

COMBINING PHARMACOLOGICAL THERAPY AND ULTRASOUND-GUIDED BOTULINUM TOXIN INJECTION RESULTED IN CLINICAL IMPROVEMENT IN BILATERAL ARTERIAL-NEUROGENIC THORACIC OUTLET SYNDROME: A CASE REPORT

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- Background:** Thoracic outlet syndrome (TOS) results from compression of the brachial plexus and/or the subclavian vessels. Botulinum toxin (BTX) has been shown to be useful in TOS both as a predictor of surgical outcome and as a therapeutic option.
- Case Report:** We present the case of a 21-year-old woman with a rare form of bilateral TOS with combined arterial and neurogenic involvement. After surgical treatment on the right side, the patient developed symptoms on the left side. We adopted a multimodal therapeutic approach that effectively reduced her symptoms and improved her quality of life.
- Conclusions:** Our case suggests that alleviating neurovascular compression with BTX, together with pharmacological agents that modulate pain pathways, may lead to clinical improvement, even in complex and poorly documented cases of TOS.
- Key words:** Thoracic outlet syndrome, botulinum toxin injection, pharmacological therapy, case report

BACKGROUND

Thoracic outlet syndrome (TOS) is characterized by compression of the neurovascular bundle in an anatomical area known as the thoracic outlet. At the base of the neck, the scalene triangle serves as a corridor for the subclavian vessels and brachial plexus as they travel out of the neck. These structures pass under the clavicle and continue distally beneath the pectoralis minor muscle (PMM) toward the axilla. Any lesion impinging on the nerves or vessels along their course may cause one of the three forms of TOS: neurogenic (nTOS), venous, or arterial (aTOS) (1).

TOS is a rare condition (1-3 per 100,000), and the medical literature uses a variety of names to describe it. It most commonly occurs between 20 and 50 years of age, presenting

unilaterally in the dominant arm. nTOS is more common in women (90% to 95% of cases), while aTOS affects both genders equally (1% to 2% of cases) (1,2). Symptoms and physical findings affecting the upper limb, cervical region, and thoracic region are heterogeneous. Different forms of TOS may overlap, and to aid diagnosis, a wide range of provocative maneuvers and dynamic imaging techniques are utilized. nTOS typically causes weakness of the intrinsic hand muscles, pain, and paresthesia radiating down the medial forearm. In contrast, aTOS may cause arm pain but is typically associated with vascular claudication, cold limbs, and swelling (1-3). TOS is a challenging condition to treat, and its disabling symptoms significantly impact patients' quality of life: pain interferes with night-time rest, work,

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and recreational activities. A conservative therapeutic approach based on avoiding pain-triggering activities and physical therapy rarely provides adequate relief. The most commonly used medications to treat symptoms are opioids and nonsteroidal anti-inflammatory drugs (NSAIDs), as well as agents used to treat neuropathic pain and muscle relaxants. Another option is surgical decompression of the neurovascular bundle, usually achieved by first rib resection and/or scalenectomy. The type of surgery varies depending on the anatomical alteration causing TOS (1).

We present an uncommon case of a young woman with bilateral compression of both the subclavian artery and the brachial plexus. She came to our attention after her right side had already been surgically treated. Botulinum toxin (BTX) injections into the anterior scalene muscle (ASM), middle scalene muscle (MSM), or PMM are valuable for both diagnostic and therapeutic purposes, particularly in nTOS. BTX reduces muscle tone, thereby helping to alleviate compression between the muscles and the brachial plexus or subclavian vessels (4,5). BTX was administered as part of a multimodal, ultrasound-guided, targeted therapeutic approach.

