Bedside Pectoralis Minor and Scalene Muscles Injections

Reza Salajegheh, Logan D. Kinch, and Cody C. Rowan

Essential Concepts

- Ultrasound-guided Pectoralis Minor and Scalene Injections serve as potential diagnostic tools in the discovery of Neurogenic Thoracic Outlet Syndrome (NTOS) and Pectoralis Minor Syndrome
- Along with physical therapy, these procedures may also serve as potential therapeutic modalities in the treatment of NTOS.
- Goals of treatment with Pectoralis Minor and Scalene injections may be to interrupt a symptomatic flare, as part of maintenance therapy, or as a precursor to potential definitive surgical correction.
- The mechanism of action is unknown but is thought to involve relaxation of the musculature, resulting in alleviation of the neurogenic compression.
- Pain/symptomatic relief should be rapid (determination of relief should occur within the same visit) and may last hours, to days, to weeks, to months.
- Lateral pectoral nerve, located between pectoralis minor and pectoralis major muscles can be injected for relief of otherwise unexplained anterior shoulder pain.

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1 Bedside Pectoralis Minor and Scalene Muscles Injections

Overview

- Thoracic outlet syndrome is a controversial diagnosis in the evaluation of neck, shoulder, and upper extremity pain and paresthesias. Originally introduced in 1956, the term "Thoracic Outlet Syndrome" (TOS) was coined to describe neurovascular compression within the thoracic outlet as a possible cause for these symptoms [1]. The two primary subtypes of TOS include neurogenic thoracic outlet syndrome (NTOS) which will be the focus of this chapter and vascular thoracic outlet syndrome. Greater than 90% of cases of TOS are considered to be neurogenic in origin, and though sometimes categorized separately. Pectoralis Minor Syndrome does fall under this umbrella as well [2, 3]. Neurogenic TOS is further divided into "Disputed" or "True"; where true NTOS is defined as having objective diagnostic findings while disputed NTOS lacks these [2]. Indeed, an advantage of pectoralis minor and scalene muscles injections is that they may help to shift more cases from the "disputed", to the "true" subcategory. Along with physical therapy, these procedures may also serve as potential therapeutic modalities in the treatment of NTOS.

2 Indications and Contraindications

Neurogenic TOS is thought to be due to compression of brachial plexus structures within the interscalene triangle, the costoclavicular space, or the retropectoralis minor (subpectoralis) space [2]. This can be due to trauma, repetitive use, or congenital anatomic abnormalities [4]. Any circumstance that results in inadequate volume or reduced compliance of the thoracic outlet can cause neurogenic TOS, but the presence of these factors does not always prove symptomatic. Why this is the case is unclear, but it has contributed to the controversy surrounding the diagnosis. One explanation is the possibility of a double crush scenario, where nerve compression may remain subclinical unless it occurs at two or more sites [5]. In any case, a diagnosis of NTOS should be one of exclusion as provocative testing has proven to have a high false-positive rate [6]. If TOS is suspected, every effort should be made to confirm the diagnosis and treat conservatively, and pectoralis/scalene injections are a tool to that end (Tables 1, 2, and 3). The lateral pectoral nerve can be typically found in the fascial plane between pectoralis minor and pectoralis major muscles. A blockade of this nerve can be used for the relief of otherwise unexplained anterior shoulder pain.

Common indications for this procedure include neurogenic thoracic outlet syndrome. The procedure can be diagnostic or therapeutic. Common contraindications include infection at the injection site or systemic infection, known side effects or allergy to injectate, and patient refusal. Anticoagulation, including iatrogenic, or platelet dysfunction, including iatrogenic, are typically not considered to be contraindications.

