

THORACIC OUTLET SYNDROME ANAESTHESIA TUTORIAL OF THE WEEK 286

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QUESTIONS

Before continuing, try to answer the following questions. The answers can be found at the end of the article, together with an explanation.

1. Which of the following are transmitted through the thoracic outlet?
 - a. Internal jugular vein
 - b. Thoracic duct
 - c. Trachea
 - d. Oesophagus
 - e. Brachial plexus
2. List 5 different causes of thoracic outlet syndrome.
3. The following are important anaesthetic considerations in surgical correction of thoracic outlet syndrome.
 - a. Risk of haemorrhage
 - b. Risk of air embolus
 - c. Invasive monitoring with an arterial line is often required
 - d. Post-operative bleeding will be seen by closely monitoring losses into drains
 - e. All patients should have a chest x-ray performed in recovery

INTRODUCTION

Thoracic outlet syndrome (TOS) refers to a constellation of symptoms caused by compression of the neurovascular bundle of the upper limb as they pass between the uppermost rib and clavicle en route to the axilla. Precise symptoms depend on the component affected – the brachial plexus, subclavian artery or subclavian vein – giving rise to neurogenic, arterial or venous TOS, respective

AETIOLOGY

Compression of the neurovascular bundle can be caused by congenital or acquired soft tissue and bony abnormalities. (table 1)

Any process that narrows the passage through which these important neurovascular structures pass can lead to symptoms of thoracic outlet syndrome. Major locations of compression of the neurovascular structures include over the first rib, behind pectoralis minor and within the scalene muscle triangle.

Table 1. Causes of thoracic outlet syndrome

Skeletal Factors (30%)	Soft Tissue Abnormalities	
	Congenital	Acquired
Cervical rib (figure 1 & 2)	Fibrous bands	Post-traumatic fibrous scarring
Elongated C7 transverse process	Variations in scalene muscle insertion	Post-operative scarring
Exostosis / tumour of 1 st rib or clavicle	Supernumerary muscles	Space-occupying lesion (Pancoast's tumour, cysts)
Excess callus following fracture of 1 st rib or clavicle		Soft tissue inflammation
Bifid clavicle		Hypertrophic muscles (athletes, swimming)
1 st / 2 nd rib fusion		Poor posture and weak muscular support

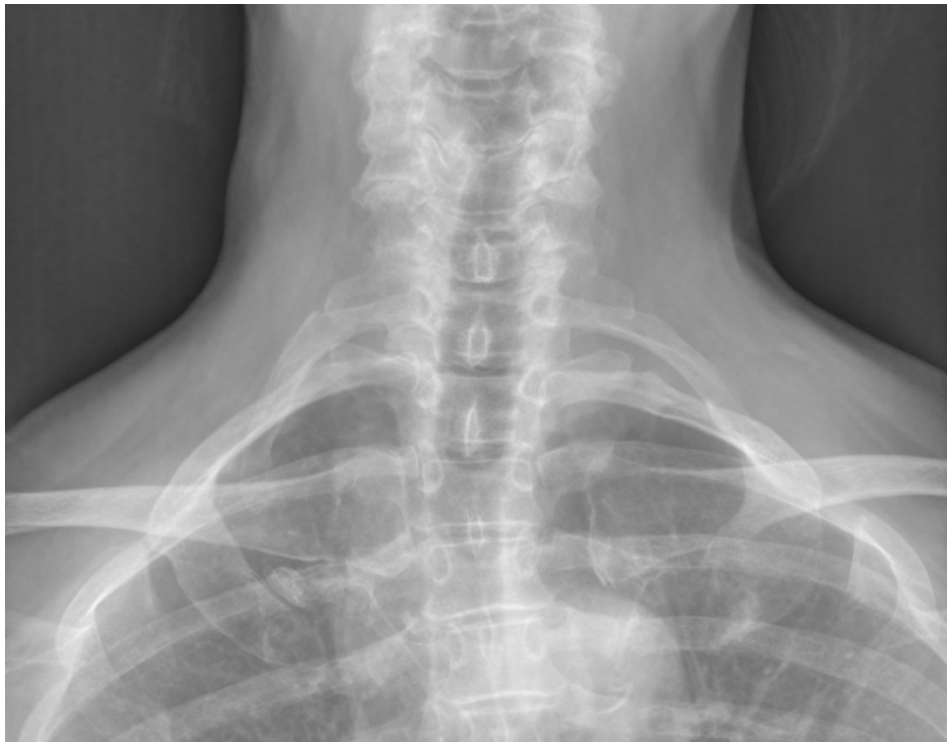


Figure 1. Chest radiograph showing bilateral cervical ribs



Figure 2. 3D CT reconstruction demonstrating a cervical rib with a small subclavian aneurysm located just distal to the tip of the cervical rib.