CASE PRESENTATION

The patient provided informed consent. In October 2025, a 21-year-old female medical student with no relevant comorbidities was referred to our pain management clinic. We collected her complete medical history. She reported a 4-year history of dull, aching pain on the right side of the neck, radiating to the right shoulder and axilla. Symptoms gradually extended to the hand, leading to position-dependent swelling and cyanosis, and were associated with finger paresthesias. Her ability to perform daily activities progressively declined, forcing her to become left-handed. In July 2025, following unsuccessful physical therapy and many inconclusive medical evaluations, the patient was referred to a specialized center in mainland Italy, where a diagnosis of combined right-sided nTOS/aTOS was made. She subsequently underwent a total anterior scalenectomy with brachial plexus neurolysis. In the operating theatre, compression of the subclavian artery and the C8-T1 nerve trunks caused by abnormal fascial bands and a narrowed scalene triangle was confirmed and treated. Preoperative medical records documented positive Adson and Wright tests and also the presence of trigger points in the right supraclavicular region. Magnetic resonance imaging of the brachial plexus was performed with the arm in a neutral position, as pain limited arm elevation. The scan did not show any impingement. Cervical radiculopathy, which

may present similarly to TOS, was excluded, and a right upper limb electromyography showed no abnormalities. Doppler ultrasonography showed the sole diagnostic finding suggestive of TOS: a position-dependent stenosis of the right subclavian artery during arm abduction above 90°. The postoperative course was uneventful, and symptoms showed a partial but satisfactory improvement according to our patient. Unfortunately, in August 2025, 2 months before referral to our clinic, the patient began to experience left-sided TOS symptoms, which caused emotional distress and a marked decline in self-sufficiency and quality of life. On physical examination, no signs of pallor, cyanosis, or edema were observed at rest in either arm. Palpation revealed bilaterally hypertonic trapezius muscles and trigger points in both supraclavicular regions, even on the right side above the surgical scar. Sensory examination did not show any objective deficits, except for mild left-hand paresthesia at rest. The strength and range of motion of the right arm were normal. Interestingly, dynamic scapular winging on the right side with associated tenderness on palpation was noted. This finding may be related to iatrogenic neuropathy of the dorsal scapular and/or long thoracic nerves, as such complications have been reported in the literature (6,7). Function of the left arm was severely limited by movement-evoked pain. Accordingly, the patient's QuickDASH score was 72.7/100 (8); this score is useful and reproducible for measuring upper-limb disability. TOS-specific provocative maneuvers were subsequently performed (1-3), and the results are summarized and graded in Table 1.

A Doppler ultrasonography of the right upper limb showed that arterial flow was unaffected by arm position, suggesting resolution of arterial compression following surgery. In contrast, abduction of the left arm resulted in reduced flow in the left subclavian artery. Complete cessation of blood flow in the left radial and ulnar arteries was observed when the arm was abducted 45° above the shoulder. Because our patient presented with complex and bilateral involvement, a multimodal therapeutic strategy, which included pharmacological management and the option of BTX treatment, was adopted. The patient had previously been treated with NSAIDs, with minimal benefit. Therefore, therapy was initiated with a low-dose opioid analgesic and a muscle relaxant. Tapentadol was selected due to its favorable efficacy-safety profile compared with other opioids and its dual mechanism of action on nociceptive and neuropathic pain pathways (9). An extended-release formulation of 25 mg twice daily was prescribed to minimize adverse effects. Eperisone hydro-

Table 1. First assessment (precombined treatment, October 2025).

TOS PROVOCATIVE maneuvers	LEFT SIDE	RIGHT SIDE
Adson's Test	Radial pulse reduction; moderate hand paresthesia	Negative
Eden's Test/Costoclavicular Pressure	Radial pulse reduction; moderate pain and hand paresthesia	Tenderness
Morley's Test/Brachial Plexus Compression	Moderate pain and hand paresthesia	Tenderness
Roos Test/EAST	Hand muscle weakness and hand numbness at 20 s	Mild hand paresthesia at 30 s
Elvey's Test/ULTT	Position 1: mild hand paresthesia Position 2: severe hand paresthesia and arm pain Position 3: unbearable for the patient	Position 1: mild arm pain Position 2: mild arm pain Position 3: mild arm pain

Abbreviations: TOS, thoracic outlet syndrome; EAST, elevated arm stress test; ULTT, upper limb tension test.

chloride, a centrally acting muscle relaxant, was chosen for its ability to reduce muscle stiffness without significantly impairing muscle strength. Additionally, eperisone exerts vasodilatory effects and improves muscle perfusion through blockade of voltage-dependent calcium channels (10). A dosage of 100 mg once daily was prescribed. At the 2-week follow-up, the patient reported significant improvement in resting pain in the right periscapular and deltoid regions, with no medication-related side effects.

