left hand I was sudden in onset severe in pain, sever increasing in intensity on exposure to cold with itching. Pain relieved b exposure to

warmth. I was associated with pain parenthesis and itching. He experiences no triphasic color change, no oral ulcers, no alopecia, no photosensitivity no musculoskeletal weakness no dysphagia, no complain of arthritis, no complaint of epistaxis, nasal surgery, no hemoptysis, orv repeat sinuses. On cardiovascular inquiry no chest pain no shortness of breath, no palpitations, on CNS inquiry no seizure no headache no syncope. On respirator enquiry no cough, no fever, no gastrointestinal inquiry no diarrhea, no constipation, no hematemesis, no melena. on genitourinary inquiry no burning micturition m no hematuria, no froth urination.no past medical and surgical history. No personal or family history. No drug history .no drug or allergic history. On pulsation of the right upper limb ulnar, radial, brachial and dorsalis pedis is palpable. On left side of upper limb there is no ulnar, radial or brachial pulsation. No dorsal pedals pulsation. No posterior tibial pulsation. No carotid bruit, no renal bruit, No Aortic bruits. No Iliac bruits. On inspection of the respiratory system s1 $_s$s2 is audible**.**

Table 1. Baseline investigations: Complete blood profile

Name of investigation	Results at admission	Results at discharge	Normal Range	Unit
Hemoglobin	14	14	M=14-18 F= 11.7-15.7	mg/dl
W.B.C	6320	6320	15.6	x10^3/dl
Neutrophils	50%	50%	40-70%	x10^3/dL
Lymphocytes	21%	21%	20-25%	x10^3/dL
Monocytes	4%	4%	2-10%	x10^3/dL
Eosinophil	1%	1%	1-2%	x10^3/dL
Platelets Count	249	249	150-400	x10^6/L
Sodium	140	140	136-149	mmol/L
Potassium	4	4	3.8-5.2	mmol/L
Chloride	100	`100	98-107	mmol/L
Random Blood Sugar	100	105	80-140	mg/dl
Blood Urea	20	20	10-50	mg/dl
Alkaline Phosphatase	55	55	40-129	mg/dl
Serum Calcium (Total)	10	10	8.8-12.0	mg/dl
Total Bilirubin	.3	.3	0.1-1	mg/dl
Creatinine kinase	20	20	10-120	micrograms per liter (mcg/L)
ANF	Negative	Negative	negative	
ESR	10	10	0 to 15 mm/hr in men. 0 to 20 mm/hr in women	mm/hr
Ferritin	200	200	Male: 30 to 400 nanograms per milliliter (ng/mL) Female: 13 to 150 ng/mL	ng/mL
CRP	0.5	0.5	0.3 to 1.0	mg/dL
LDH	160	160	140 to 280	U/L
Anti CCP	10	10	less than 20 Units	
Urine R/E	Normal	Normal	looking for any nitrates and WBC, RBC and PH most of the time or amt sediments	
Serum procalcitonin	Less than 0.1	Less **than 0.1**	less than 0.1	ng/mL

2.1 All Investigations

X ray:

X Ray investigation reports of cervical rib have been depicted in Figs. 1 and 2.

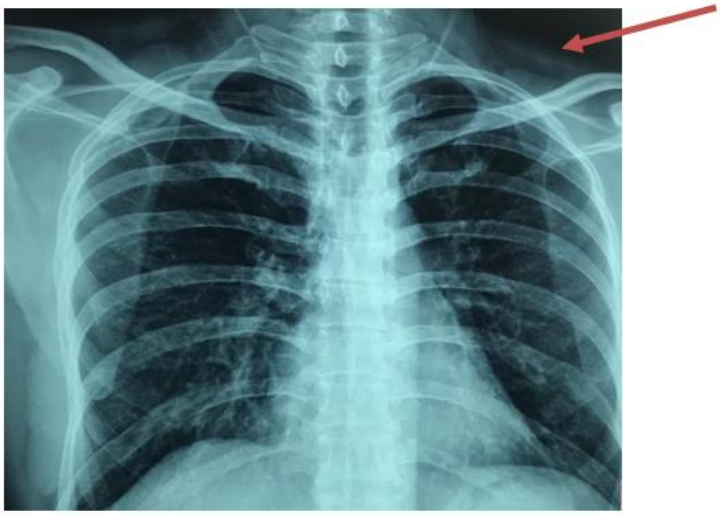

Fig. 1. X ray showing extra cervical rib on left side

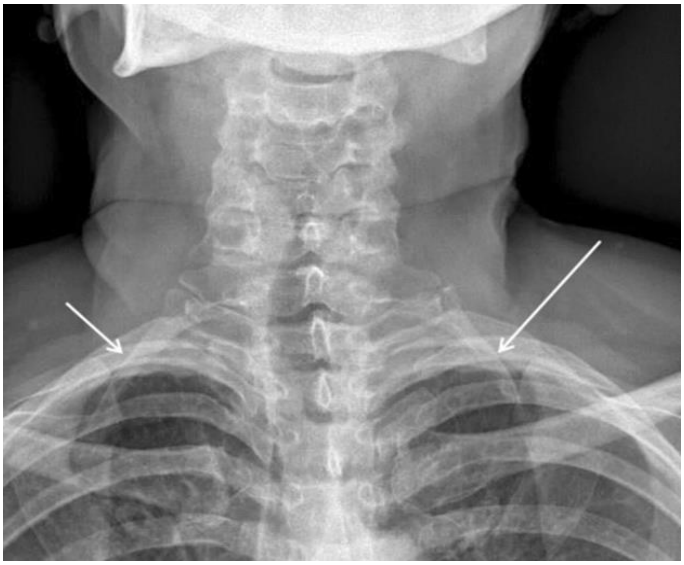

Fig. 2. Display the C7 vertebra prominently; ensuring it is the origin point of the extra cervical rib, there are bilateral extra cervical rib present seen in the X ray imaging

