
Thoracic outlet syndrome - TOS

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Thoracic outlet syndrome

The right brachial plexus, viewed from in front.

Specialty

Vascular surgery, thoracic surgery

Symptoms

Pain, weakness, loss of muscle at the base of the thumb, swelling, paleness, bluish coloration[1][2]

Usual onset

20 to 50 years of age[1]

Types

Neurogenic, venous, arterial[1]

Causes

Compression of the nerves, arteries, or veins in the superior thoracic aperture (thoracic outlet), the passageway from the lower neck to the armpit[1]

Risk factors

Trauma, repetitive arm movements, tumors, pregnancy, cervical rib[1]

Diagnostic method

Nerve conduction studies, medical imaging[1]

Differential diagnosis

Rotator cuff tear, cervical disc disorders, fibromyalgia, multiple sclerosis, complex regional pain syndrome,[1] pectoralis minor syndrome[3]

Treatment

Pain medication, surgery[1][2]

Frequency
~1%[4]

Thoracic outlet syndrome (TOS) is a condition in which there is compression of the nerves, arteries, or veins in the superior thoracic aperture the passageway from the lower neck to the armpit, also known as the thoracic outlet.[1] There are three main types: neurogenic, venous, and arterial.[1] The neurogenic type is the most common and presents with pain, weakness, paraesthesia, and occasionally loss of muscle at the base of the thumb.[1][2] The venous type results in swelling, pain, and possibly a bluish coloration of the arm.[2] The arterial type results in pain, coldness, and pallor of the arm.[2]

TOS may result from trauma, repetitive arm movements, tumors, pregnancy, or anatomical variations such as a cervical rib.[1] The diagnosis may be supported by nerve conduction studies and medical imaging.[1] TOS is difficult to diagnose and there are many potential differential diagnoses as well as other diseases that are often co-occurrent with TOS.[5]

Initial treatment for the neurogenic type is with exercises to strengthen the chest muscles and improve posture.[1] NSAIDs such as naproxen may be used for pain.[1] Surgery is typically done for the arterial and venous types and for the neurogenic type if it does not improve with other treatments.[1][2] Blood thinners may be used to treat or prevent blood clots.[1] The condition affects about 1% of the population.[4] It is more common in women than men and it occurs most commonly between 20 and 50 years of age.[1] The condition was first described in 1818 and the current term "thoracic outlet syndrome" first used in 1956.[2][6]

Contents

Signs and symptoms

TOS affects mainly the upper limbs, with signs and symptoms manifesting in the shoulders, neck, arms and hands. Pain can be present on an intermittent or permanent basis. It can be sharp/stabbing, burning, or aching. TOS can involve only part of the hand (as in the pinky and adjacent half of the ring finger), all of the hand, or the inner aspect of the forearm and upper arm. Pain can also be in the side of the neck, the pectoral area below the clavicle, the armpit/axillary area, and the upper back (i.e., the trapezius and rhomboid area). Discoloration of the hands, one hand colder than the other hand, weakness of the hand and arm muscles, and tingling are commonly present.[citation needed]

Only 1% of people with carpal tunnel syndrome have concomitant TOS.[7]

Repetitive motions can cause enlargement of muscles which causes compression of veins. Besides, overuse injury of the upper limbs causes swellings, small bleeding, and subsequent fibrosis which would cause the thrombosis of the subclavian vein, leading to Paget–Schroetter disease or effort-induced thrombosis.[7]

TOS can be related to cerebrovascular arterial insufficiency when affecting the subclavian artery.[8] It also can affect the vertebral artery, in which case it could produce vision disturbances, including transient blindness,[9] and embolic cerebral infarction.[10]

TOS can also lead to eye problems and vision loss as a circumstance of vertebral artery compression. Although very rare, if compression of the brain stem is also involved in an individual presentation of TOS, transient blindness may occur while the head is held in certain positions.[9] If left untreated, TOS can lead to neurological deficits as a result of the hypoperfusion and hypometabolism of certain areas of the brain and cerebellum.[11]

TOS has similar symptoms to pectoralis minor syndrome (PMS), which usually results from compression of the brachial plexus beneath the pectoralis minor muscle (while neurogenic TOS is caused by compression of the same nerves above the clavicle).[12] Unlike TOS there is typically few headaches or neck pain in patients with PMS only, instead with pain in the chest area.[13] Initially, it was believed that 95 percent of patients with TOS had nerve compression in the scalene

area, but in the twenty-first century it is now recognized that the majority have nerve compression under the pectoralis minor, either by itself or in addition to the scalene area.[14] One study of 100 patients diagnosed with neurogenic TOS found that 75 percent had neurogenic PMS and 30 percent in fact had PMS without TOS.[3][14]

Causes

Thoracic outlet syndrome

TOS can be attributed to one or more of the following factors:[15]

Congenital abnormalities are frequently found in persons with TOS. These include cervical rib, prolonged transverse process, and muscular abnormalities (e.g., in the scalenus anterior muscle, a sickle-shaped scalenus medius) or fibrous connective tissue anomalies.[15]

