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Ultrasound guided interscalene brachial plexus block

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Abstract

Peripheral nerve blocks have long been established as a crucial part of the enhanced recovery pathways after surgery. Interscalene brachial plexus block (ISB) is mainly indicated for anaesthesia and analgesia during shoulder and proximal arm surgery. Ultrasound technology has remarkably improved the efficacy and success rates of the ISB while limiting its potential complications.

Keywords: Interscalene brachial plexus block; regional anaesthesia; ultrasound

Introduction

During the past few years there has been a notable revival of regional anaesthesia, and more specifically of the peripheral nerve blocks, with their ubiquitous implementation in enhanced recovery after surgery pathways and pain management [1]. Surface landmarks and nerve stimulation were used in the past to perform peripheral nerve blocks. However, nowadays, ultrasound (US) guidance is becoming the standard of care in performing peripheral nerve blocks due to its advantages in real time visualization of the needle and relevant anatomy, higher efficiency and block success rates, reduced complications, faster performance and onset times, improved postoperative pain control and faster recovery [2-4] .

Interscalene brachial plexus block (ISB) is typically indicated to provide anaesthesia and analgesia for shoulder and proximal arm surgery and as well as surgery of the clavicle (when combined with cervical plexus nerve block) [5]. It includes mainly C5 to C7 blockade. The procedure was first well described and popularized by Alon Winnie in 1970 [6].

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Anatomy

The brachial plexus is formed by the ventral rami of C5 – T1 nerve roots. The roots emerge from the intervertebral foramina, pass over the superior aspects of the transverse processes and run in the interscalene groove, a space between anterior and middle scalene muscles, at the level of the cricoid cartilage/ C6 vertebral body in the neck. Medial to the anterior scalene muscle, the vertebral artery enters into the transverse foramen of the C6 vertebra. The middle scalene muscle lies deep to its anterior counterpart. Between these two muscles are the subclavian artery and the roots/trunks of the brachial plexus. Superficial to all of the above mentioned structures are the sternocleidomastoid muscle and the external jugular vein which runs vertically along the neck just external to the fascia of the sternocleidomastoid [7]. The roots will then divide and join to form trunks, divisions, cords and finally terminal nerve branches.

The interscalene groove is located between the anterior and middle scalene muscles and more specifically lateral to the anterior scalene muscle, carotid artery and internal jugular vein and deep to the sternocleidomastoid muscle. The roots combine to form trunks as they cross the first rib. The superior trunk is formed by C5 and C6, the median trunk consists of C7, and the inferior trunk is formed from C8 and T1.

During an ISB, administration of local anaesthetic around the roots or trunks of the brachial plexus at the level of interscalene groove takes place.

Principles of brachial plexus block

The brachial plexus can be blocked at the level of its roots, trunks, divisions, cords or terminal branches. The choice of each approach whether an anaesthetic or analgesic effect is required depends on the innervation of the area of the body. The interscalene approach blocks the brachial plexus mainly at the level of the roots, thus it is ideally used for shoulder and proximal humerus procedures.

Ultrasound guided interscalene block

US guidance dramatically facilitates the performance of ISB for several reasons. Firstly, the brachial plexus at this level lies superficially and is easily identified. Secondly, optimal needle visibility is ensured which in turn allows a more accurate needle positioning with fewer needle redirections. Thirdly, the fact that US guidance allows the visualization of the anatomy and also the spread of local anaesthetic leads to an important reduction in the volume of the local anaesthetic required to achieve the nerve block, a fact that dramatically improves patient safety [8]. The use of US during peripheral nerve blocks has been shown to reduce the procedure performance time, improve the success rate, shorten the onset time of the block and reduce the incidence of complications [9].

Indications

The interscalene approach can reliably anesthetize all of the shoulder and the radial aspect of the arm, forearm and hand with the exception of its ulnar aspect. Taking into consideration that the anatomical landmarks are easy to identify in all patient populations, including obese patients, this block can be performed where anaesthesia or analgesia of the shoulder or the proximal arm is required [7].