CT angiography of left upper limb: Aortic arch, right brachiocephalic trunk, right common carotid artery and left common carotid artery are normal contrast opacified. A filling defect is noted in the proximal left subclavian artery resulting in near complete occlusion. This segment lies 1cm distal to its origin from the aortic arch. The involved partly occluded segment has length of 2.5cm.mild to moderate compression of left subclavian artery is observed between first rib and scalenus anterior suggest thoracic outlet syndrome. There is no evidence of cervical rib. The left vertebral artery is patent. Res of subclavian artery and axillary artery are patent. No Ct evident. Visualizing lung apices appear normal.

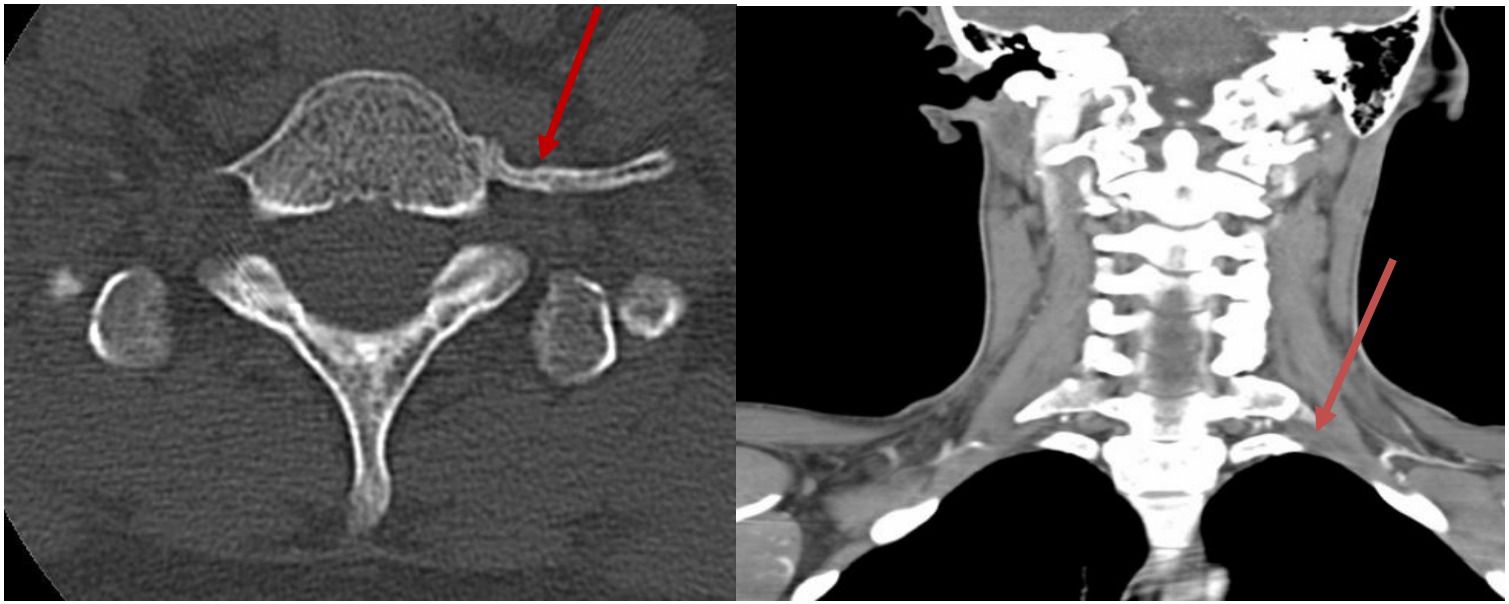

Fig. 3. Aortic arch, right brachiocephalic trunk, right common carotid artery and left common carotid artery are normal contrast opacified. A filling defect is noted in the proximal left subclavian artery resulting in near complete occlusion

Findings of CT scan:

1- Findings are suggestive of short segment partial thrombosis of left subclavian artery, rest of upper limb arteries is patent.

2-mild to moderate compression of left subclavian artery is observed between scalenus anterior and first rib suggestive of thoracic outlet syndrome.

2.2 ECHO: Normal Findings

Doppler ultrasound both leg: limb examination was performed using Doppler ultrasound imaging with special and colored. No detection flow in the left radial artery. Low velocity patch monophasic flow in left radial artery flow is noted in o left brachial are a hide image of scan IAL left upper.

