PAIN MEDICINE CASE REPORTS

ISSN 2768-5152
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Volume 9, Number 6, pp. 295-299

Graded Improvement of Pectoralis Minor Syndrome Symptom Duration With Repeat Botulinum Neurotoxin Injections: A Case Report

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Background: Neurogenic thoracic outlet syndrome (NTOS) and pectoralis minor syndrome (PMS) are clinically similar syndromes that originate from different sites of neurovascular compression, respectively, at or below the thoracic outlet. Botulinum neurotoxin (BoNT) has demonstrated therapeutic relief for NTOS but has limited study in PMS.

Case Report: We present a case of a 67-year-old woman who experienced graded improvement of PMS symptomatic relief with BoNT treatments. She received 5 rounds of BoNT treatments over 2 years, all with significant symptomatic relief that increased in duration and resulted in decreased severity of symptoms upon pain return.

Conclusions: Our case contributes to the limited body of evidence that BoNT can have therapeutic benefits for PMS. Additionally, this case also shows an interesting finding of graded improvement of symptomatic relief duration, which is not commonly seen with BoNT injections that typically provide neuromuscular relaxation for a predictable 3-4 months.

Key words: Pectoralis minor syndrome, botulinum neurotoxin, botox, thoracic outlet syndrome, case report

BACKGROUND

Thoracic outlet syndrome (TOS) is a group of disorders caused by compression of neurovascular structures at the thoracic outlet. The compression site is most commonly in the scalene triangle but can also be the costoclavicular or subcoracoid spaces. Compression leads to various symptoms correlated with the affected source. Neurogenic TOS (NTOS) classically presents with upper extremity pain, paresthesia, and weakness; whereas, venous TOS and arterial TOS present with vascular claudication, cold limbs, and swelling (1,2). A condition with similar clinical presentation to NTOS is pectoralis minor syndrome (PMS). NTOS and PMS differ, however, in their anatomical sites of compression of the brachial plexus and/or subclavian vessels. PMS is defined by entrapment that occurs beneath the pectoralis minor muscle, below the clavicle, inferior to the thoracic outlet, as depicted in Fig. 1 (3,4).

Distinguishing between the 2 syndromes can be made clinically with physical exam and a variety of provocative maneuvers (1). PMS is typically reproduced by compression of the neurovascular structures between the pectoralis minor and thoracic wall, and lacks positive findings to classic provocative thoracic outlet tests like rotational neck maneuvers, Adson's Test, or Roos Test. Other diagnostic tests include electromyography (EMG), and anterior scalene and pectoralis minor muscle diagnostic injections. Treatment options range from conservative approaches, such as physical therapy, to surgical procedures (1,5).

Botulinum neurotoxin (BoNT) has become a treatment for diverse indications in numerous medical conditions.

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Disclaimer: There was no external funding in the preparation of this manuscript.
Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.
Patient consent for publication: Consent obtained directly from patient(s).
This case report adheres to CARE Guidelines and the CARE Checklist has been provided to the journal editor.
Accepted: 2025-06-17, Published: 2025-10-31

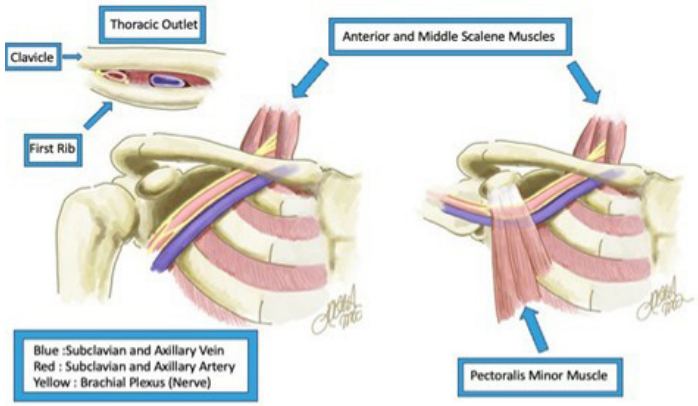

Fig. 1. Anatomy of the thoracic outlet and pectoralis minor areas. The scalene muscles and thoracic outlet are labeled above the clavicle. The pectoralis minor muscle is labeled below the clavicle, inferior to the thoracic outlet. NTOS and PMS differ in their anatomical compression of the nerves of the brachial plexus at these 2 sites, respectively. Image borrowed with original author's permission (4). NTOS, neurogenic thoracic outlet syndrome; PMS, pectoralis minor syndrome.