Equipment

The standard equipment comprises an US machine with linear transducer (8-14 MHz), sterile sleeve and gel, standard nerve block tray, a syringe containing the local anaesthetic, a 5 cm, 22 gauge, short-bevel, insulated stimulating needle, opening injection pressure monitoring system, and sterile gloves

Patient positioning

Any position that allows ergonomic placement of the transducer and needle advancement is appropriate. ISB is typically performed with the patient in a supine, beach chair, or semi-lateral decubitus, with the patient's head facing away from the side to be blocked. Asking the patient to reach the ipsilateral knee can be helpful as the shoulder is lowered providing more space for the

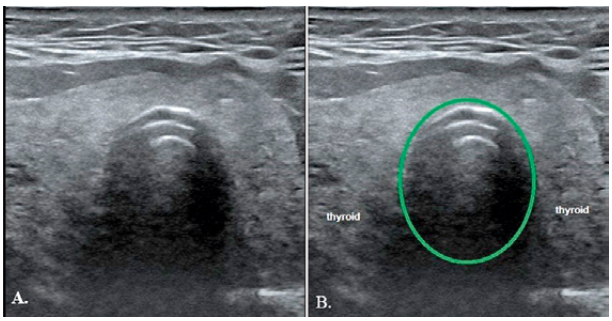

Fig 1. A-B. Trachea (green circle) and Thyroid gland (annotated).

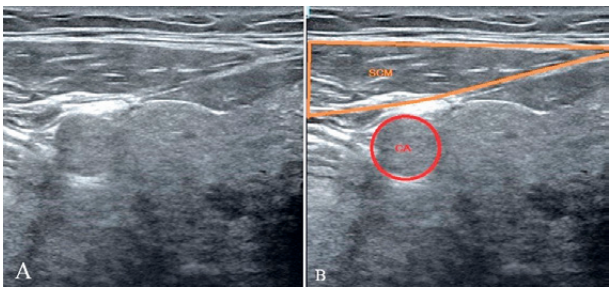

Fig 2. A-B. Right side-common carotid artery (CA-red) and sternocleidomastoid muscle (SCM-orange).

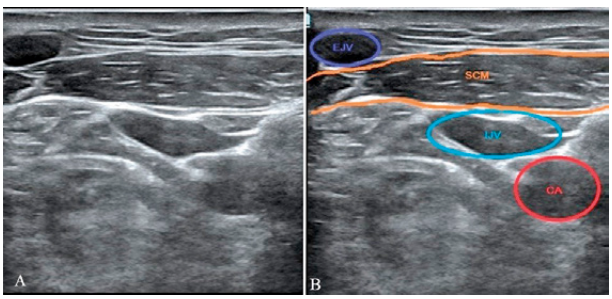

Fig 3. A-B. Right side-common carotid artery (CA-red), internal jugular vein (IJV-light blue), sternocleidomastoid muscle (SCM-orange), external jugular vein (EJV-deep blue).

performance of the block. After obtaining a proper position, skin disinfection and transducer positioning in a transverse plane should follow.

Scanning usually starts just below the level of the cricoid cartilage and medial to the sternocleidomastoid muscle to identify the carotid artery (fig 1-3).

Once the carotid artery is identified the transducer is moved laterally across the neck aiming to identify the anterior and middle scalene muscles (fig 4) and the roots of brachial plexus located in the interscalene groove (fig 5).

To facilitate the visualization of the brachial plexus between the scalene muscles, a "trace-back" technique is recommended where the transducer is lowered to the supraclavicular fossa. At this level, the brachial plexus is identified posterior and superficial to the subclavian

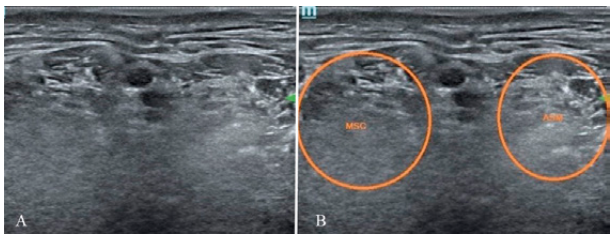

Fig 4. A-B. Anterior scalene muscle and middle scalene muscle (ASM and MSM-orange circles).

