

Interscalene Blocks and Biocellular Therapy for Shoulder Regeneration: A Comprehensive Guide

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Abstract

Shoulder pain, often resulting from degenerative changes, trauma, overuse, arthritis, or scarring, significantly impacts quality of life. Traditional treatments may not always yield satisfactory long-term outcomes, leading to increased interest in biocellular therapy as a regenerative alternative. This therapy—particularly tissue-derived stromal vascular fraction (tSVF) combined with high-dose platelet-rich plasma (HD PRP)—aims to promote tissue healing and functional recovery. Because orthobiologic procedures can be painful, effective procedural pain management is essential. The interscalene block, a regional anesthesia technique targeting the brachial plexus, provides reliable anesthesia for shoulder interventions and is especially useful when performing biocellular therapeutic interventions. This paper reviews the anatomical considerations, procedural protocol, clinical application, and advantages of ultrasound-guided interscalene blocks. It additionally outlines the role of high-definition (HD) ultrasound in diagnostics and precise injection guidance for orthobiologic therapies. The integration of interscalene regional anesthesia, biocellular therapy, and HD ultrasound offers a comprehensive strategy for treating shoulder musculoskeletal disorders, potentially improving outcomes and patient experience.

Keywords: Interscalene block, regional anesthesia, shoulder pain, biocellular therapy, tSVF, HD PRP, ultrasound guidance, regenerative medicine, orthobiologic therapy.

1. INTRODUCTION

Shoulder pain is a prevalent condition resulting from degenerative changes, trauma, overuse, arthritis, or postoperative scarring, and can significantly reduce quality of life.¹ Traditional treatments—including physical therapy, pharmacologic management, and surgery—do not always provide durable relief.² Regenerative approaches such as biocellular therapy have gained attention for their potential to restore tissue function by leveraging autologous cells and growth factors.³⁻⁴

Biocellular therapy, particularly the combination of tissue-derived stromal vascular fraction (tSVF) and high-dose platelet-rich plasma (HD PRP), is used to stimulate tissue healing and modulate inflammation. However, these procedures can produce considerable discomfort, necessitating effective pain control.

The interscalene brachial plexus block is well-suited for shoulder interventions and provides

targeted regional anesthesia for orthobiologic procedures involving the shoulder.⁵

1.1. Anatomical Considerations

The shoulder complex includes several articulations, with the glenohumeral joint representing the primary site of motion between the humeral head and glenoid fossa.⁶ Stability and mechanics are supported by the rotator cuff (supraspinatus, infraspinatus, teres minor, subscapularis), deltoid, and peri-scapular musculature. Shoulder innervation arises predominantly from the brachial plexus (C5–T1).

For interscalene block placement, the target structures are the C5–C7 roots within the interscalene groove between the anterior and middle scalene muscles.⁷ The following nerves are particularly relevant:

- Axillary nerve (C5–C6): Motor to deltoid and teres minor; sensory to glenohumeral joint.

- Suprascapular nerve (C5–C6): Motor to supraspinatus and infraspinatus; major sensory contribution to glenohumeral joint.
- Lateral pectoral nerve (C5–C7): Motor to pectoralis major; Sensory to the anterior glenohumeral joint.

The interscalene block effectively anesthetizes these nerves, making it well-suited for procedures involving the shoulder joint, distal clavicle, and upper arm. However, for complete anesthesia of the entire shoulder region—including the upper clavicle, the acromioclavicular joint and superior shoulder skin—supplementary local infiltration may be necessary, as these areas can also receive innervation from branches of the cervical plexus (C3–C4).

1.2. Protocol for Interscalene Block

The interscalene block is best performed under ultrasound guidance to ensure accuracy and safety. A standard protocol includes:

1.2.1 Patient Positioning

- Supine or semi-Fowler's position with the head rotated contralaterally.
- Semi-lateral positioning is an alternative for operator ergonomics.⁷

1.2.2. Ultrasound Setup

- High-frequency linear transducer (10–15 MHz) for optimal visualization.
- Use color Doppler to identify vascular structures.

1.2.3. Transducer Placement

- Transverse orientation at the level of the cricoid cartilage.
- Identify anterior and middle scalene muscles and the hypoechoic brachial plexus roots (C5–C7) within the interscalene groove.

1.2.4. Needle Insertion

- In-plane lateral-to-medial approach, aiming towards the interscalene groove, is preferred.
- Needle tip must remain visualized continuously to prevent vascular entry or neural injury.

1.2.5. Local Anesthetic Administration

- Slow injection of 10–15 mL of anesthetic (e.g., 0.5% ropivacaine).
- Observe circumferential spread around plexus roots.

- Lower volumes reduce phrenic nerve involvement and associated complications.⁸

1.2.6. Block Confirmation

- Assess sensory and motor loss (e.g., diminished shoulder abduction) to confirm block efficacy.

2. REGIONAL BLOCK ANESTHESIA FOR SHOULDER SITES

The interscalene block reliably anesthetizes the glenohumeral joint, distal clavicle, and upper arm. However, supplemental nerve blocks may be necessary in some situations:

2.1. Supraclavicular Nerve Block (Cervical Plexus)

While the deep structures of the acromioclavicular joint are innervated by the brachial plexus (axillary nerve), the skin overlying the acromioclavicular joint is most often innervated by the cervical plexus (supraclavicular nerve). In instances where sensory block is desired at the skin directly over the AC joint, supplemental supraclavicular nerve block may be warranted.

