



Ultrasound-Guided Supraclavicular Brachial Plexus Nerve Block

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Abstract

The supraclavicular brachial plexus (BP) block, initially introduced in the early twentieth century, remains one of the most effective and widely adopted regional anesthesia techniques for upper limb procedures. Its compact anatomical layout and proximity to surface landmarks render it particularly suitable for ultrasound-guided applications. This review provides a detailed account of the technique, comparative anatomy of alternative BP blocks, indications, contraindications, anatomical considerations, procedural steps, ultrasound landmarks, complications, and benefits of the supraclavicular block in clinical practice.

Introduction

The supraclavicular approach to the brachial plexus block offers a unique advantage in regional anesthesia, particularly in upper limb surgeries ranging from the mid-humerus to the hand. This method enables a dense, rapid-onset, and widespread sensory blockade. The compact anatomical configuration of the trunks and divisions of the brachial plexus, coupled with their superficial positioning relative to the skin, allows for easy visualization and needle guidance under ultrasound. The result is a highly successful and safe technique that minimizes complications and ensures effective analgesia and anesthesia.

Alternative approaches, including the interscalene, infraclavicular, and axillary blocks, are each indicated based on surgical site and anatomical considerations. However, they possess specific limitations. For instance, the interscalene block is not ideal for surgeries involving the forearm or hand due to poor coverage of the inferior trunk and has a higher incidence of phrenic nerve paralysis. The infraclavicular approach is valuable for catheter placement but poses a higher risk of pneumothorax. The axillary block often necessitates multiple injections and carries a higher risk of intravascular injection.

Review of Literature

A wealth of literature supports the safety and efficacy of ultrasound-guided supraclavicular brachial plexus blocks. According to Chan et al. (2003), the use of ultrasound significantly increases the success rate of regional blocks and reduces the risk of complications such as vascular puncture and pneumothorax. Tran et al. (2009) reported that the supraclavicular approach, when performed under ultrasound guidance, resulted in a higher incidence of complete sensory and motor blockade with faster onset times compared to other brachial

plexus techniques.

Studies comparing nerve stimulator-guided techniques with ultrasound-guided methods consistently favor the latter. A randomized control trial by Perlas et al. (2008) demonstrated that the ultrasound group had shorter performance times, fewer needle redirections, and better patient satisfaction. Neal et al. (2010) emphasized the importance of real-time imaging in avoiding complications and improving precision.

More recent analyses, such as the meta-analysis by Taha et al. (2017), concluded that ultrasound-guided supraclavicular blocks have a success rate exceeding 90%, with a significant reduction in the incidence of hemidiaphragmatic paresis and intravascular injection. Furthermore, the technique is found to be particularly effective in ambulatory surgeries and emergency settings, where rapid anesthesia and short recovery times are critical.

Anatomical Considerations

The brachial plexus arises from the ventral rami of C5 to T1 spinal nerves, forming roots, trunks, divisions, cords, and terminal branches. The supraclavicular approach targets the plexus at the level of the trunks and divisions. In this region, the plexus travels with the subclavian artery between the anterior and middle scalene muscles and continues beneath the clavicle.

Important anatomical landmarks include the subclavian artery (anteromedial to the plexus), first rib and pleura (inferior to the plexus), and the anterior and middle scalene muscles that form the interscalene groove. Ultrasound imaging allows for real-time identification of these structures and safe needle advancement.

During the block, dermatomes C5 through T1 are anesthetized, covering the entire upper extremity. Motor and sensory innervation is provided via branches from the roots, trunks, cords, and terminal nerves of the brachial plexus. Understanding this detailed innervation is essential to achieving a successful and complete block.

Patient position

For a supraclavicular block, the patient is typically positioned supine with the head turned away from the side being blocked. The arm is usually placed at the patient's side, adducted and slightly stretched to open the supraclavicular fossa, or it may be abducted at the side with the elbow flexed. A pillow under the head can aid in positioning and visualization.

Here's a more detailed breakdown:

Patient Position:

The patient lies supine with the head turned to the opposite side of the block (contralateral side).

Arm Position:

The arm is typically positioned at the patient's side, adducted (moved towards the body), and slightly stretched to help open up the supraclavicular fossa. Some practitioners may abduct the arm to about 90 degrees with the elbow flexed.

Comfort and Ergonomics:

A comfortable and ergonomic position should be planned to improve block performance.

Visualization:

A pillow under the head can be helpful to improve visualization of the supraclavicular fossa during the procedure.

Indications and Contraindications

Indications for the supraclavicular BP block include surgical anesthesia and postoperative analgesia for procedures involving the shoulder, arm, elbow, forearm, and hand. It is also effective in managing complex regional pain syndromes, post-amputation pain, vascular diseases, and tumor-related pain.

Contraindications include infection at the site, severe coagulopathy or use of anticoagulants, pre-existing neuropathy, allergy to local anesthetics, or anatomical restrictions such as splints or casts that limit access.