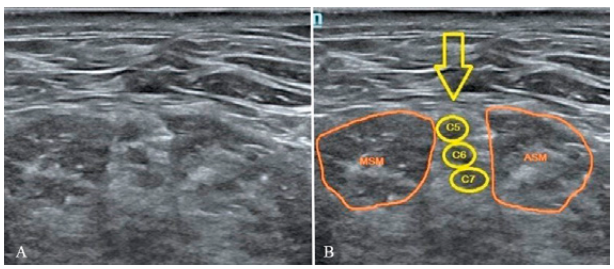

Fig 5. A-B. Anterior scalene muscle and middle scalene muscle (ASM and MSM-orange), roots (C5, C6, C7-yellow circles), interscalene groove (yellow arrow).

artery. From here, the brachial plexus is traced cranially to the desired interscalene level.

Needle insertion

Both out of plane and in plane techniques have been described. However, needle insertion is most commonly in-plane toward the brachial plexus, in a lateral-to-medial direction (fig 6). Out of plane technique can always be a reasonable alternative in experienced hands in situations where the in-plane approach is hard to perform. However, the out of plane technique has not been shown to be superior to the in-plane approach in terms of analgesia or complications [10].

Moreover, both continuous and single-shot injection techniques can be used. When a continuous technique has been chosen a nerve catheter is placed through the needle at the interscalene groove and local anaesthetic is continuously administered through this catheter.

In order to minimize the risk of accidental nerve injury the needle should always be aimed in between the roots (fig 7, fig 8) instead of being directed at them. During the passage of the needle through the prevertebral fascia, a "pop" can often be felt. When using nerve stimulation (0.5 mA, 0.1 msec.), the entrance of the needle in the interscalene groove is often associated with a motor response of the shoulder, arm, or forearm as an additional confirmation of proper needle placement. Careful aspiration to rule out intravascular needle placement is always advised. After intravascular needle placement is ruled out, a small amount of local anaesthetic is injected to verify proper needle placement. In order to decrease the risk of intrafascicular injection, high resistance during injection should always be absent. Following injection of several milliliters of local anaesthetic a slight displacement of the brachial plexus away from the needle occurs. Small advancements of the needle toward the brachial plexus are then recommended in order to ensure the proper spread of the local anaesthetic (fig 9, fig 10, fig 11). When the spread around the brachial plexus is not satisfactory additional needle repositioning and injections might be necessary.

Complications

Possible complications of ISB are: puncture of vascular structure – intravascular injection, bleeding/haematoma, local anaesthetic toxicity, nerve injury, infection, epidural or subarachnoid injection, Horner's syndrome, pneumothorax, or hemiparesis of the diaphragm – phrenic nerve block.

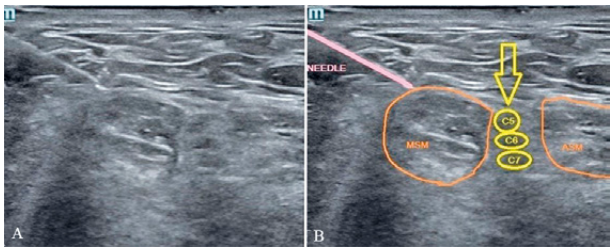

Fig 6. A-B. Right ISB, in plane approach-. Anterior scalene muscle and middle scalene muscle (ASM and MSM-orange), roots (C5, C6, C7-yellow circles), interscalene groove (yellow arrow), needle (pink line).

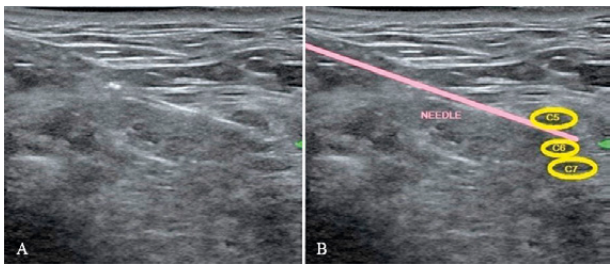

Fig 7. A-B. Right ISB, in plane approach. Needle aiming between the roots C5-C6. Roots (C5, C6, C7-yellow circles), Needle (pink line).