Table 1 Symptomatology of neurogenic thoracic outlet syndrome (NTOS)

• Numbness or paresthesias in upper extremity
• Pain in neck, shoulder, or upper extremity
• Often unilateral, but can present bilaterally
• Occipital headaches
• Cold intolerance (sympathetically mediated rather than vascular source)
• Diminished dexterity

Table 2 Clinical tests for neurogenic thoracic outlet syndrome

• Elevated arm stress
• Supraclavicular pressure
• Cyriax release
• Upper limb tension
• Cervical rotation lateral flexion

Table 3 Other diagnoses to consider that may have similar symptomatology

Rule out other causes:
• Cervical radiculopathy
• Rotator cuff injury
• Peripheral nerve injury/impingement
• Psychological conditions
• CNS conditions such as CVA or MS

3 Clinical Anatomy

As mentioned, the "thoracic outlet" is comprised of three relevant spaces: the interscalene triangle, the costoclavicular space, and the retropectoralis minor (subpectoralis) space. The interscalene triangle is comprised of the anterior scalene muscle (anteriorly), the middle scalene muscle (posteriorly), and the medial surface of the first rib (inferiorly) (Fig. 1).

The retropectoralis minor space is comprised of the coracoid process superiorly, the pectoralis minor anteriorly, and ribs two through four posteriorly [2]. It is the interaction of the subclavian artery, vein, and brachial plexus with the described anatomy above that determines the subtype of TOS, as well as helps to guide the diagnostic and therapeutic course. Specifically, with NTOS, brachial plexus compression can occur between the anterior and middle scalene muscles, or as it passes below the pectoralis minor. This can be observed with the brachial plexus structures observed between the scalene musculature on ultrasound but is less obvious with the pectoralis minor (Fig. 2). The lateral pectoral nerve can be typically found in the fascial plane between pectoralis minor and pectoralis major muscles.

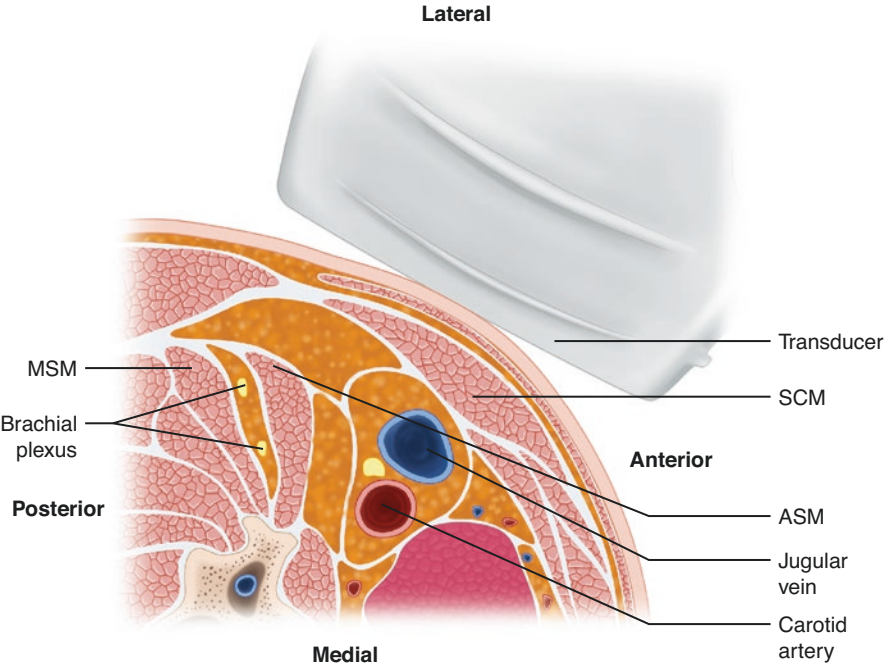

Fig. 1 Cross-sectional anatomy schematic. *ASM* anterior scalene muscle, *MSM* middle scalene muscle, *SCM* sternocleidomastoid muscle