Therapeutic benefits of BoNT derive from its blockade of acetylcholine release at the neuromuscular junction, leading to inhibitory actions on muscle contraction and overall relaxation of the muscle. BoNT has demonstrated therapeutic benefit across a range of medical conditions, including migraines, overactive bladder, and various movement disorders (6,7). Recent literature (8-10) has also demonstrated the efficacy of BoNT injections in the anterior scalene muscle to provide symptomatic relief for NTOS. Current findings (11,12), however, are limited in the study of BoNT for PMS specifically. BoNT is thought to be effective in managing pectoralis minor muscle hyperactivity by inducing relaxation, alleviating compression of neurovascular structures within the retropectoralis minor space that contribute to symptomatology.

We present a rare case of a 67-year-old woman who experienced graded improvement of PMS symptom duration and severity following BoNT treatments. While further studies are needed, this case suggests that BoNT can be an effective modality for symptomatic treatment, whether as an adjunct for nonoperative therapies or as a bridge to surgical interventions. As the case report is devoid of patient identifiable information, it is exempt from institutional review board review requirements as per University of North Carolina policy. Informed consent was obtained from the patient.

CASE PRESENTATION

Our patient is a 67-year-old woman with a medical history significant for hyperlipidemia, migraines, laryngopharyngeal reflux in the setting of esophageal dysmotility, peripheral neuropathy, and osteoporosis. She presented to the pain management clinic with a reported 2-year history of right upper extremity (RUE) sensorium changes, most prominent in the ulnar distribution. The patient reported symptoms that initially began as an aching, painful sensation, which gradually became an intermittent cold sensation without associated pain. She frequently worked at a desk and was unable to tolerate typing due to her symptoms. A trial of physical therapy was not beneficial, and the placement of a pillow under her arms resulted in worsening symptoms. Deep stretching, dry needling, and massage to the pectoralis minor muscle did yield noticeable improvement.

On exam, the patient's symptoms were provoked by neck rotation to the left, right-arm flexion, massage of her right anterior scalene muscles, and massage of the right pectoral muscles. Palpation was significant for minor tenderness and stiffness of the right scalene muscle region, and tenderness to deep palpation of the pectoralis minor muscle. She had full RUE range of motion without pain. She had a slight decrease in temperature sensation at the right hand, radial artery pulses were 2+ bilaterally, and muscle strength in her upper extremities was 5/5 bilaterally. Adson's and Roos Tests were both negative.

Magnetic resonance imaging demonstrated multilevel degenerative changes of the cervical spine, most prominent at C5-C6 and C6-C7 with mild spinal canal and neural foraminal stenosis (Fig. 2). RUE EMG was normal, and a bilateral upper extremity arterial duplex demonstrated a notable decrease in pulse pressure gradient amplitude with the patient in military position with her head turned to the left. Her overall presentation was concerning for NTOS, but with an unknown area of compression.

To aid in the diagnosis, staged diagnostic injections of her right pectoralis minor muscle and right anterior scalene muscle were performed under ultrasound guidance. The right pectoralis minor muscle injection was performed first with 0.75 mL of 0.25% bupivacaine injected at 2 locations within the muscle, resulting

in 90% symptom relief (Fig. 3). A month later, a right anterior scalene muscle injection was performed with 0.75 mL of 0.25% bupivacaine injected at 2 locations within the muscle, resulting in 0% symptom relief. Her symptomatic response to these diagnostic blocks led to the diagnosis of PMS. This was because she received only relief following local anesthetic injection of the pectoralis minor muscle, and not after injection of the anterior scalene muscle, which would have been implicated in the diagnosis of NTOS instead. After these diagnostic injections, treatment goals were discussed, and the patient expressed interest in a trial of BoNT injections in hopes of avoiding surgical intervention.

Two months after receiving her diagnostic right-side muscle injections, the first BoNT injection of right pectoralis minor muscle was performed. The area of interest was sterilely prepped with chlorhexidine and sterilely draped. Ultrasound was used to visualize the right pectoralis minor muscle and its attachment to the coracoid process. Then a skin wheal was made with a 25G 1.5-inch needle and 0.5% lidocaine. Then a 25G 1.5-inch needle was inserted into the right pectoralis minor muscle using ultrasound guidance for visualization under inplane visualization. Negative aspiration was confirmed prior to BoNT injection, and contrast was not used (Fig. 3).