Right upper extremity triplex imaging was performed with a high frequency linear array transducer. Triplex examination included imaging in the transverse, sagittal planes with both grayscale and color Doppler. Pulsed wave spectral Doppler data was also acquired for radial and ulnar arteries. Triphasic flow was noted in the right axillary, right brachial, right ulnar and right radial artery. V max of arteries of right upper limb is as follow:

- Right axillary artery -83.9cm/s
- Right brachial - 60.9cm/s
- Right ulnar – 29.8cm/s
- Right radial – 26.3cm/s

Summary: adequate flow in the arteries of right upper limb

Conclusion: Normal bilateral carotid ultrasound, highly suboptimal stud as origin of left subclavian artery is narrowed and on is location. However visualized proximal left subclavian artery is narrowed on and on spectral analysis showing biphasic flow and distally the left subclavian artery is normal showing triphasic flow. Findings are suggestive of partial stenosis of left subclavian artery a is origin.

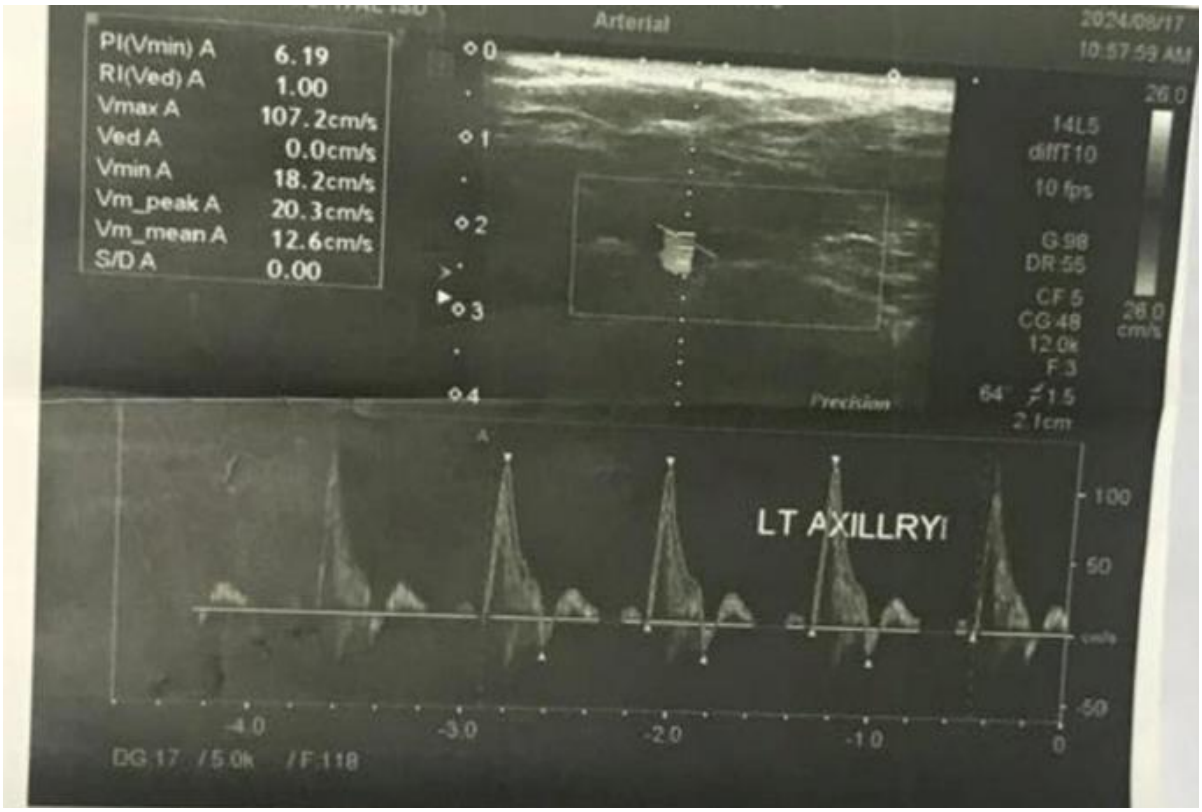

Fig. 4. Proximal left Axillary artery is narrowed o and on spectral analysis showing biphasic flow and distally he left subclavian artery is normal showing triphasic flow