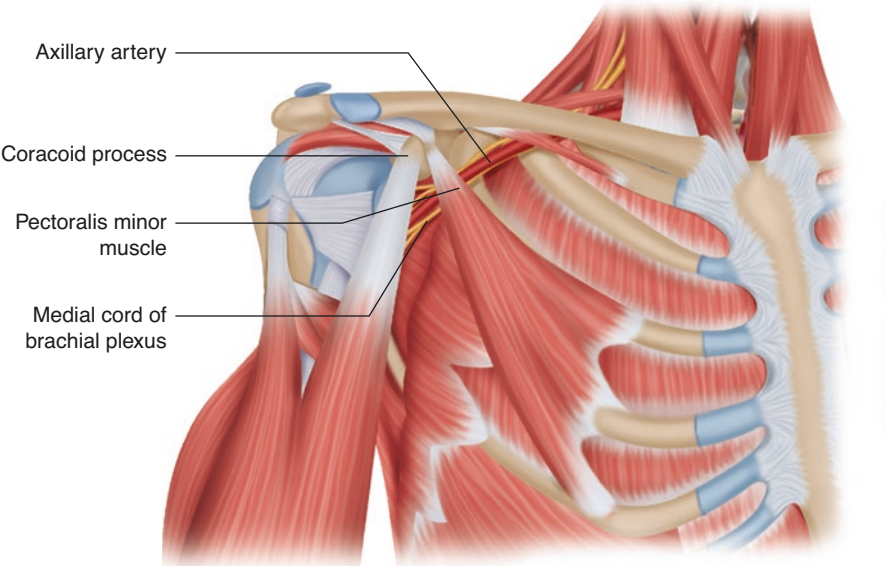

Fig. 2 Pectoralis minor muscle, anatomy schematic, as labeled

4 Equipment and Supplies

Anterior and middle scalene intramuscular injections can readily be performed at the bedside. Alcohol (or betadine in those allergic) based skin prep will be necessary for appropriate skin sterilization. A linear high-frequency ultrasound probe with sterile probe cover is utilized for identifying target muscles, critical structures, and needle guidance. A small syringe with local anesthetic (lidocaine), attached to a small gauge needle will be needed to attain cutaneous anesthesia. A 22–25 G needle, typically 1.5 for scalene injections, and up to 3.5 in. for pectoralis minor muscle injections, will be needed for in-plane advancement to the target tissue. A larger syringe with an anesthetic or an anesthetic and steroid combination will be needed for deposition of injectate at the target site(s). Similarly, ultrasound-guided pectoralis minor intramuscular injections are also straightforward and may utilize the same set of the equipment described above. Adjustments in needle size and ultrasound probe of choice may be required depending on patient body habitus (Table 4).

5 Anterior and Middle Scalene Injections

While these injections can be potentially performed utilizing landmarks we do not recommend that. The anterior and middle scalene intramuscular injections can be completed utilizing a similar view and approach as an interscalene nerve block. Patient placed semi-recumbent with head turned towards the contralateral shoulder. Perform a sterile wide prep over the neck and supraclavicular area (Fig. 3).

Utilizing a linear, high-frequency probe, identify the subclavian artery and associated brachial plexus. Track the brachial plexus cephalad until nerve roots C5–7 are identified between the anterior and middle scalene muscles (Fig. 4).

Maintain awareness of major vascular structures such as the carotid artery and internal jugular. Provide local anesthetic with approximately 1 ml of 1% lidocaine with a small gauge needle. Utilizing preferably an echogenic b-bevel needle, advance with an in-plane approach into the anterior and/or middle scalene muscle body. This is an intramuscular injection only, use caution to avoid deposition of local anesthetic outside of the muscle around the brachial plexus as this can create

Table 4 Equipment/medications needed for the procedure

Syringe	3 ml and 5–10 ml syringe
Needle	25–27 gauge or smaller for skin wheal 22–25 gauge 1.5 in. needle (may need 3.5 in. needle for pectoralis minor injection)
Local anesthetic	0.25–0.5% bupivacaine or 0.2–0.5% Ropivacaine 1–2% lidocaine (for skin wheal)
Corticosteroid	Triamcinolone 40–80 mg ($t1/2$ life: 18–36 h) Methylprednisolone 40–80 mg ($t1/2$ life: 18–36 h) Betamethasone 6–12 mg ($t1/2$ life: 36–54 h) Dexamethasone 4–10 mg ($t1/2$ life: 36–54 h)