Trauma (e.g., whiplash injuries) or repetitive strain is frequently implicated.[15]

Rarer acquired causes include tumors (especially pancoast tumor), hyperostosis, and osteomyelitis[15]

Diagnosis

Adson's sign and the costoclavicular maneuver lack specificity and sensitivity and should make up only a small part of the mandatory comprehensive history and physical examination undertaken with a patient suspected of having TOS. There is currently no single clinical sign that makes the diagnosis of TOS with any degree of certainty.[citation needed]

Additional maneuvers that may be abnormal in TOS include Wright's test, which involves hyperabducting the arms over the head with some extension and evaluating for loss of radial pulses or signs of blanching of the skin in the hands indicating a decrease in blood flow with the maneuver. The "compression test" is also used, exerting pressure between the clavicle and medial humeral head causes radiation of pain and/or numbness into the affected arm.[16]

Doppler arteriography, with probes at the fingertips and arms, tests the force and "smoothness" of the blood flow through the radial arteries, with and without having the patient perform various arm maneuvers (which causes compression of the subclavian artery at the thoracic outlet). The movements can elicit symptoms of pain and numbness and produce graphs with diminished arterial blood flow to the fingertips, providing strong evidence of impingement of the subclavian artery at the thoracic outlet.[17] Doppler arteriography does not utilize probes at the fingertips and arms, and in this case is likely being confused with plethysmography, which is a different method that utilizes ultrasound without direct visualization of the affected vessels. Doppler ultrasound (not really 'arteriography') would not be used at the radial artery in order to make the diagnosis of TOS. Finally, even if a Doppler study of the appropriate artery were to be positive, it would not diagnose neurogenic TOS, by far the most common subtype of TOS. There is plenty of evidence in the medical literature[citation needed] to show that arterial compression does not equate to brachial plexus compression, although they may occur together, in varying degrees. Additionally, arterial compression by itself does not make the diagnosis of arterial TOS (the rarest form of TOS). Lesser degrees of arterial compression have been shown in normal individuals in various arm positions and are thought to be of little significance without the other criteria for arterial TOS.[citation needed][clarification needed]

MRI scan can show the anatomy of the thoracic outlet, the soft tissues causing compression, and can show directly the brachial plexus compression.[7]

Classification

By structures affected and symptomatology

There are three main types of TOS, named according to the cause of the symptoms; however, these three classifications have been coming into disfavor because TOS can involve all three types of compression to various degrees. The compression can occur in three anatomical structures (arteries, veins and nerves), it can be isolated, or, more commonly, two or three of the structures are compressed to greater or lesser degrees. In addition, the compressive forces can be of different magnitude in each affected structure. Therefore, symptoms can be variable.[18]

Neurogenic TOS includes disorders produced by compression of components of the brachial plexus nerves. The neurogenic form of TOS accounts for 95% of all cases of TOS.[19]

Arterial TOS is due to compression of the subclavian artery.[19] This is less than one percent of cases.[2]

Venous TOS is due to compression of the subclavian vein.[19] This makes up about 4% of cases.[2]

By event

There are many causes of TOS. The most frequent cause is trauma, either sudden (as in a clavicle fracture caused by a car accident), or repetitive (as in a legal secretary who works with his/her hands, wrists, and arms at a fast-paced desk station with non-ergonomic posture for many years)[citation needed]. TOS is also found in certain occupations involving much lifting of the arms and repetitive use of the wrists and arms[citation needed].

One cause of arterial compression is trauma, and a recent case involving fracture of the clavicle has been reported.[20]

The two groups of people most likely to develop TOS are those with neck injuries due to traffic accidents and those who use computers in non-ergonomic postures for extended periods of time.[citation needed] TOS is frequently a repetitive stress injury (RSI) caused by certain types of work environments[citation needed].

By structure causing constriction

It is also possible to classify TOS by the location of the obstruction:[citation needed]

Anterior scalene syndrome (compression on brachial plexus and/or subclavian artery caused by muscle growth).

Cervical rib syndrome (compression on brachial plexus and/or subclavian artery caused by bone growth).

Costoclavicular syndrome (narrowing between the clavicle and the first rib) – diagnosed with the costoclavicular maneuver.

Some people are born with an extra incomplete and very small rib above their first rib, which protrudes out into the superior thoracic outlet space. This rudimentary rib causes fibrous changes around the brachial plexus nerves, inducing compression and causing the symptoms and signs of TOS. This is called a "cervical rib" because of its attachment to C-7 (the seventh cervical vertebra), and its surgical removal is almost always recommended. The symptoms of TOS can first appear in the early teen years as a child is becoming more athletic.

Treatment

Evidence for the treatment of thoracic outlet syndrome as of 2014 is poor.[21]

Physical measures

Stretching, occupational and physical therapy are common non-invasive approaches used in the treatment of TOS. The goal of stretching is to relieve compression in the thoracic cavity, reduce blood vessel and nerve impingement, and realign the bones, muscles, ligaments, or tendons that are causing the problem.[citation needed]

One commonly prescribed set of stretches includes moving the shoulders anteriorly (forward – called "hunching"), then back to a neutral position, then extending them posteriorly (backward, called "arching"), then back to neutral, followed by lifting the shoulders up as high as possible, and then back down to neutral, repeated in cycles as tolerated.