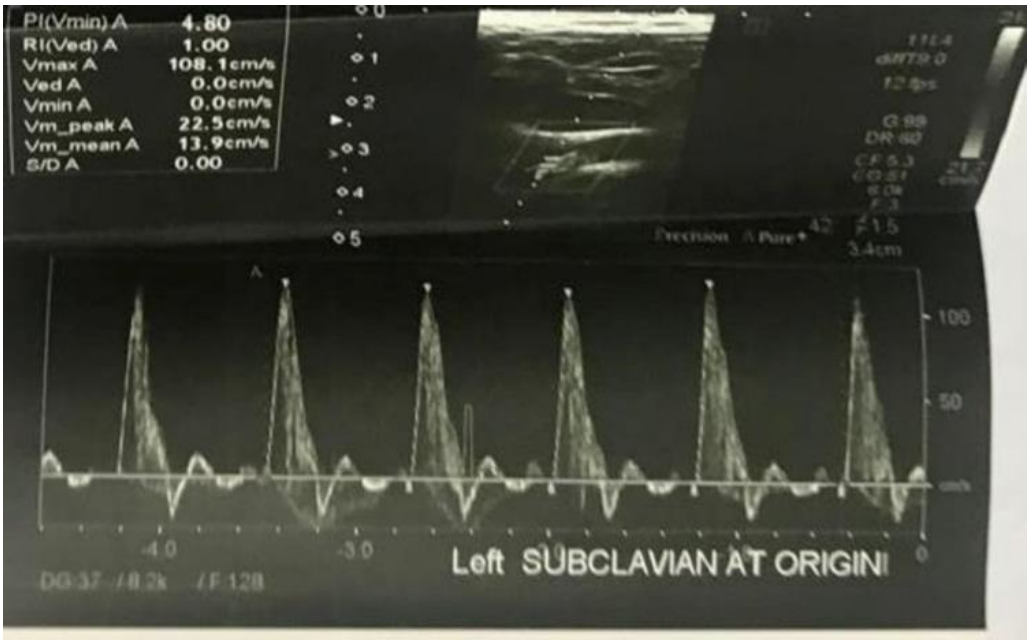

Fig. 5. Findings are suggestive of partial stenosis of left subclavian artery at its origin

Treatment:

Table 2. Treatment received. Inj. injection; Syp. Inf. infusion, ; Tab. tablet ; IV, intravenous; PO, per oral; TSF, teaspoon; OD, once daily; TDS, thrice daily; BD, twice daily

Serial No.	Name of a drug	Route of administration	Dosage	Duration
1.	Gtn Ointment	topical	As required	8 HOURL
2.	Capsule Gabica	Oral	75mg	HS
3.	**T**ablet **T**ramal plus	Oral		BD
4.	tablet Msdipine	Oral	30mg	BD
5.	tablet benpros**t**	Oral	20mg	OD
6.	Injection Heparin	IV	6000IU	BD
7.	tablet Loprin	Oral	75mg	OD
8.	tablet Risek	Oral	20mg	BD
9.	tablet Folic acid	Oral	5mg	OD
10.	tablet Xept	Oral	10mg	OD
Home Based Reamen:				
1.	Gn Ointmant	Opical	As required	8 HOURL
2.	Capsule Gabica	Oral	75mg	HS
3	**T**ablet **t**ramaul plus	Oral		BD
4	tablet Msdipine	Oral	30mg	BD
5.	tablet benpros**t**	Oral	20mg	OD
6.	Injection Heparin	IV	6000IU	BD
7.	tablet Loprin	Oral	75mg	OD
8.	tablet Risek	Oral	20mg	BD
9.	tablet Folic acid	Oral	5mg	OD
10.	tablet Xept	Oral	10mg	OD

Literature review:

Search strategy: To identify articles for inclusion in the meta-analysis, searches Were performed to September 2017 in the following databases; PubMed, EMBASE, Science Direct, and Other articles, published in Pakistan as well.

Etiology: some researchers suggest a vertebral column grows faster **t**han upper extremity thus leading to more suscep**t**ible **t**o neurovascular compression, with further scapular descent. Delay symptoms may last several weeks or acute trauma [10].

Treatment**:** thoracic outlet syndrome has persistent pain**,** muscle atrophy, or progressive deficit.

Prognosis: symptoms in 90% of patients are resolved with conservative therapy; postsurgical success rates over 1 ear vary from 43-78%.A total cure is not achievable with surgery.

Complication; Ischemic changes include gangrene; pulmonary embolism is reported in 0-28.5% of patients. Venous gangrene and upper extreme can lead to phlegm Asia. Nerve injury e.g. brachial plexus neurapraxia is most common complication of post-surgical. Bleeding can even occurred [11].

In-Hospital Complications and Incidence Rates in Patients Undergoing Surgical Treatment for Thoracic Outlet Syndrome (TOS):

Thoracic Outlet Syndrome (TOS) refers to a group of disorders caused by the compression of neurovascular structures (brachial plexus, subclavian artery, or subclavian vein) in the thoracic outlet. Surgical treatment is often required in severe cases, particularly when conservative management has failed. However, surgery for TOS is not without risk, and various complications can arise postoperatively, some of which are significant enough to impact clinical outcomes [12].

This report provides an overview of the common in-hospital complications observed in patients undergoing surgical treatment for TOS, along with the incidence rates of these complications and traditional clinical outcomes.

1. In-Hospital Complications

Surgical intervention for TOS, including procedures such as first rib resection, scalenectomy, or neurovascular decompression, carries potential risks. The most common in-hospital complications reported include:

a) Nerve Injuries:

- **Incidence**: 5-10%
- **Description**: Nerve injuries, particularly affecting the brachial plexus, are among the most concerning complications of TOS surgery. They can result in motor or sensory deficits in the upper limb. Transient neuropraxia (nerve bruising) is more common, but permanent nerve damage is rare.

b) Pneumothorax:

- **Incidence**: 2-5%
- **Description**: Pneumothorax occurs when air leaks into the space between the lung and chest wall, causing lung collapse. This complication is generally more common with procedures involving the transaxillary or supraclavicular approach, as the proximity to the pleura increases the risk of accidental puncture.

c) Vascular Complications:

- **Incidence**: 1-5%
- **Description**: Injuries to the subclavian artery or vein can occur during surgery, leading to hemorrhage, arterial embolism, or venous thrombosis. Vascular injuries may require immediate repair or grafting and are more common in cases of arterial or venous TOS.

d) Hematoma Formation:

- **Incidence**: 3-6%
- **Description**: Postoperative hematoma can develop due to bleeding during or after surgery. This complication may require drainage if it becomes large or causes compression of surrounding structures.

e) Chylothorax:

- **Incidence**: < 1%
- **Description**: A rare complication where lymphatic fluid leaks into the thoracic cavity due to injury of the thoracic duct. This may require thoracoscopic intervention or other drainage procedures [13].

f) Wound Infection:

- **Incidence**: 2-4%
- **Description**: Infections at the surgical site can occur but are generally low due to the use of prophylactic antibiotics. Treatment involves wound care and, in some cases, antibiotics.

g) Phrenic Nerve Injury:

- **Incidence**: < 1%
- **Description**: Injury to the phrenic nerve, which controls the diaphragm, can lead to diaphragmatic paralysis and breathing difficulties. This is rare but more likely in supraclavicular or transaxillary approaches.

h) Recurrence of Symptoms:

- **Incidence**: 5-15%
- **Description**: A significant number of patients may experience a recurrence of symptoms postoperatively, often due to inadequate decompression, scar tissue formation, or other postoperative anatomical changes.

2. Incidence Rates of Traditional Clinical Measures of Outcome

Traditional clinical measures used to evaluate the success of TOS surgery and patient outcomes include symptom relief, functional recovery, and long-term recurrence rates. The incidence of successful outcomes versus complications varies based on the type of TOS, the surgical technique used, and the individual patient's condition.

a) Symptom Relief:

- **Incidence**: 70-85%
- **Description**: The majority of patients report significant improvement or resolution of symptoms postoperatively, particularly in cases of neurogenic TOS. Outcomes for arterial and venous TOS are also favorable, but recovery may take longer [14].

b) Functional Recovery:

- **Incidence**: 60-75%
- **Description**: Most patients regain full or near-full functionality in the affected arm and shoulder after rehabilitation, particularly in terms of strength and range of motion. Neurogenic TOS patients often experience the most notable improvement in pain and numbness.

c) Recurrence of TOS Symptoms (Long-Term):

- **Incidence**: 5-25% (depending on the type of TOS)
- **Description**: Symptom recurrence remains a concern in a subset of patients. Neurogenic TOS has a higher recurrence rate, particularly in cases where surgery did not fully alleviate compression or where scar tissue forms postoperatively.

d) Postoperative Pain:

- **Incidence**: 10-20%
- **Description**: Some patients may experience chronic postoperative pain, which can persist long after the surgery, particularly in cases of nerve irritation or incomplete decompression. This is more common in neurogenic TOS.

e) Rehospitalization and Reoperation Rates:

- **Incidence**: 5-10% (rehospitalization), 3-7% (reoperation)
- **Description**: Complications requiring rehospitalization or further surgery are relatively uncommon but can occur, particularly in cases of recurrent TOS, vascular complications, or severe nerve damage [15].

Physical Examination: physical examination includes evaluation of cervical spine, shoulder, and upper extremity. Attention should be given to evaluation of head, neck and shoulder, Thoracic kyphosis should be keep in mind, pain overall posture re should be assessed. Comparing the upper limb of each other, regarding skin, color, Temperature, hair distribution, muscle atrophy and nail change. Gil muscle sumner hand finds atrophy of abductor pollicis brevis and o lesser degree hypothenar and o lesser extension in**t**erosseous**.** A BP difference of 20 MMHG between two extremities is a significant finding of Vascular TOS. Upper limbs and chest may be congested and edematous with prominent superficial veins in venous Tos and hence appear to be paler. Distal skin changes, ulceration, and signs of micro embolic events can even occur. Palpation of the supraclavicular

region may reveal some masses and tenderness. Vascular examination emphasizes the quality of radial pulse with different positions of arms.

1-Wright test: is described as decrease in radial pulse with the arm in hyper abduction and external rotation, with head turned in opposite direction**.**

2-Adson Test: is described as bringing the arm in extension, asking the patient to take a deep breath, and turning towards the affected side**.**

3-Roos Test: is more reliable test for tOS it's and elevated arm stress test. In this maneuver the patient places both arms in a 90 abducted position with elbows flexed to 90. Hands are hen opened and closed for 3 minutes. Normal people have minor fatigue while tOS patients have dramatic symptoms and discomfort. Some are even unable to do th*is* test due to pain.

Clinicians have done many trials showing that compression of subclavian arteries can lead to reduced blood supply and compression can further cause ischemia. Though treatment is possible through man exercise but it's not effective in our case. In our case vasodilators and anticoagulants are given so that blood flow can be increased. Supraclavicular region is most for Tos. Tos is associated with compression of blood vessels and nerves leading to various symptoms. Ongoing researches are done to further improve and manage the toS.[6]

Different surgical techniques for correction of TOS:

Thoracic Outlet Syndrome (TOS) is a condition involving compression of neurovascular structures (nerves, arteries, or veins) at the thoracic outlet, which can lead to pain, numbness, and other symptoms in the shoulder, arm, and hand. Several surgical techniques are employed depending on the type and severity of the syndrome. Here are the most common ones:

1. Transaxillary First Rib Resection

- **Description**: The transaxillary approach involves removing part of the first rib through an incision in the armpit (axilla). This method allows access to the compressed area without disturbing major chest muscles.
- **Indications**: Primarily used for neurogenic TOS (nerve compression) or in some cases of venous TOS.
- **Advantages**: Less invasive; minimal scarring since the incision is hidden in the armpit.
- **Disadvantages**: Limited visibility for the surgeon, which can make the procedure technically challenging. There is also a risk of damaging nerves and blood vessels.