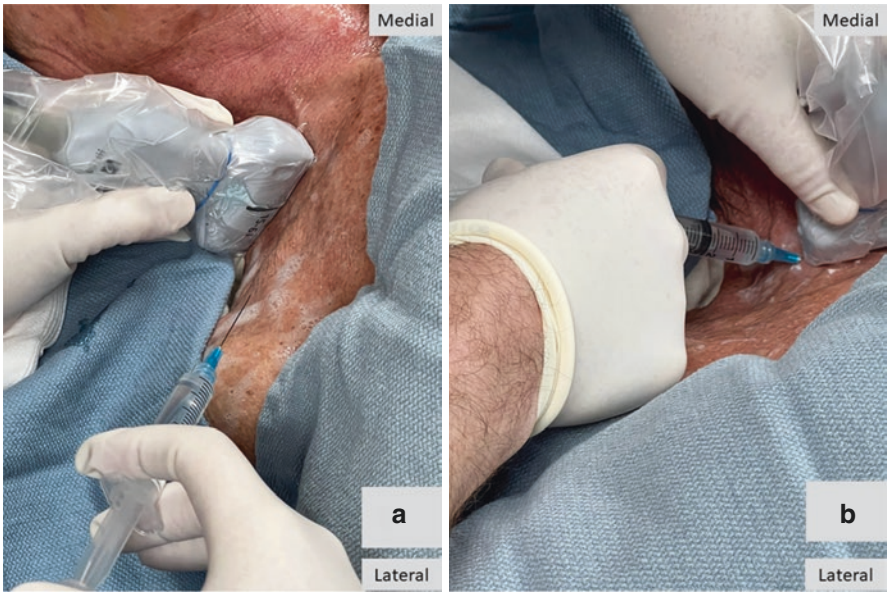

Fig. 3 Anterior scalene muscle injection. The patient positioning and ultrasound transducer orientation (**a**) and needle direction (**b**) are presented

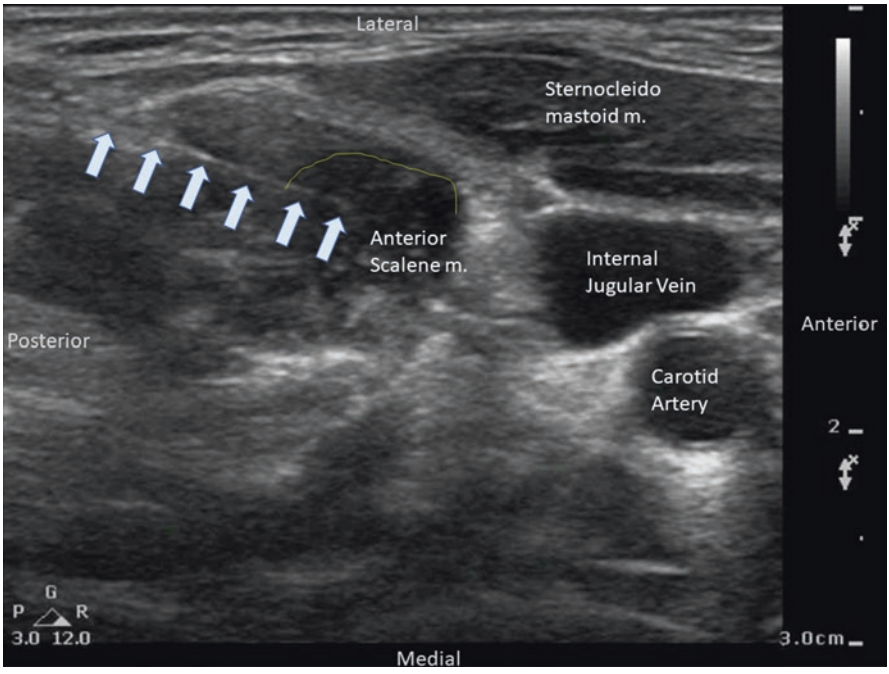

Fig. 4 Ultrasonogram identifying target structures as labeled. Blue arrows point towards the needle advanced towards the anterior scalene muscle. The yellow line indicates the local anesthetic volume injected into the muscle

a false positive diagnostic and therapeutic response. For small or thin muscles, this may require repositioning needle into multiple locations within the muscle belly to prevent extravasation that can occur with a single large depot (or if patient has multiple trigger points, may target these specifically). Utilize Doppler as needed to avoid these vascular structures.