RELEVANT ANATOMY

The relations of the thoracic outlet are the body of T1 posteriorly, the medial borders of the first ribs laterally and the superior border of the manubrium anteriorly (figure 3). It transmits the oesophagus, trachea, thoracic duct, phrenic, vagus and recurrent laryngeal nerves, sympathetic trunks, common carotid and subclavian arteries, internal jugular, brachiocephalic and subclavian veins.

The brachial plexus emerges between scalenus anterior and scalenus medius, superior to the thoracic outlet, and runs over the first rib into the axilla. It is accompanied by the subclavian artery, which becomes the axillary artery at the lateral border of the first rib.

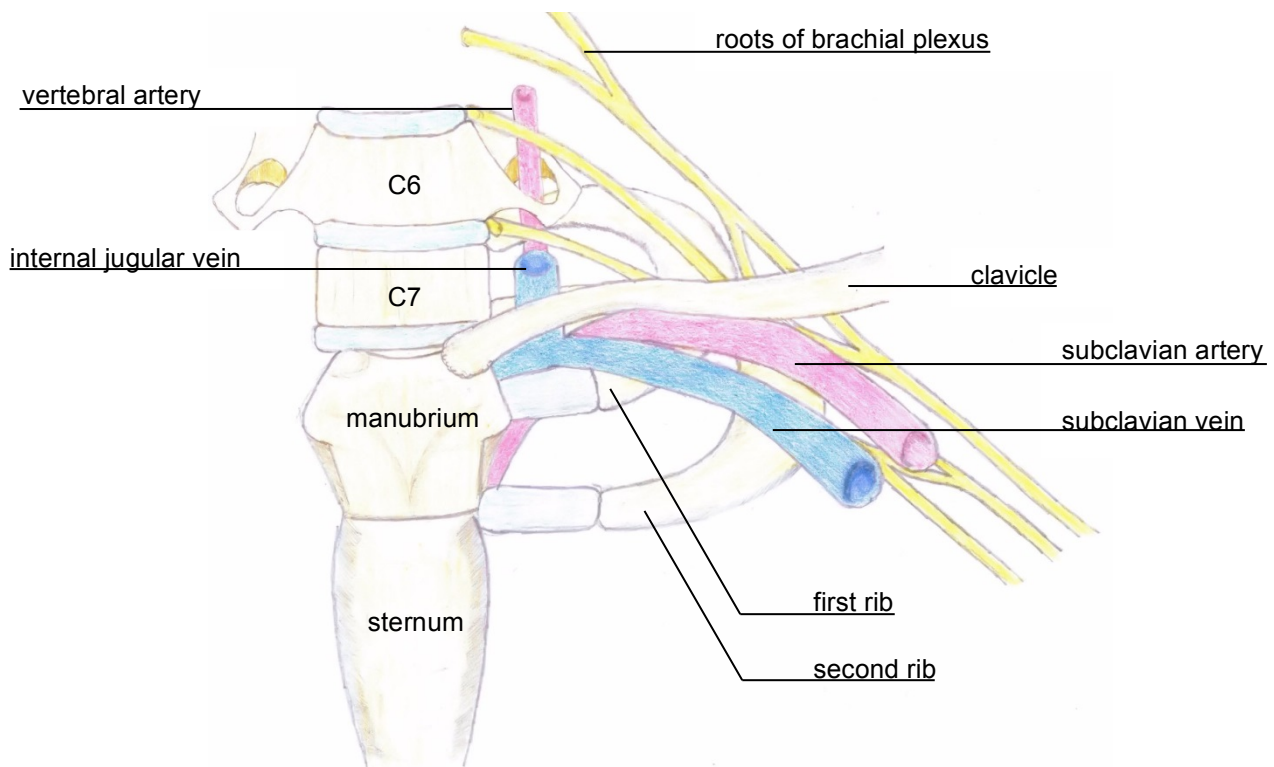


Figure 3. Anatomy of the thoracic outlet, demonstrating subclavian artery, vein and brachial plexus passing between the clavicle and first rib

INCIDENCE

TOS most commonly affects young females aged between 20 and 40 years of age, with a 4:1 female to male preponderance. Traumatic causes of thoracic outlet syndrome have an equal sex distribution.