Resting symptoms of the left arm improved significantly, although movement-related pain persisted. Therefore, BTX therapy was considered to improve symptom control and delay a second surgical intervention. Before treatment, a diagnostic local anesthetic (LA) test was performed. Although LA and BTX act via different mechanisms, LA temporarily reduces muscle hypertonicity by blocking intramuscular motor fibers. LA to some extent mimics the effect of BTX. Under ultrasound guidance, 2 mL of 1% lidocaine was injected into the left ASM and MSM. Thirty minutes later, movement-evoked pain in the left arm was markedly reduced. The patient developed a transient, self-limiting left-sided Horner's syndrome, likely due to LA spread to the cervical sympathetic chain, while the brachial plexus remained unaffected by LA. The analgesic effect lasted approximately 2 days. One week later, under ultrasound guidance (Fig. 1) and sterile conditions, BTX was administered: 40 IU into the left MSM, 40 IU into the left ASM, and 20 IU into the PMM, diluted in 0.9% saline (50 IU/mL). No complications occurred. Two weeks after injection, the patient reported marked improvement in movement-related symptoms of the left arm, preceded only by transient injection-site soreness. The QuickDASH score improved to 25/100. Postcombined treatment physical examination findings are summarized in Table 2.

The patient experienced complete remission of symptoms for approximately 6 weeks following the injection, during which she independently discontinued her phar-

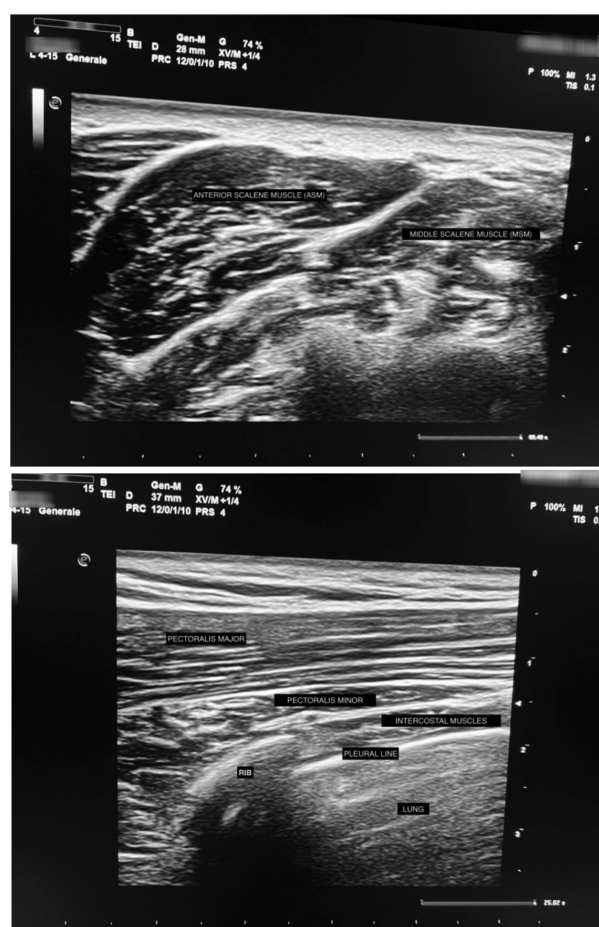


Fig. 1. Ultrasound scan prior to needle insertion and BTX injection, showing relevant sonoanatomy. (December 2, 2025). BTX, botulinum toxin; ASM, anterior scalene muscle; MSM, middle scalene muscle.

macological therapy. In early February, she reported an initial recurrence of her symptoms. She was subsequently advised to resume pharmacological treatment, both to

prevent the pain from becoming chronic and to optimize symptom control. In the absence of other complications, we remained available to repeat the BTX injection over the following months to postpone the need for surgical intervention.