6 Pectoralis Minor Injection

Similar to the previous procedure, the pectoralis minor muscle or tendon sheath injection can be performed using landmarks. We do not recommend this approach. Below were present ultrasound-guided pectoralis minor injection. Pectoralis minor intramuscular injections can be performed with the patient in supine or semi-recumbent position with the ipsilateral arm at the patient's side or abducted to the side (Fig. 5).

With the probe oriented in a cephalad to caudad direction, or lateral to medial direction, identification of the pectoralis minor can be achieved deep to the pectoralis major and superficial to the serratus anterior (Fig. 6). The typical volume of local anesthetic injected is 2–4 ml.

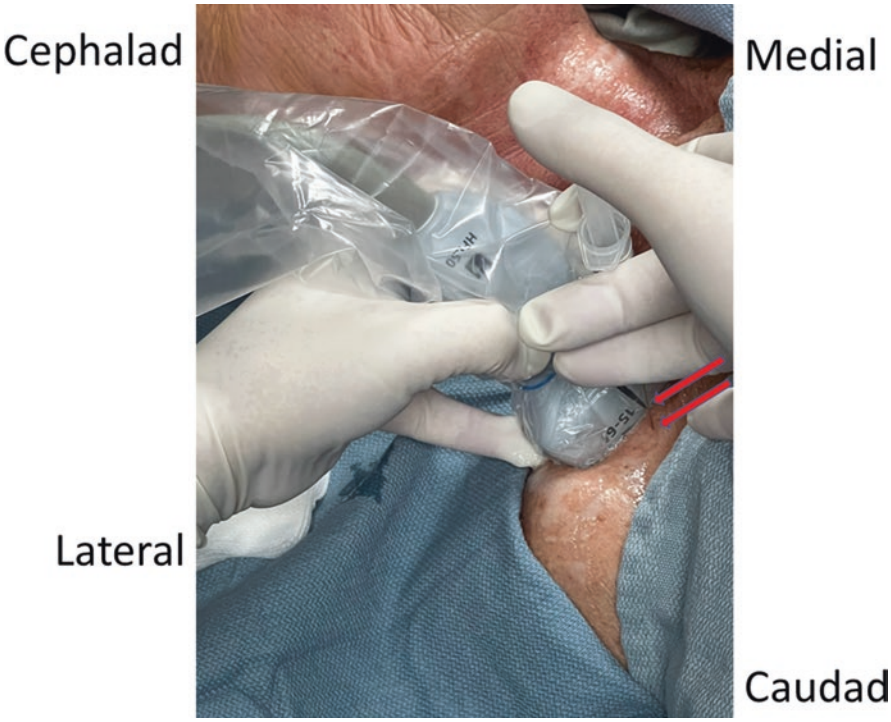

Fig. 5 Pectoralis minor muscle injection. The patient positioning and ultrasound transducer orientation. Red arrows point towards the needle