This first BoNT treatment included 40 units of BoNT reconstituted with 1 mL of 1% lidocaine and injected at 2 locations within the muscle (20 units in each location). She experienced 2 months of 100% symptomatic relief following this treatment, with gradual return of symptoms. She returned 4 months after the initial BoNT treatment for a repeat of this ultrasound-guided

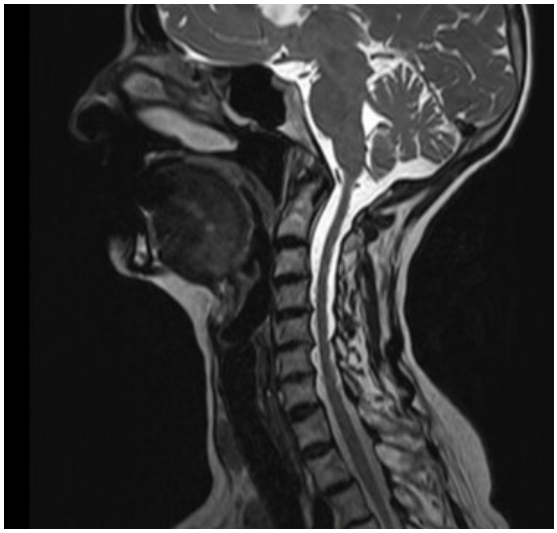

Fig. 2. MRI C-spine impression.
Multilevel degenerative changes of the cervical spine most prominent at C5-C6 and C6-C7, with mild spinal canal and neural foraminal stenosis at these levels. Questionable protrusion within the left C5-C6 foramen.
MRI, magnetic resonance imagining.

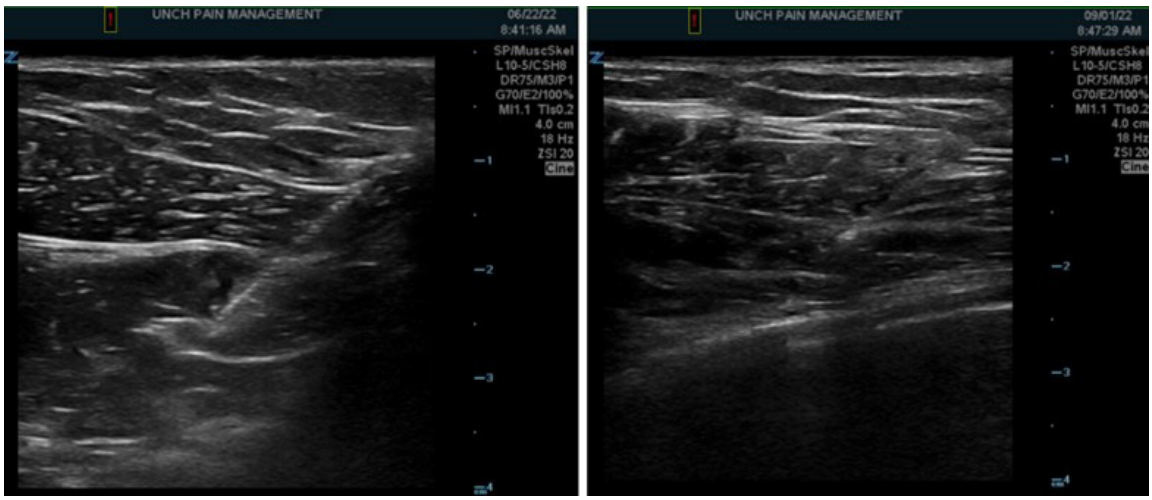

Fig. 3. Injections of the right pectoralis minor muscle under ultrasound-guided inplane visualization.
Left: 06/22/22: patient's initial diagnostic pectoralis minor muscle injection with 0.75 mL of 0.25% bupivacaine injected at 2 locations within the muscle. Right: 09/01/22: patient's first therapeutic BoNT injection with 40 U with 1 mL of 1% lidocaine injected at 2 locations (20 U/0.5 mL in each location).
BoNT, botulinum neurotoxin; U, unit.