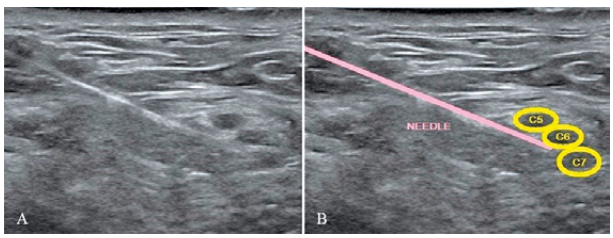

Fig 8. A-B. Right ISB, in plane approach. Needle aiming between the roots C6-C7. Roots (C5, C6, C7-yellow circles), Needle (pink line).

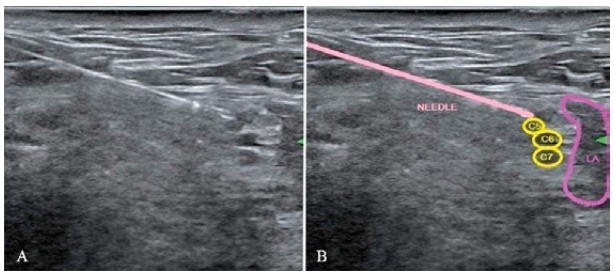

Fig 9. A-B. Right ISB, in plane approach - local anaesthetic spread. Needle aiming over the root C5. Roots (C5, C6, C7-yellow circles), needle (pink line), local anaesthetic spread (LA-purple).

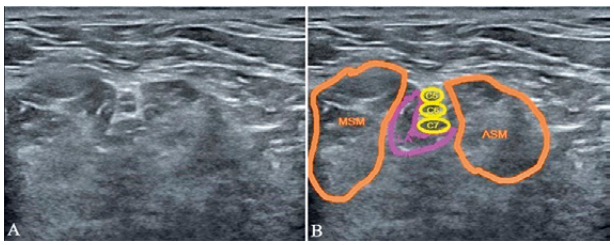

Fig 10. A-B. Right ISB - local anaesthetic spread. Roots (C5, C6, C7-yellow circles), anterior scalene muscle and middle scalene muscle (ASM and MSM-orange), local anaesthetic spread (LA-purple).

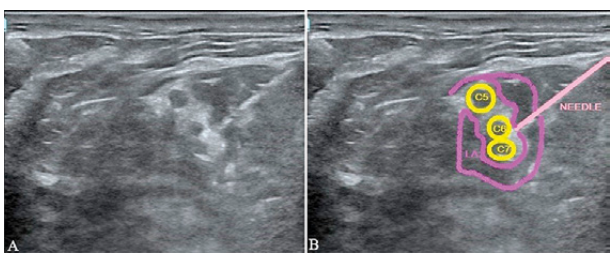

Fig 11. A-B. Left ISB, in plane approach - local anaesthetic spread. Roots (C5, C6, C7-yellow circles), needle (pink line), local anaesthetic spread (LA-purple).

The inadvertent phrenic block is common following ISB. This type of complication warrants the immediate attention of the anaesthesiologist as it can potentially cause respiratory system compromise especially in patients with pre-existing pulmonary pathology. Identifying the phrenic nerve, with the help of the US, and injecting local anaesthetic far away from the nerve might be worthwhile (fig 12, fig 13). The phrenic nerve lies just superficially to the interscalene groove at the level of the cricoid cartilage. It courses anteriorly and travels distally along the superficial aspect of the anterior scalene muscle. Taking into consideration the above mentioned information a medial-to-lateral insertion should be avoided in order to prevent injury to the phrenic nerve.

However, one should be aware that during lateral-to-medial insertion the dorsal scapular nerve and the long thoracic nerve usually course through the middle scalene and could potentially be injured as well. Injury of the long thoracic nerve may lead to paralysis of the serratus anterior muscle causing a phenomenon called winging of scapula. This may be avoided if the needle path is kept within the superior third of the middle scalene muscle [11,12].