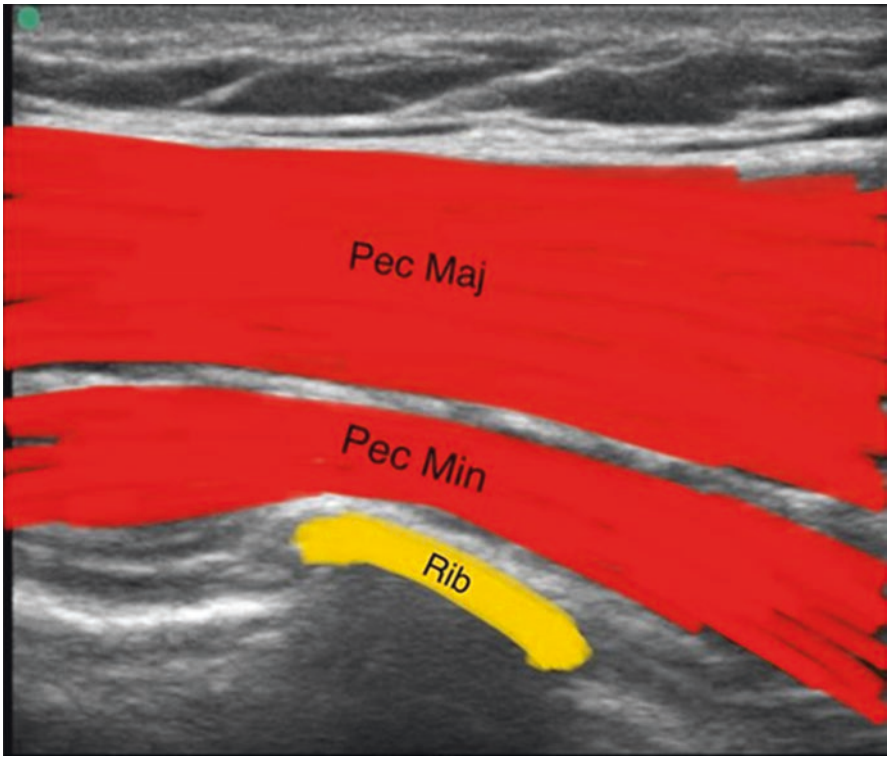

Fig. 6 Cross-sectional anatomy schematic on the ultrasonogram, as labeled

Following sterile prep and skin wheal anesthetic, in-plane advancement of an echogenic or nonechogenic needle under ultrasound guidance with a high-frequency linear probe is conducted until placement is within the muscle body. Injection of anesthetic or anesthetic/steroid mixture can now be completed. The typical volume of local anesthetic injected is 2–4 ml. during this procedure use caution to avoid placement of local anesthetic within the fascial plane between the pectoralis major and minor as this can result in a false positive procedure unless the lateral pectoral nerve is targeted (Fig. 7).

For small or thin muscles, this may require repositioning the needle into multiple locations within the muscle belly to prevent extravasation that can occur with a single large depot (or if patient has multiple trigger points, may target these specifically). Moreover, given the close proximity to the pleura, needle visualization during advancement is vital to avoid causing a pneumothorax.

7 Potential Complications and Adverse Effects

Pectoralis minor and scalene injections are ultrasound guided intramuscular injections, and as such similar to trigger point injections, they are considered generally safe and well tolerated. However, as with any interventional procedure, there is