procedure. At this second treatment, she received an increased dose of 60 units of BoNT reconstituted with 2 mL of 0.5% lidocaine injected at 2 locations within the muscle (30 units in each location). She experienced 3 months of 100% symptomatic relief following this treatment, with a gradual wane of relief afterward. A repeat of the same ultrasound-guided procedure was performed for her third BoNT treatment, which provided 9 months of 100% symptomatic relief, followed by a gradual wane as well. This was followed by a fourth BoNT treatment with 60 units of BoNT reconstituted with 2 mL of 0.25% bupivacaine, which provided 100% symptomatic relief for nearly 4 months. Return of pain then presented only as slight tightness of her upper arm; however, it significantly improved compared to her previous long-term symptoms down the arm to her hand. She presented then for her fifth BoNT treatment with 60 units of BoNT reconstituted with 1 mL of 0.25% bupivacaine, injected only at one location within the tender point of the muscle where her upper arm tightness correlated with the exacerbation of her pain syndrome. She received 100% relief following this treatment, and 8 months later (at the time that this case report is being written), the patient has not endorsed return of her pain syndrome. An overview of her BoNT injections and symptomatic relief, with notably graded increased duration of improvement with decreased severity of pain symptoms, is outlined in Table 1.

In summary, the patient received a series of 5 BoNT treatments over 2 years, each providing varying durations of complete symptom relief following initial treatment. The first treatment provided 2 months of complete symptom relief, with subsequent treatments resulting in progressively longer durations of relief – up to 9 months after the third injection. Each treatment was adjusted based on the patient's prior symptomatic response, with the fifth and final injection targeting a specific tender point that resulted in complete relief, which has persisted for 8 months at the time of current reporting. Overall, the patient experienced a trend of increasing symptom relief duration and decreasing pain severity with each treatment.

DISCUSSION

BoNT prevents acetylcholine release from nerve synapses, which results in subsequent muscle relaxation. This neurotoxin has demonstrated clinical benefit for a variety of neuromuscular syndromes but remains an underexplored treatment modality for PMS. Its closest application in recent years has been observed indirectly, through trials targeting NTOS. In these trials, BoNT for NTOS treatment focused mainly on injection of the anterior scalene, with the addition of surrounding muscles of the thoracic outlet (2,10).

Upon review, we found limited studies of pectoralis minor BoNT injections for targeted PMS pain management. One observational cohort study (12) of patients with NTOS underwent selective BoNT injections of the pectoralis minor muscle, but utilized these injections as a diagnostic tool and not an intended treatment modality. Another case series (13) administered pectoralis minor BoNT injections for patients with PMS, but did not offer BoNT injections again after pain symptoms reemerged, instead recommending tenotomy. One case report (11), however, did describe benefit of repeat BoNT injections into the pectoralis minor muscle at regular 3-month intervals to control PMS symptoms in a patient with PMS secondary to poststroke spastic hemiparesis.

To our knowledge, this is the first case to document the longitudinal benefits of repeat BoNT injections for PMS from a nontraumatic pain origin. Notably, each successive treatment resulted in a progressively longer duration of symptomatic relief with decreased severity of symptoms upon pain return. This graded improvement may be attributed not solely to the neuromuscular relaxation from the BoNT injection itself, which typically provides relaxation for 3-4 months (11,14), but also to additional benefits, such as enhanced functional status, placebo effect, and decreased central and peripheral sensitization.

With our patient's improved functional status that she achieved after each treatment, she was able to engage more effectively in physical therapy exercises and continued to participate in regular pain psychology therapy sessions. This engagement further contributed to sustained symptom alleviation over time. Additional benefits may have also stemmed from the analgesic effects of BoNT described through its mechanism of action. BoNT inhibition of soluble N-ethylmaleimide-sensitive factor attachment protein receptor (SNARE)-mediated vesicle trafficking can lead to the decrease of SNARE-dependent exocytosis of proinflammatory and excitatory neurotransmitters (such as substance P, calcitonin gene-related peptide, and glutamate), as well as membrane insertion of peripheral pain receptors. Thus, inhibition of these sensory nerve endings can decrease the transmission of nociceptive pain that contributes to the development of peripheral and central sensitization (15).

Table 1. Timeline of right pectoralis minor muscle BoNT treatments.

Date	BoNT Dose and Reconstitution	Injection Within Muscle	Relief Duration
09/01/22	40 U with 1 mL of 1% lidocaine	2 locations (20 U/0.5 mL in each location)	100% for 2 mo, with wane of relief afterward of the entire arm
01/20/23	60 U BoNT with 2 mL of 0.5% lidocaine	2 locations (30 U/1 mL in each location)	100% for 3 mo, with wane of relief afterward of the entire arm
05/17/23	60 U BoNT with 2 mL of 0.5% lidocaine	2 locations (30 U/1 mL in each location)	100% for 9 mo, with wane of relief afterward of the entire arm
04/16/24	60 U BoNT with 2 mL of 0.25% bupivacaine	2 locations (30 U/1 mL in each location)	100% relief for 4 mo, with wane of relief only with slight tightness of the upper arm
08/16/24	60 U BoNT with 1 mL of 0.25% bupivacaine	1 location (60 U/1 mL in the location) at the site associated with arm tightness	100% relief for 8 mo and still experiencing relief at the time of this case report being written

Abbreviations: BoNT, botulinum neurotoxin; U, unit; mo, month.