DISCUSSION

To date, TOS remains a controversial clinical entity. A Cochrane systematic review by Povlsen et al (11) highlighted the lack of an agreed definition of TOS, particularly for the disputed form, as well as the absence of standardized outcome measures and high-quality randomized trials comparing interventions with no treatment or with each other. Evidence (11) remains particularly sparse for vascular forms of TOS, and many cases are classified as nonspecific rather than purely neurogenic or vascular.

BTX is a neurotoxin, which inhibits the fusion of acetylcholine-containing vesicles with the presynaptic membrane. This prevents neurotransmitter release and reduces muscle contraction and tone. BTX is widely used to treat disorders of the autonomic nervous system and movement disorders. Moreover, increasing evidence (12) suggests that BTX modulates peripheral and central pain sensitization mechanisms and may promote neuronal repair, resulting in analgesic effects independent of its muscle-relaxant action.

In addition to the middle and anterior scalene muscles, the PMM was also injected, as the literature (13) suggests this may provide additional decompression of the neurovascular bundle. A total of 100 IU of BTX was administered; a dose up to 187 IU per treated side is reported in the literature (4). In our case, the patient's pain had a multifactorial pathophysiology, including compressive neuropathy of the brachial plexus, reduced arterial blood flow, and compensatory antalgic muscle patterns.

The emotional and psychological burden of persistent symptoms also contributed to the overall clinical picture. Therefore, we believe that a combination of multiple drugs was an appropriate choice for this patient. Also, we considered it important to continue the patient's oral drug therapy. Frequent administration of BTX carries the risk of developing neutralizing antibodies, as reported in several studies (14,15) involving its use for conditions, such as cervical dystonia, spasticity, and overactive bladder. We will evaluate whether to repeat the BTX treatment. Arterial involvement in TOS is quite insidious, potentially leading to aneurysmal dilation of the subclavian artery and distal embolization. As the rarest form of TOS, evidence regarding the use of BTX in aTOS is lacking (4,15). In our patient, no lesions of the left subclavian artery were observed at presentation; however, she was referred for surgical evaluation at the same center where she had previously been treated. To our knowledge, this is the only reported case of bilateral neurogenic and aTOS treated with a multimodal therapeutic approach. The patient experienced no adverse effects and reported satisfaction with the clinical improvement.

CONCLUSIONS

Our case report describes a young patient with TOS managed at our pain clinic using a multimodal approach that included oral pharmacological therapy and BTX injections. The intervention resulted in a significant improvement in quality of life, enabling the patient to resume normal activities and defer surgical treatment. Given the rarity of TOS and the limited high-quality evidence supporting specific therapeutic strategies, detailed case reports, such as this, contribute valuable clinical insights and may help inform individualized patient care.

Table 2. Second assessment (postcombined treatment, mid-December 2025).

TOS PROVOCATIVE maneuvers	LEFT SIDE	RIGHT SIDE
Adson's Test	No radial pulse reduction or hand paresthesia	Negative
Eden's Test/Costoclavicular Pressure	No radial pulse reduction or hand paresthesia	Tenderness
Morley's Test/Brachial Plexus Compression	Tenderness	Tenderness
Roos Test/EAST	Negative	Negative
Elvey's Test/ULTT	Position 1: negative Position 2: mild hand paresthesia Position 3: mild hand paresthesia	Position 1: negative Position 2: negative Position 3: mild arm pain

Abbreviations: TOS, thoracic outlet syndrome; EAST, elevated arm stress test; ULTT, upper limb tension test.

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