CLINICAL PRESENTATION & DIAGNOSIS

Neurogenic

This refers to compression of the brachial plexus (figure 4), and accounts for the majority of cases of TOS, with symptoms reflecting the nerve roots involved. Symptoms do not follow a dermatomal distribution, distinguishing TOS from radicular nerve pathology.

90% of cases involve the C8 and T1 nerve roots causing pain and paraesthesia in an ulnar nerve distribution and wasting of abductor pollicis brevis, the hypothenar eminence and interossei.

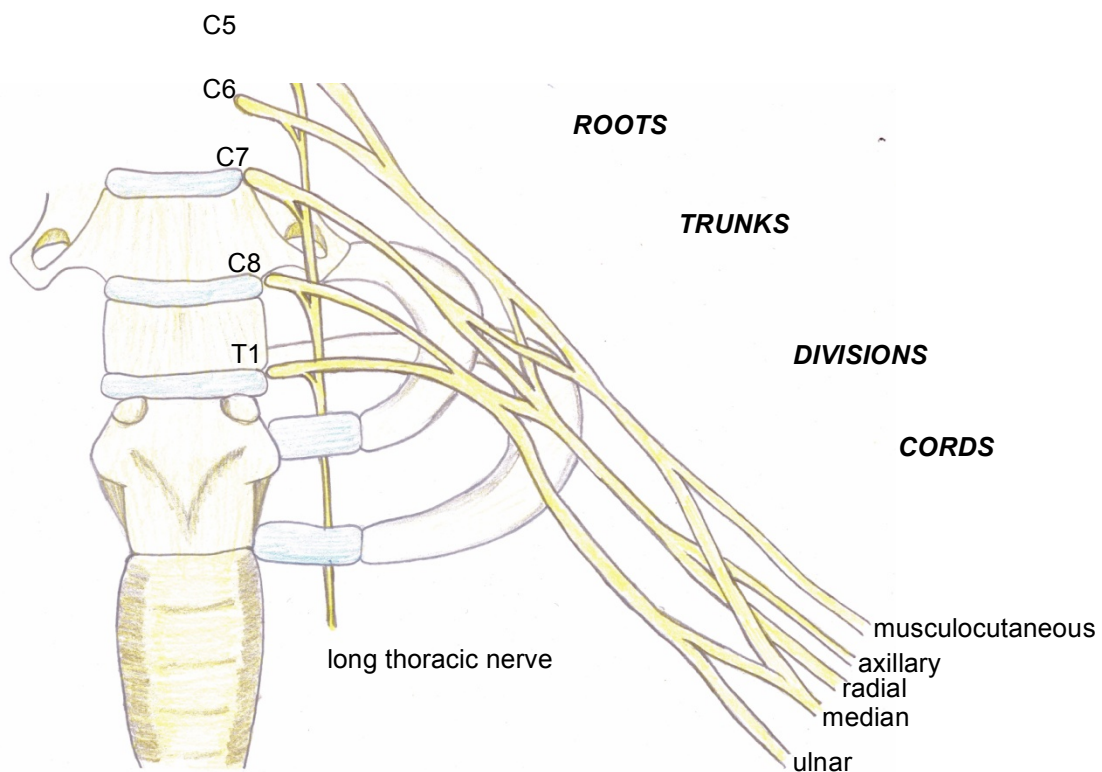


Figure 4. Brachial plexus

Involvement of C5, C6 and C7 causes pain referred to the upper chest, neck, ear and outer arm. Radial nerve symptoms can also be present. Symptoms of sympathetic dysfunction, including cold extremities, Raynaud's phenomenon and trophic changes may occur. Nerve conduction studies can play a useful role in helping make the diagnosis, but can be normal.

Arterial

This is more often seen in patients with a history of arm overuse (e.g. painters, mechanics, swimmers, rowers). Subclavian artery compression causing arterial TOS can lead to pallor, claudication, coldness and paraesthesia. Post-stenotic aneurysm or dilatation, producing a palpable supraclavicular fossa mass, may be seen. Distal embolisation from mural thrombus may cause acute brachial ischemia. Diagnosis is made with a combination of arteriography (figure 5), ultrasound, CT or MRI imaging.



Figure 5. Arteriography demonstrating subclavian artery aneurysm in a patient with a cervical rib

Venous

Venous TOS causes swelling and congestion of the arm. Cyanosis, pain in the arm and venous distension over the shoulder and chest may be present. Paraesthesia can occur, and is due to swelling rather than nerve compression.