2. Supraclavicular Decompression

- **Description**: This technique involves an incision just above the collarbone (clavicle) to remove the first rib or portions of the scalene muscles that may be causing the compression. It also allows for resection of fibrous bands or cervical ribs if present.
- **Indications**: Useful for neurogenic and arterial TOS, and provides excellent exposure of the brachial plexus and subclavian vessels.
- **Advantages**: Superior visualization of the brachial plexus and surrounding structures. Better for cases with arterial or nerve involvement.
- **Disadvantages**: More visible scarring, and the procedure may require longer recovery compared to transaxillary approaches.

3. Infraclavicular First Rib Resection

- **Description**: This approach is performed through an incision below the collarbone, offering direct access to the thoracic outlet. It allows for resection of the first rib and decompression of neurovascular structures.
- **Indications**: Primarily used for venous TOS when there is compression of the subclavian vein.
- **Advantages**: Provides direct access to the vein and nerves. Preferred for cases where the subclavian vein is compressed or thrombosed (Paget-Schroetter syndrome).
- **Disadvantages**: Larger incision and more tissue dissection, resulting in a longer recovery period.

4. Video-Assisted Thoracoscopic Surgery (VATS)

- **Description**: A minimally invasive surgical technique using small incisions and a camera (thoracoscope) to guide the removal of the first rib or other compressing structures.
- **Indications**: Typically used for neurogenic and venous TOS.

- **Advantages**: Minimally invasive, resulting in less pain, faster recovery, and reduced scarring.
- **Disadvantages**: Requires a high degree of surgical expertise and may not be suitable for all cases.

5. Scalenectomy (Scalene Muscle Removal)

- **Description**: In some cases, especially for neurogenic TOS, the compression is caused by hypertrophy or abnormal positioning of the scalene muscles. The scalene muscles are partially or completely removed to alleviate the compression.
- **Indications**: Neurogenic TOS with evident compression from the scalene muscles.
- **Advantages**: Directly addresses muscle-related compression.
- **Disadvantages**: May not resolve symptoms if other structures are involved in the compression.

6. Clavicle Resection or Cervical Rib Resection

- **Description**: If a cervical rib or abnormal bony structure is present, part of it can be surgically removed to relieve pressure on the nerves or blood vessels.
- **Indications**: Specifically indicated for cases involving congenital cervical ribs or bony anomalies contributing to TOS.
- **Advantages**: Direct treatment of the underlying anatomical cause.
- **Disadvantages**: Potential for complications related to bone removal.

Each of these techniques has its own set of risks and benefits, and the choice of procedure depends on the specific type of TOS (neurogenic, venous, or arterial) and the patient's individual anatomy [16].

Transaxillary Thoracic Outlet Decompression in Thoracic Outlet Syndrome (TOS): Procedure and Outcomes:

Introduction: Transaxillary thoracic outlet decompression is a common surgical approach used to treat Thoracic Outlet Syndrome (TOS), especially in cases of neurogenic and venous TOS. This minimally invasive procedure focuses on decompressing neurovascular structures by resecting the first rib, thereby relieving the pressure on the brachial plexus and/or subclavian vessels. Procedure: Transaxillary Thoracic Outlet Decompression.

1. **Patient Positioning and Incision**:

   - The patient is positioned supine with the arm of the affected side elevated to provide access to the axilla.

2. **Muscle and Rib Exposure**:

   - The pectoralis minor and scalene muscles are retracted or partially divided to expose the first rib. Care is taken to avoid injury to the brachial plexus, phrenic nerve, and subclavian vessels.

3. **First Rib Resection**:

   - The surgeon removes a portion of the first rib, which is often the main structure causing compression in TOS. In some cases, other anatomical abnormalities like fibrous bands or hypertrophied scalene muscles are also addressed.

4. **Wound Closure**:

   - After ensuring that all neurovascular structures are decompressed and no complications have arisen, the incision is closed in layers.

Postoperative Care:

- Patients are typically monitored for a short period postoperatively to observe for complications such as pneumothorax, nerve injuries, or hematoma formation.
- Pain management, early mobilization, and physical therapy are crucial for recovery and the prevention of stiffness or chronic pain.

Outcomes of Transaxillary Thoracic Outlet Decompression:

1. **Symptom Relief**:

   - **Success Rates**: Studies report that **70-85%** of patients experience significant symptom relief following transaxillary thoracic outlet decompression. This includes improvement in pain, numbness, and functional impairments in the affected limb.

- **Neurogenic TOS**: This procedure is particularly effective for neurogenic TOS, where relief of nerve compression often results in improved motor and sensory function.
- **Venous TOS**: For patients with venous TOS, decompression reduces venous congestion, and in some cases, additional procedures like venoplasty may be required.

2. **Functional Outcomes**:

- **Functional Recovery**: Most patients regain functional use of the affected arm and shoulder within a few months of surgery. This includes the restoration of strength, range of motion, and overall limb function.
- **Physical Therapy**: Postoperative rehabilitation is key to achieving optimal functional recovery. Physical therapy begins within days of surgery and focuses on strengthening and mobility exercises.