2.2. Suprascapular Nerve Block

In most individuals the suprascapular nerve, which provides innervation to the supraspinatus, infraspinatus and the glenohumeral joint, arises from the upper branch of the brachial plexus. As such, traditional interscalene block will provide effective anesthesia to structures innervated by the suprascapular nerve. However, anatomical variations exist where the suprascapular nerve branches directly from the C5 root or even from the cervical plexus. In such cases, adequate blockade of the structures innervated by the suprascapular nerve necessitate supplemental suprascapular nerve block.⁹

3. BIOCELLULAR THERAPY IN SHOULDER DISORDERS

Biocellular therapy for shoulder disorders typically involves injecting a mixture of tissue-derived stromal vascular fraction (tSVF) and high-density platelet-rich plasma (HD PRP). The tSVF is a heterogeneous mixture of stem cells, endothelial cells, and other progenitor cells derived from adipose tissue, while HD PRP (>4x circulating platelet concentration) provides a concentrated source of growth factors and cytokines. Together, this combination promotes tissue regeneration and healing by exerting structural, paracrine, and immunomodulatory effects that support:

- Tendon and ligament repair
- Reduction of synovitis
- Improved joint lubrication and mechanics
- Modulation of inflammatory cascades^{3,10-12}

Clinical studies have shown promising results, with patients experiencing significant pain reduction and functional improvement after treatment with biocellular therapy, also termed orthobiologic regenerative treatment.

The safety and efficacy of the combination of partially (micronized) or fully emulsified tSVF (Nanofat) combined with HD PRP and placed in specific targets to achieve relief of pain and repair of functional tissues has increasingly become a highly successful application. The tSVF contents have shown to be modulating to the inflammatory and immunological state in orthobiologic non-invasive techniques.^{11,12} Regional anesthesia greatly improves patient comfort during these procedures, making outpatient treatment more accessible and tolerable.

3.1. Diagnostics with HD Ultrasound

High-definition ultrasound is essential for both diagnosis and procedural accuracy in orthopedic biologic therapy. It allows visualization of:

- Rotator cuff tendons: tears, tendinopathy, calcifications¹³
- Biceps tendon: subluxation, rupture, or tendinopathy
- Sub acromial–subdeltoid bursitis
- Glenohumeral joint: effusion, synovitis, or labral tears (note that MRI is considered superior for labral pathology)¹⁴
- AC joint: arthritis, impingement, or separation

HD ultrasound's high resolution and dynamic imaging capabilities make it ideal for identifying the precise location of pathology, which is essential for targeting biocellular therapy. Use of HD Ultrasound for placing the Biocellular Mix is indispensable for ensuring the precise placement of the tSVF + HD PRP mixture into the target tissues, whether it's the tendon/ligament, joint, labral, muscular, or bursal treatment. This precision enhances the therapeutic effect and safety of the procedure, reducing the risk of off-target injections. For example, in rotator cuff tendinopathy, HD ultrasound can guide the injection directly into degenerative or damaged tendons¹⁰, maximizing the regenerative potential within the shoulder. The use of HD ultrasound

also allows for real-time visualization of the injectate spread, confirming that it reaches the intended area, and helps avoid neurovascular structures, further enhancing safety.¹⁵

3.2. Complications and Management

While the interscalene block is generally safe, it may be associated with several potential complications:

- Horner's Syndrome can result due to sympathetic chain blockade, resulting in ipsilateral miosis, ptosis, and anhidrosis. This is usually benign and resolves as the local anesthetic wears off.⁷
- Hemi diaphragmatic Paralysis may be an issue in the event of inadvertent phrenic nerve blockade, which can reduce ipsilateral pulmonary function by up to 25%. This risk can be minimized by using lower volumes of local anesthetic.⁸
- Nerve Injury is rare, but can occur if the needle inadvertently contacts the brachial plexus roots. Ultrasound guidance reduces the risk of neural injury.⁷
- Local Anesthetic Systemic Toxicity can occur with inadvertent intravascular injection. Careful aspiration and slow injection under ultrasound guidance help prevent intravascular injection.⁷

3.4. Volume Considerations

These complications can be mitigated by using ultrasound guidance, reducing local anesthetic volumes, and diligent patient monitoring.¹⁶

Historically, local anesthesia volumes as high as 25 mL have been administered when performing interscalene brachial plexus block¹⁷. This, however, has proved to be not without complications and has resulted in a reduction of the amount of volume utilized. The New York Society of Regional Anesthesia has recommended 7-15 mL of local anesthesia for interscalene block¹⁸. Volumes as low as 5 mL have been reported to result in the same immediate post-operative pain scores as volumes of 20 mL⁸. Nevertheless, reduced local anesthesia volume in the interscalene approach may contribute to a less reliable block of the suprascapular nerve thus necessitating the addition of a suprascapular nerve block, as previously mentioned.

1. 5-10cc of local agent has been associated with a reduced risk of phrenic nerve block & Ultrasound guidance, and slow injection.

- 15-20cc may result in a slightly increased risk of Horner's syndrome. Hemi diaphragmatic paralysis is mitigated by use of lower volumes, and careful monitoring.
- >20cc may result in a higher incidence of local anesthetic toxicity & is not recommended. It is important under any circumstances to avoid intravascular injection (this risk is reduced with HD Ultrasonographic targeting in guidance.)

A thorough informed consent process is essential prior to performing any peripheral nerve block.

4. CONCLUSION

Integrating ultrasound-guided interscalene block during biocellular interventions involving the shoulder provides a highly effective method for managing procedural pain. The interscalene block offers targeted, reliable analgesia, facilitating patient comfort during these regenerative interventions. Biocellular therapy, using a combination of tSVF and HD PRP promotes tissue healing and functional restoration. The utilization of HD ultrasound enhances diagnostic accuracy and ensures precise biocellular delivery. Together, these techniques hold significant potential for improving patient outcomes in the management of shoulder pain and dysfunction.

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