Catastrophic case reports of nerve or even spinal cord injuries during the performance of ISB in deeply sedated patients or patients under general anaesthesia has raised concerns about the safety of this practice. In 2008, recommendations were published stating that ISB should not be performed in anaesthetized or heavily sedated adult or paediatric patients [13]. However, more recent literature exists supporting the safety of ISB performance in paediatric patients under general anaesthesia [14].

Discussion

Adequate postoperative analgesia is an important factor to improve patients' outcomes [15]. It is reasonably believed that regional anaesthesia and analgesia will be encountered in the everyday practice of all anaesthesiologists because of its widespread implementation in enhanced recovery pathways after surgery and pain management.

Despite the efficiency, alternatives to ISB are currently being under investigation. It has been suggested that suprascapular nerve block (SSNB), within a multimodal analgesia regimen, may be considered an effective and safe alternative for shoulder surgery analgesia with no clinically important analgesic differences between the two blocks [16] . According to a recent meta-analysis,

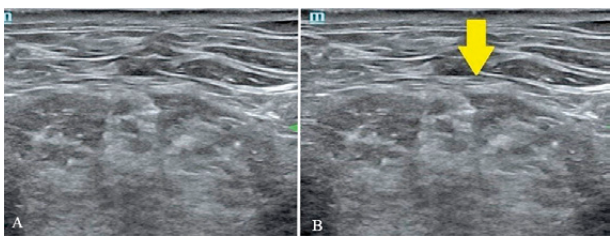

Fig 12. A-B. Phrenic nerve course (yellow arrow).

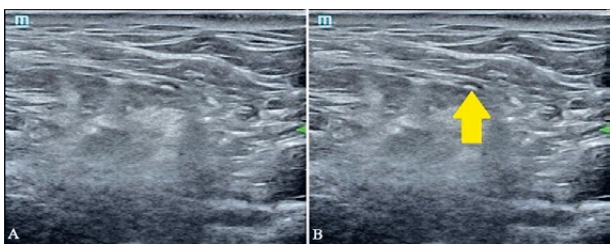

Fig 13. A-B. Phrenic nerve course (yellow arrow).

ISB seems to offer minor transient analgesic advantages which are limited to the immediate postoperative period [17]. Moreover, SSNB does appear to reduce the risk of Horner syndrome, numbness, subjective dyspnea, and hoarseness [17]. Similar results in terms of analgesia and complications were found in another recent meta-analysis that compared the use of SSNB in combination with axillary nerve block (ANB) as an alternative to ISB during shoulder arthroscopy [18]. The supraclavicular block has also been successfully used for acute pain control following shoulder surgery as part of multimodal analgesia [19,20]. Based on a recent meta-analysis it has been suggested that continuous interscalene block (CISB) provides superior analgesia compared with single shot injection interscalene block (SISB) after major shoulder surgery without increasing side-effects or complications [21].

In **conclusion,** the rapid emergence of US guidance as a standard of care provides a faster and more efficient way of performing regional anesthesia. Whichever technique is chosen in terms of drug administration, CISB or SISB, or level of the block, attention should always be given to continuous visualization of the needle advancement, tip position and spread of local anaesthetic in order to minimize intravascular and intraneural injection.