3. **Complications**:

- **Nerve Injuries**: Incidence of **5-10%**.
- **Pneumothorax**: This complication occurs in **2-5%** of cases and is usually managed with observation or chest tube placement.
- **Vascular Complications**: The risk is higher in venous TOS, where compression of the subclavian vein can lead to thrombosis or hemorrhage.
- **Wound Infection and Hematoma**: Incidence rates for wound infections are **2-4%**, while hematoma formation occurs in **3-6%** of patients.
- **Long-Term Outcomes**:
- **Symptom Recurrence**: Although most patients achieve good long-term outcomes, symptom recurrence occurs in **5-15%** of cases.
- **Chronic Pain**: Some patients may develop chronic pain postoperatively, which can be challenging to manage.
- **Reoperation Rates**: Reoperation rates are low, typically around **3-7%**, and are generally performed in cases of recurrent symptoms or complications.

4. **Patient Satisfaction**:

- Overall, patient satisfaction following transaxillary thoracic outlet decompression is high, especially in those who experience significant symptom improvement and functional recovery.

Associations:

Turner syndrome
Cleidocranial dysplasia
Aarskog syndrome
Trisomy 8 syndrome
Fifteen thoracic vertebrae, each with a pair of ribs: isolated case report [17].

Differentials for thoracic outlet syndrome:

1. Cervical radiculopathy
2. Carpal tunnel syndrome
3. Rotator cuff injury or impemgiment syndrome.
4. Pancoast tumor.
5. Brachial plexopathy
6. Subclavian steal syndrome
7. Peripheral nerve entrapment syndrome
8. Shoulder Bursitis
9. Raynaud's Disease/Phenomenon
10. Complex Regional Pain Syndrome (CRPS)
11. Myofascial Pain Syndrome
12. Anterior Scalene Syndrome

Investigations: 1. **Clinical** Examination and Provocative Tests, Adson's Test**, roos and wright tests etc.**

2. Imaging Studies includes a) **X-Ray (Plain Radiography),** b) **MRI (Magnetic Resonance Imaging), c**) **CT Angiography (CTA),** d) **Venography** e) **Ultrasound (Doppler).**

f) Dynamic Magnetic Resonance Angiography (MRA)

- **Purpose**: MRA is often used in conjunction with provocative positioning to evaluate blood flow and vessel integrity.
- **Findings**: This imaging study can assess both vascular and neurogenic TOS by identifying changes in arterial or venous flow during arm movements that mimic the patient's symptoms.

Electrophysiological Studies:

a. **Nerve Conduction Studies (NCS)**
b. **Electromyography (EMG)**
c. **Somatosensory Evoked Potentials (SSEPs)**

Provocative Testing with Imaging
Digital Subtraction Angiography (DSA)
Dynamic CT or MRI:
Vascular Studies

Arterial and Venous Duplex Ultrasound
Pulse Volume Recording (PVR)
Ankle-Brachial Index (ABI)

With all evaluation, we have come to know that exercise therapy has a good effect on patients; exercise is beneficial in reducing pain even. Resistive exercise has proven to reduce VAS level significantly. Few conclusions have shown more effective results with the medication even. In shorter period more effective treatment can be possible. Half of the patients were almost cured. Physical activity has shown more improvement. Follow up of more 6 ears is seen mostly cases [18].

3. DISCUSSION

The prevalence of CR is underreported because they are found incidentally on radiography or only if associated with symptoms. The presence of CR can result in thoracic outlet syndrome (TOS) and symptoms such as ipsilateral limb pain, weakness, numbness, or cold intolerance. TOS develops from neural and/or vascular compression of the structures traversing the interscalene triangle, which is bordered by the anterior scalene muscle anteriorly, middle scalene muscle posteriorly, and superior border of the first rib inferiorly.

A significant development within the vascular surgery community focused on treatment of TOS was the development and adoption of standardized diagnostic criteria. These include the SVS and CORE-TOS criteria, which also have been adopted in modified form by this workgroup. Similarly, the neurosurgical community, through the section of peripheral nerve surgery of the European Association of Neurosurgical Societies recently adopted consensus statements focused on anatomy, diagnosis and classification of TOS. A follow-up publication provided consensus recommendations for management of NTOS. Within the orthopedic and plastic hand surgery community, however, there remains a significant variation in clinical practice ranging in all aspects from tools used for diagnosis of NTOS to indications and techniques for surgical management of NTOS.

Regarding specific surgical details, the majority of the workgroup used an anterior supraclavicular approach for exposure of the supraclavicular brachial plexus, with an infraclavicular approach and adjunctive procedures for select patients. An anterior supraclavicular approach is also the preferred surgical approach by the neurosurgical consensus group. The trans axillary approach remains uncommonly used by hand surgeons in general, though two members of the workgroup used this as the first line approach to the supraclavicular brachial plexus. This may reflect region-specific surgical preferences.