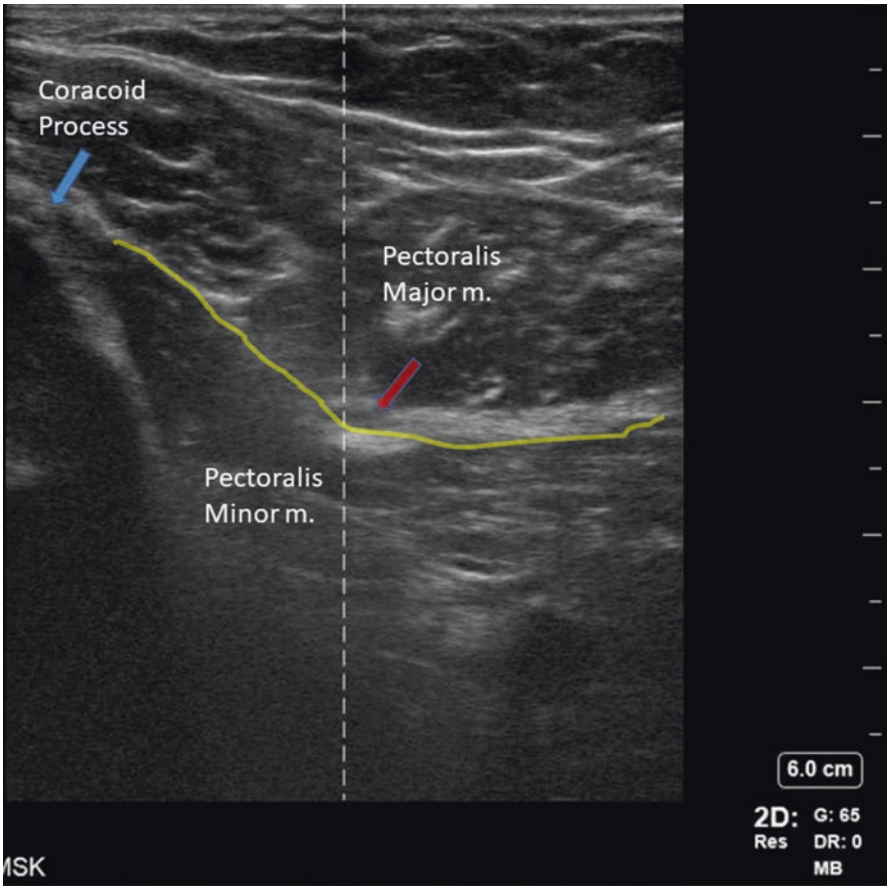

Fig. 7 Ultrasonogram identifying target structures. Blue arrow points towards the coracoid process, the site of attachment of pectoralis minor muscle. Dashed line represents needle trajectory. The needle shaft is not seen as the injection performed using out of plane technique. However, the position of the injectate around the lateral pectoral nerve is visible (red arrow). Injection of local anesthetic around this nerve can lead to false-positive results of the diagnostic injection but can be used as a technique to alleviate otherwise unexplained anterior shoulder pain

the risk of bleeding or hematoma formation (particularly in anti-coagulated patients), infection or abscess formation, nerve injury (plexus injury given the anatomic proximity) or injury of other nearby structures, allergic reactions or intolerance to the substances injected. The anatomy and needle trajectory of the pectoralis minor injection lends itself to the possibility of lung injury or pneumothorax. There is also the risk of temporary phrenic nerve blockade with scalene injections. Discomfort at the injection site or worsening of usual pain symptoms may occur. It is of particular importance to be cautious in patients with atypical anatomy—such as that with prior pectoralis injury, or atypical course of brachial plexus (Table 5).

Table 5 Additional potential complications and adverse effects

• Though unlikely with volume of local anesthetic utilized and with ultrasound guidance, but due to proximity of vascular structures, clinician should be vigilant about signs and treatment of local anesthetic systemic toxicity (LAST).
• Risks should be weighed against benefits in the pregnant patient, particularly with utilization of steroid, though not administered systemically or chronically, there may be a weak association with oral cleft, gestational diabetes, or other complications [7, 8].
• There is the potential for sympathetic blockade and resultant Horner's syndrome given the proximity of the stellate ganglion and other sympathetic structures.
• Caution should be taken in the diabetic patient if utilizing steroid and baseline glucose levels should be determined.
• Though unlikely, anaphylaxis can occur with exposure to local anesthetics or due to preservatives within steroid injectate.
• Caution should be taken in the COPD patient given the risk for pneumothorax and phrenic nerve blockade.

Clinical and Technical Pearls

- Meticulous care should be taken to prevent spread of local anesthetic onto the brachial plexus, as this would diminish the diagnostic value of the intramuscular injection
- Though controversial, to reduce the potential for procedural placebo effect, injection should not be considered to have diagnostic value without a minimum 60% (but ideally 80%) reduction in pain and symptomatology [9].
- Extra caution should be taken in patients with chronic obstructive pulmonary disease, given their increased risk of pneumothorax, but also due to the potential for phrenic nerve block with scalene injection.
- Though unlikely with US guidance and with the volume of local anesthetic use, proximity to arterial structures should warrant extra vigilance for the possibility of local anesthetic systemic toxicity.
- When combined with physical therapy, these injections can form the basis of maintenance or potentially curative treatment. But if they fail to provide prolonged relief, they can provide diagnostic value for potential surgical treatment.

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Further Reading

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