Another set of stretches involves tilting and extending the neck opposite to the side of the injury while keeping the injured arm down or wrapped around the back.

Occupational or Physical therapy can include passive or active range of motion exercises, working up to weighted or restricted sets (as tolerated).

TOS is rapidly aggravated by poor posture.[citation needed] Active breathing exercises and ergonomic desk setup and motion practices can help maintain active posture.[citation needed] Often the muscles in the back become weak due to prolonged (years of) "hunching" and other poor postures.[citation needed]

Ice can be used to decrease inflammation of sore or injured muscles. Heat can also aid in relieving sore muscles by improving blood circulation to them. While the whole arm generally feels painful in TOS, some relief can be seen when ice or heat is intermittently applied to the thoracic region (collar bone, armpit, or shoulder blades).[citation needed]

Medications

In a review, botox was compared to a placebo injected into the scalene muscles. No effect in terms of pain relief or improved movement was noted. However, in a six-months follow-up, paresthesia (abnormal sensations such as in pins

and needles) was seen to be significantly improved.[21]

Surgery

Surgical approaches have also been used successfully in TOS. Microsurgery can be used approaching the area from above the collar bone (supraclavicular) followed by neurolysis of the brachial plexus, removal of the scalene muscle (scaleneotomy), and the release of the underlying (subclavicular) blood vessels. This approach avoids the use of resection, and has been found to be an effective treatment.[22] In cases where the first rib (or a fibrous band extending from the first rib) is compressing a vein, artery, or the nerve bundle, part of the first rib and any compressive fibrous tissue, can be removed in a first rib resection and thoracic outlet decompression surgical procedure; scalene muscles may also need to be removed (scaleneotomy). This allows increased blood flow and the reduction of nerve compression.[23] In some cases there may be a rudimentary rib or a cervical rib that can be causing the compression, which can be removed using the same technique.[citation needed]

Physical therapy is often used before and after the operation to improve recovery time and outcomes. Potential complications include pneumothorax, infection, loss of sensation, motor problems, subclavian vessel damage, and, as in all surgeries, a very small risk of permanent serious injury or death.[citation needed]

Notable cases

Sports

Several Major League Baseball players, especially pitchers, have been diagnosed with thoracic outlet syndrome, including Stephen Strasburg, Chris Archer, Matt Harvey,[24] Chris Carpenter,[25] Jaime Garcia,[26] Shaun Marcum,[27] Matt Harrison,[28] Clayton Richard,[29] Nate Karns,[30] and Noah Lowry.[31] Starting pitcher Chris Young, who previously struggled with shoulder problems, underwent surgery for TOS in 2013 and felt "completely different" post-recovery.[32] Young exceeded expectations on his return to the major leagues at age 35, becoming a valuable member of the 2014 Seattle Mariners' starting rotation.[33] In July 1980, Houston Astros starting pitcher J.R. Richard collapsed while playing a game of catch, and was found to have experienced a stroke due to severe blockage of his right carotid artery. Given the fact that shortly beforehand, he had been found to have near-total obstruction of the arteries supplying his right arm, he was eventually diagnosed with extensive arterial thoracic outlet syndrome. Although he attempted a comeback, his professional baseball career was effectively ended.[34]

NHL defenseman Adam McQuaid was diagnosed with TOS in September 2012, and as a result was nominated for the Bill Masterton Memorial Trophy.[35] Forward Chris Kreider was diagnosed with a malformed rib in 2017. Kreider dealt with multiple symptoms prior to the diagnosis, such as shortness of breath on the ice, swelling/numbness in his right arm, coughing up blood and a blood clot in his right arm. Kreider underwent successful surgery to resect a rib in January 2018 (the same surgery as TOS) and has performed well since returning to the Rangers.[36]

NBA guard Markelle Fultz was diagnosed with TOS in December 2018.[37][38]

UFC fighter Matt Serra had a rib removed to alleviate TOS.[39]

Music

Musician Isaac Hanson had a pulmonary embolism as a consequence of thoracic outlet syndrome.[40]

The Japanese band Maria disbanded in 2010 due to drummer Tattsu's TOS which made it impossible for her to continue playing.[41]

In 2015, singer Tamar Braxton had to leave Dancing With The Stars due to TOS.[42]

See also

Pectoralis minor syndrome

May–Thurner syndrome – a similar compressive pathology involving the left common iliac vein

Backpack palsy – a similar compressive pathology involving the long thoracic nerve, or adjacent brachial plexus nerves

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External links

Classification

D

ICD-10: G54.0

ICD-9-CM: 353.0

MeSH: D013901

DiseasesDB: 13039

External resources

MedlinePlus: 001434
eMedicine: pmr/136
Patient UK: Thoracic outlet syndrome
Orphanet: 97330

thoracic at NINDS

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Diseases relating to the peripheral nervous system