4. CONCLUSION

The upper extremity pain and numbness typical of the condition have been subcategorized into distinct disorders based on the structures involved. A history of trauma or repetitive motions combined with supportive physical exam findings suggests the correct diagnosis. Other diagnostic modalities such as MRI, ultrasound, and nerve conduction studies can further support the diagnosis, and ongoing developments in this sphere are currently underway. Patients develop TOS secondary to congenital abnormalities such as cervical ribs or fibrous bands originating from a cervical rib leading to an objectively verifiable form of TOS. The treatment is surgery. By 8 weeks postoperatively, patients can begin resistance strength training. Surgical treatment complications include injury to the subclavian vessels potentially leading to exsanguination and death, brachial plexus injury, hemothorax, and pneumothorax. Despite advances, substantial controversy regarding the diagnosis remains. This is evidenced by the lack of objective findings surrounding nTOS, the most common and widely disputed form of TOS. The challenges associated with diagnosis complicate the selection of the appropriate treatment option. In some cases, e.g., acute vascular insufficiency or progressive neurologic dysfunction, surgical decompression is clearly indicated. Prompt recognition and treatment of TOS provide the greatest opportunity for optimal recovery. Unfortunately, the multitude of nonspecific symptoms and challenges in diagnosis can delay treatment and increase the risk of complications.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

CONSENT

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Aljabri B, Al-Omran M. Surgical management of vascular thoracic outlet syndrome: A teaching hospital experience. Ann Vasc Dis. 2013;6(1):74–79.
2. Huang, Jason HMD, Zager, Eric LMD. Thoracic outlet syndrome. Neurosurgery. October 2004;55(4):897-903.
   DOI: 10.1227/01.NEU.0000137333.04342.4D
3. Arthur LG, Teich S, Hogan M, Caniano DA, Smead W. Pediatric thoracic outlet syndrome: a disorder with serious vascular complications. J Pediatr Surg. 2008 Jun. 43(6):1089-94.
4. Peet RM, Henriksen JD, Anderson TP, Martin GM: Thoracic-outlet syndrome: Evaluation of a therapeutic exercise program. Proc Staff Meet Mayo Clin. 1956;31(9):281–287.
5. Nakatsuchi Y, Saitoh S, Hosaka M, Matsuda S, Conservative treatment of thoracic outlet syndrome using an orthosis, J Hand Surg Br. 1995;20:34-39.
6. Laulan J, Fouquet B, Rodaix C, Jauffret P, Roquelaure Y, Descatha A. Thoracic outlet syndrome: Definition, aetiological factors, diagnosis, management and occupational impact. Journal of occupational rehabilitation. 2011 Sep 1;21(3):366-73.
7. Yin ZG, Gong KT, Zhang JB. Outcomes of surgical management of neurogenic thoracic outlet syndrome: a systematic review and Bayesian perspective. J Hand Surg Am. 2019;44: 416.e1-416.e17.
8. Martinez BD, Wiegand CS, Evans P, Gerhardinger A, Mendez J. Computer-assisted instrumentation during endoscopic transaxillary first rib resection for thoracic outlet syndrome: a safe alternate approach. Vascular. 2005;13:327–35.
9. Abdellaoui A, Atwan M, Reid F, Wilson P. Endoscopic assisted transaxillary first rib resection. Interact Cardiovasc Thorac Surg. 2007;6:644–6.
10. Furushima K, Funakoshi T, Kusano H, Miyamoto A, Takahashi T, Horiuchi Y, et al. Endoscopic-assisted transaxillary approach for first rib resection in thoracic outlet syndrome. Arthrosc Sports Med Rehabil. 2021;3: e155–62.
11. Satake H, Honma R, Nito T, Naganuma Y, Shibuya J, Maruyama M, et al. Midterm results of endoscopically assisted first rib resection in the zero position for thoracic outlet syndrome. Interact Cardiovasc Thorac Surg. 2022;35:ivac239.
12. Fried SM, Nazarian LN. Dynamic neuromusculoskeletal ultrasound documentation of brachial plexus/thoracic outlet compression during elevated arm stress testing. Hand (N Y). 2013;8: 358–65.
13. Dahlstrom KA, Olinger AB. Descriptive anatomy of the interscalene triangle and the costoclavicular space and their relationship to thoracic outlet syndrome: a study of 60 cadavers. J Manipulative Physiol Ther. 2012;35:396–401.
14. Alnahhal KI, Penukonda S, Lingutla R, Irshad A, Allison GM, Salehi P. The effects of major depression disorder on neurogenic thoracic outlet syndrome surgery outcomes. Vascular. 2023;31:359–68.
15. Kocher GJ, Zehnder A, Lutz JA, Schmidli J, Schmid RA. First rib resection for thoracic outlet syndrome: the robotic approach. World J Surg. 2018;42:3250–5.
16. Citisli V. Assessment of diagnosis and treatment of thoracic outlet syndrome, an important reason of pain in upper extremity, based on literature. J Pain Relief. 2015;04(02):1–7.
17. Abdolrazaghi H, Riyahi A, Taghavi M, Farshidmehr P, Mohammadbeigi A. Concomitant neurogenic and vascular thoracic outlet syndrome due to multiple exostoses. Ann Card Anaesth. 2018;21(1):71–73.
18. Ingegnoli F, Gualtierotti R, Orenti A, et al. Uniphasic blanching of the fingers, abnormal capillaroscopy in

nonsymptomatic digits, and autoantibodies: expanding options to increase the level of suspicion of connective tissue diseases beyond the classification of Raynaud's phenomenon. J Immunol Res. 2015;2015:371960.

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