Conflict of interest: none

References

1. Kaye AD, Allampalli V, Fisher P, et al. Supraclavicular vs. Infraclavicular Brachial Plexus Nerve Blocks: Clinical, Pharmacological, and Anatomical Considerations. Anesth Pain Med 2021;11:e120658.
2. Sites BD, Beach ML, Spence BC, et al. Ultrasound guidance improves the success rate of a perivascular axillary plexus block,. Acta Anaesthesiol Scand.2006;50:678-684.
3. Neal JM. Ultrasound-Guided Regional Anesthesia and Patient Safety Update of an Evidence-Based Analysis.Reg Anesth Pain Med 2016;41:195-204.
4. Williams SR, Chouinard P, Arcand G, et al. Ultrasound Guidance Speeds Execution and Improves the Quality of Supraclavicular Block. Anesth Analg 2003;97:1518-1523.
5. Ardon AE, Prasad A, McClain RL, Melton MS, Nielsen KC, Greengrass R. Regional Anesthesia for Ambulatory Anesthesiologists. Anesthesiol Clin 2019;37:265-287.
6. Winnie AP. Interscalene brachial plexus block.Anesth Analg 1970;49:455–466,.
7. Mian A, Chaudhry I, Huang R, Rizk E, Tubbs RS, Loukas M. Brachial Plexus Anesthesia: A Review of the Relevant Anatomy , Complications , and Anatomical Variations. Clin Anat 2014;27:210-221.
8. Kapral S, Greher M, Huber G, et al. Ultrasonographic guidance improves the success rate of interscalene brachial plexus blockade. Reg Anesth Pain Med 2008;33:253-258.
9. Ranganath A, Srinivasan KK, Iohom G. Ultrasound guided axillary brachial plexus block. Med Ultrason 2014;16:246-251.
10. Schwenk ES, Gandhi K, Baratta JL, et al. Ultrasound-Guided Out-of-Plane vs. In-Plane Interscalene Catheters: A Randomized, Prospective Study. Anesth Pain Med 2015;5:e31111.
11. Kadam VR. Ultrasound guided quadratus lumborum block or posterior transversus abdominis plane block catheter infusion as a postoperative analgesic technique for abdominal surgery.J Anaesthesiol Clin Pharmacol 2015;31:130-131.
12. Hanson NA, Auyong DB. Systematic Ultrasound identification of the dorsal scapular and long thoracic nerves during interscalene block. Reg Anesth Pain Med 2013;38:54-57.
13. Bernards CM, Hadzic A, Suresh S, Neal JM. Regional Anesthesia in Anesthetized or Heavily Sedated Patients. Reg Anesth Pain Med 2008;33:449-460.
14. Taenzer A, Walker BJ, Bosenberg AT, et al. Interscalene Brachial Plexus Blocks Under General Anesthesia in Children: Is This Safe Practice ? A Report From the Pediatric Regional Anesthesia Network (PRAN). Reg Anesth Pain Med 2014;39:502-505.
15. Valsamis EM, Wade S, Thornhill C, Carey C, Ricketts D. A simple guide to regional anaesthesia. Br J Hosp Med (Lond) 2018;79:211-217.
16. Hussain N, Goldar G, Ragina N, Banfield L, Laffey JG, Abdallah FW. Suprascapular and Interscalene Nerve Block for Shoulder Surgery: A Systematic Review and Meta-analysis. Anesthesiology 2017;127:998-1013.
17. Sun C, Ji X, Zhang X, et al. Suprascapular nerve block is a clinically attractive alternative to interscalene nerve block during arthroscopic shoulder surgery : a meta-analysis of randomized controlled trials. J Orthop Surg Res 2021;16:376.
18. Sun C, Zhang X, Ji X, Yu P, Cai X, Yang H. "Suprascapular nerve block and axillary nerve block versus interscalee nerve block for arthroscopic shoulder surgery: A meta-analysis of randomized controlled trials. Medicine (Baltimore) 2021;100:e27661..
19. Hussain N, Costache I, Kumar N, et al. Is Supraclavicular Block as Good as Interscalene Block for Acute Pain Control Following Shoulder Surgery? A Systematic Review and Meta-analysis. Anesth Analg 2020;130:1304-1319.
20. Schubert AK, Dinges HC, Wulf H, Wiesmann T. Interscalene versus supraclavicular plexus block for the prevention of postoperative pain after shoulder surgery A systematic review and meta-analysis. Eur J Anaesthesiol 2019;36:427-435.
21. Vorobeichik L, Brull R, Bowry R, Laffey JG, Abdallah FW. "Should continuous rather than single-injection interscalene block be routinely offered for major shoulder surgery ? A meta-analysis of the analgesic and side-effects profiles," Br J Anaesth 2018;120:679-692.