Venous TOS can be thrombotic (Paget-Schrotter Syndrome or effort thrombosis) or non-thrombotic. Thrombotic venous TOS commonly follows strenuous upper body exertion. Repetitive compression of the subclavian vein causes intimal damage, activating the clotting cascade causing acute venous thrombosis. 10% of patients may develop pulmonary emboli. Diagnosis is made by venography (figure 6).



Figure 6. Venography demonstrating subclavian vein thrombosis – note the “meniscus” in the subclavian vein

TREATMENT

Management ranges from conservative with advice regarding posture, physiotherapy and multimodal analgesia to surgical intervention. Surgical management can vary from excision of soft tissue or bony abnormalities to complex vascular reconstructions sometimes involving bypass grafts.

The transaxillary route is suitable for removal of the first rib in uncomplicated arterial and venous TOS. A cervical rib can also be removed using the transaxillary approach, but the first rib must be removed first in order to gain safe access. The supraclavicular approach is necessary for complicated arterial cases, e.g. subclavian aneurysms, and cases of neurogenic TOS which require exploration of the brachial plexus or removal of a cervical rib or band. The first rib can also be removed by the supraclavicular route.

Neurogenic

Physiotherapy and multimodal analgesic techniques play an important role in the management of neurogenic TOS. Surgical exploration of the brachial plexus may be considered, especially if abnormal anatomy is thought to be the cause of nerve compression or there is evidence of neurological deterioration (muscle weakness or wasting).

Arterial

Mild brachial ischaemia may be amenable to physiotherapy. Acute brachial ischaemia may require urgent surgical decompression and immediate revascularisation. This may be achieved by thrombolysis or thrombectomy. Subclavian arterial reconstruction may be required for occlusive or aneurysmal lesions.

Venous

Venous TOS is managed with thrombolysis in the first instance (figure 7), followed by anticoagulation with heparin until surgical decompression by resection of the first rib can be performed. Balloon venoplasty is performed 2 -3 weeks post operatively to maintain vein patency (figure 8).

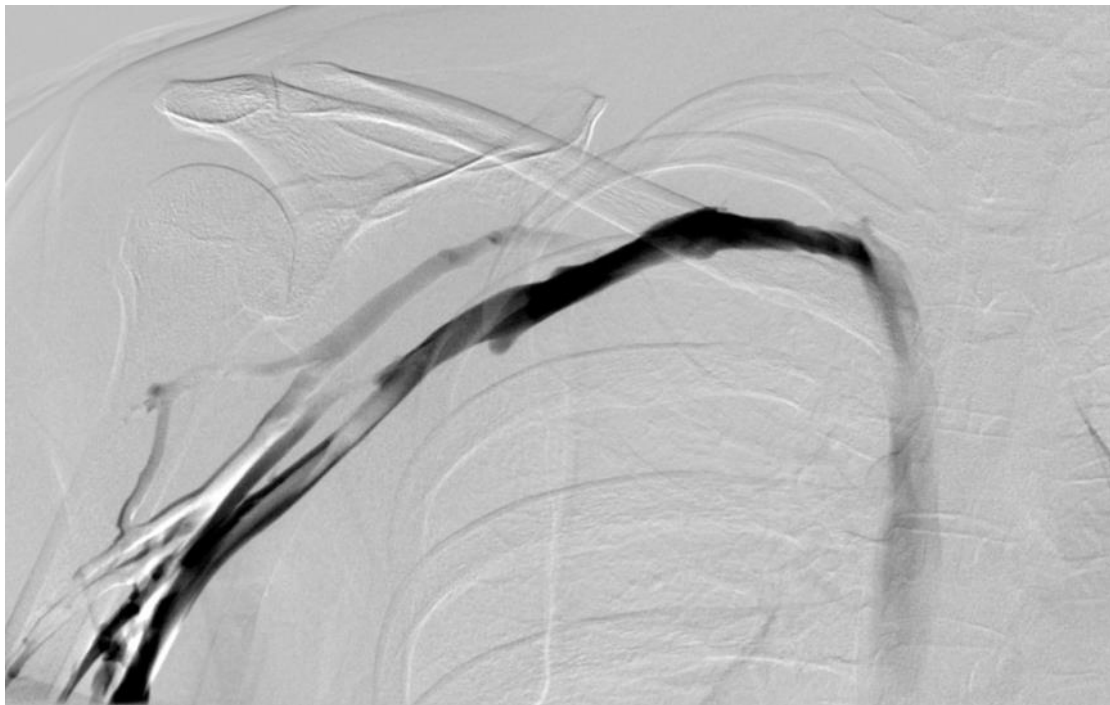


Figure 7. The same patient as figure 6 demonstrating resolution of subclavian vein thrombosis following thrombolysis