While more research is needed, BoNT injections for PMS show promising results for providing long-term symptomatic relief and could be utilized as an alternative to riskier and more invasive surgical interventions.

CONCLUSIONS

BoNT injections for PMS should be recognized for their potential as a minimally invasive treatment option capable of providing significant symptomatic relief. This relief can be long-lasting when coupled with continued physical therapy exercises and pain psychology interventions, offering an opportunity to improve patient function without need for surgical intervention. The long-term efficacy of this approach warrants further investigation through further studies involving larger patient cohorts.

REFERENCES

1. Ahmed AS, Graf AR, Karzon AL, et al. Pectoralis minor syndrome - review of pathoanatomy, diagnosis, and management of the primary cause of neurogenic thoracic outlet syndrome. *JSES Rev Rep Tech* 2022; 2:469-488.
2. Woodworth TT, Le A, Miller C, Conger A, Mahan MA, Cushman DM. Botulinum toxin injections for the treatment of neurogenic thoracic outlet syndrome: A systematic review. *Muscle Nerve* 2024; 70:28-35.
3. Sanders RJ, Annest SJ, Goldson E. Neurogenic thoracic outlet and pectoralis minor syndromes in children. *Vasc Endovascular Surg* 2013; 47:335-341.
4. Pascarella L, McGinigle K, Lobonc A, Lee K, Curcio J. Thoracic outlet syndrome, patient booklet; image on page 3. *UNC Medical Center, UNC Vascular Surgery Clinic* 2020.
5. Sanders RJ, Rao NM. The forgotten pectoralis minor syndrome: 100 operations for pectoralis minor syndrome alone or accompanied by neurogenic thoracic outlet syndrome. *Ann Vasc Surg* 2010; 24:701-708.
6. Brin MF, Burstein R. Botox (onabotulinumtoxinA) mechanism of action. *Medicine (Baltimore)* 2023; 102(suppl 1):e32372.
7. Hallett M, Albanese A, Dressler D, et al. Evidence-Based review and assessment of botulinum neurotoxin for the treatment of movement disorders. *Toxicon* 2013; 67:94-114.
8. Boezaart AP, Haller A, Laduzenski S, Koyyalamudi VB, Ihnatsenka B, Wright T. Neurogenic thoracic outlet syndrome: A case report and review of the literature. *Int J Shoulder Surg* 2010; 4:27-35.
9. Jordan SE, Ahn SS, Freischlag JA, Gelabert HA, Machleder HI. Selective botulinum chemodenervation of the scalene muscles for treatment of neurogenic thoracic outlet syndrome. *Ann Vasc Surg* 2000; 14:365-369.
10. Torriani M, Gupta R, Donahue DM. Botulinum toxin injection in neurogenic thoracic outlet syndrome: Results and experience using a ultrasound-guided approach. *Skeletal Radiol* 2010; 39:973-980.
11. Aktas I, Kaya E, Akpinar P, et al. Spasticity-Induced pectoralis minor syndrome: A case-report. *Top Stroke Rehabil* 2020; 27:316-319.
12. Martinez Del Carmen DT, Martí Mestre FX, Tripodi P, Macia Vidueira I, Ramos Izquierdo R, Romera Villegas A. Role of botulinum toxin in pectoralis minor syndrome. *Ann Vasc Surg* 2022; 81:225-231.
13. Howard M, Jones M, Clarkson R, Donaldson O. Pectoralis minor syndrome: Diagnosis with botulinum injection and treatment with tenotomy - a prospective case series. *Shoulder Elbow* 2022; 14:157-161.
14. Dressler D, Johnson E. Botulinum toxin therapy: Past, present and future developments. *J Neural Transm (Vienna)* 2022; 129:829-833.
15. Burstein R, Blumenfeld AM, Silberstein SD, Manack Adams A, Brin MF. Mechanism of action of onabotulinumtoxinA in chronic migraine: A narrative review. *Headache* 2020; 60:1259-1272.