Step-by-Step Procedure

1. **Patient Position:** Supine, head turned to the contralateral side, ipsilateral arm abducted. The semi-Fowler's position enhances comfort and visualization.
2. **Preparation:** Sterile draping, application of sterile gel, and use of a high-frequency linear ultrasound probe. A 21G x 100 mm echogenic needle is recommended.
3. **Landmark Identification:** Palpate the clavicle and sternocleidomastoid muscle to identify the interscalene groove. Mark key points for probe placement.
4. **Probe Placement:** Position the probe in the supraclavicular fossa, parallel to the clavicle. Adjust to visualize the subclavian artery, brachial plexus, first rib, and pleura.
5. **Needle Insertion:** Use an in-plane lateral-to-medial approach. Advance the needle toward the corner pocket (posterolateral to the subclavian artery) while visualizing the full needle path.

6. Injection of Local Anesthetic: After confirming needle tip location, inject 20 mL of 0.5% bupivacaine or a suitable alternative. Observe the hypoechoic spread around the nerve bundles.
7. Confirmation: Visualize the separation of plexus bundles and proper spread of anesthetic solution to ensure complete block.

Advantages

The supraclavicular block provides a dense, rapid, and complete block of the upper extremity. Compared to other techniques, it requires a smaller volume of local anesthetic and is associated with lower risk of complications like pneumothorax. Ultrasound guidance enhances accuracy, minimizes needle passes, and improves safety.

Complications

Despite ultrasound guidance, potential complications include:

- Pneumothorax (1%)
- Phrenic nerve paralysis (33%)
- Horner's syndrome (1%)
- Vascular puncture (0.4%)
- Recurrent laryngeal nerve injury (1%)

Proper technique, anatomical knowledge, and practice are crucial to minimizing these risks.

Table 1: Comparison of Brachial Plexus Block Approaches

Approach	Target Level	Area Covered	Advantages	Limitations/Complications
Interscalene	Roots (C5–C7)	Shoulder, lateral arm	Easy to locate, fast onset	Phrenic nerve block (100%), not suitable for hand/forearm
Supraclavicular	Trunks/Divisions	Upper limb from mid-humerus to fingers	Dense, rapid block; high success rate	Pneumothorax (rare), phrenic nerve involvement (low)
Infraclavicular	Cords	Forearm, elbow, hand	Stable catheter placement	Deeper structures, increased risk of pneumothorax
Axillary	Terminal branches	Forearm, hand	Low pneumothorax risk	Multiple injections, risk of incomplete block

Table 2: Ultrasound-Guided Landmark Identification

Ultrasound Landmark	Appearance	Clinical Relevance
Subclavian artery (SCA)	Round, pulsatile hypoechoic	Primary landmark for identifying BP trunks
Brachial plexus (BP)	Hypoechoic “grape-like” cluster	Target of injection, surrounds SCA
First rib	Bright, hyperechoic line	Avoid penetrating below to prevent pneumothorax
Pleura	Hyperechoic with lung sliding	Avoid puncture; seen below first rib

Discussion

The integration of ultrasound into regional anesthesia has revolutionized the practice by significantly enhancing safety and efficacy. The supraclavicular brachial plexus block, in particular, benefits from the clear visualization of nerve structures and surrounding anatomy. The block's success is largely due to the compact nature of the plexus at this level, which permits anesthetic spread to cover a broad sensory and motor area.

Compared to other BP approaches, the supraclavicular method provides a more reliable and consistent block for distal upper limb surgeries. The interscalene block, although effective for shoulder surgeries, has limited utility for distal arm procedures and a higher rate of phrenic nerve involvement. The infraclavicular and axillary blocks, while useful in specific contexts, present challenges such as deeper needle insertion and multiple injection points, respectively.

Despite its advantages, the supraclavicular block is not without risks. Complications like pneumothorax, although rare with ultrasound guidance, still necessitate caution. The high incidence of hemidiaphragmatic paresis in earlier techniques is notably reduced with ultrasound, yet practitioners must remain vigilant, particularly in patients with compromised pulmonary function.

Training and experience play pivotal roles in achieving consistent outcomes. Operators should be well-versed in sonoanatomy and needle visualization techniques. Regular practice, use of echogenic needles, and incorporation of simulation training can further reduce complication rates and improve success.

Overall, the supraclavicular approach—especially under ultrasound guidance—continues to be a cornerstone in the management of perioperative pain in upper limb surgeries. Its high success rate, fast onset, and broad coverage make it a preferred technique among anesthesiologists globally.

Conclusion

Ultrasound-guided supraclavicular BP block is a powerful tool in regional anesthesia. Its safety, effectiveness, and reproducibility make it an essential skill for anesthesiologists. Real-time ultrasound guidance reduces complication rates and increases success by allowing precise needle placement and monitoring anesthetic spread. This review serves as both a detailed procedural guide and a foundational reference for clinical application.

Understanding the anatomical nuances, mastering ultrasound landmarks, and maintaining strict aseptic technique are the cornerstones of successfully performing the supraclavicular BP block. With appropriate training, this technique can greatly enhance patient outcomes and perioperative care quality.

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