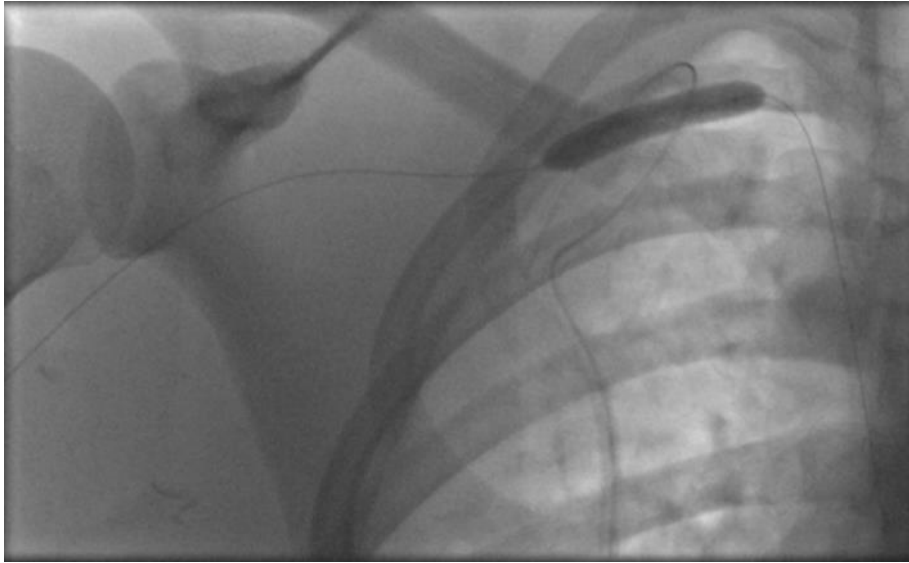


Figure 8. Subclavian venoplasty

ANAESTHETIC CONSIDERATIONS

Pre-operative Assessment

A majority of patients are young with minimal comorbidity. A group and save should be available.

Anaesthetic Technique

- The patient is placed supine with a roll between the scapulae for the supraclavicular approach.
- For the transaxillary approach, the patient is placed in a lateral position with the operative side uppermost. Surgical access may be challenging; the arm must be abducted to create enough space in the axilla to successfully excise the first rib.
- Large bore venous access is required due to the risk of haemorrhage from the subclavian vessels. Air embolus can also occur.
- A high-dose opioid, low-dose hypnotic balanced anaesthetic technique is suggested.
- Neuromuscular blocking drugs should be avoided in complex cases where a nerve stimulator may be used.
- The apical pleura may be breached with first rib resection.
- Invasive monitoring is seldom required.
- A superficial cervical plexus block provides cutaneous analgesia when the supraclavicular approach is used, otherwise local anaesthetic infiltration of the wound should be used. Paravertebral blockade may be considered.

Post-operative Care

Surgery is painful and patients should be prescribed regular simple analgesics combined with patient-controlled analgesia. An erect chest x-ray should be performed in recovery to exclude a significant pneumothorax and haemothorax on the operative side. Patients should be monitored closely for signs of ongoing, insidious blood loss into the thoracic cavity.

Due to the breach in the apical pleura, blood may accumulate in the thoracic cavity rather than in the drain. This can necessitate a return to theatre for video-assisted clot evacuation, or thoracotomy in severe cases. Patients are usually discharged 2 to 3 days post-operatively and advised to maintain shoulder and cervical spine mobility but avoid strenuous exercise or loading until physiotherapy follow-up.

- The majority of patients presenting for surgery for TOS are young and fit
- Significant blood loss can occasionally occur. Ensure there is adequate venous access and a valid group and save
- The pleura is breached in first rib resection. Blood loss may be concealed as the patient may bleed into their chest

ANSWERS TO QUESTIONS

1. TTTTF

After emerging between scalenus anterior and medius, the brachial plexus courses over the first rib. The lateral boundary of the thoracic outlet is the medial border of the first rib.

2. See table 1.

3. TTFFT

Patients are often young with little co-morbidity making invasive monitoring less important. Post-operative bleeding can be hidden, with significant amounts of blood bypassing drains and accumulating in the hemithorax.

A chest radiograph should be performed in recovery to look for pneumothorax and haemothorax.

WEBLINKS

<http://bestpractice.bmj.com/best-practice/monograph/592.html>

http://en.wikipedia.org/wiki/Thoracic_outlet_syndrome

REFERENCES and FURTHER READING

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