Suprascapular Nerve Block

A Narrative Review

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Abstract: Suprascapular nerve blockade (SSNB) is a simple and safe technique for providing relief from various types of shoulder pain, including rheumatologic disorders, cancer, and trauma pain, and postoperative pain due to shoulder arthroscopy. Posterior, superior, and anterior approaches may be used, the most common being the posterior. Recently, an ultrasound-guided approach has been described. In this review, the basic anatomy of the suprascapular nerve will be described. The different techniques of SSNB and indications for SSNB will be discussed. The complications of SSNB and outcomes of SSNB on the management of acute and chronic shoulder pain will be reviewed.

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The suprascapular nerve (SSN) is the major sensory nerve to the shoulder, especially in the posterior and superior aspect.[1] For pain originating from the shoulder and associated structures, the SSN is an accessible target for blockade. Suprascapular nerve blockade (SSNB) was first described in 1941 by Wertheim and Rovenstein.[2] Since then, SSNB has been applied in the management of acute[3,4] and chronic pain,[5] as well as for the diagnosis of suprascapular neuropathy.[6] Specific chronic shoulder pain syndromes in which SSNB has been used include rheumatoid arthritis,[5,7,8] osteoarthritis[9] of the glenohumeral joint, and various rotator cuff disorders including frozen shoulder.[5,10–13]

Recently, renewed interest in this technique has arisen owing to the potential for improved control of moderate to severe postoperative pain that follows open- and closed-shoulder surgery.[3,4,14,15] There have been numerous variations and refinements in the technique of SSNB since its introduction. The implementation of imaging guidance with ultrasound (US) most recently has attempted to improve the accuracy of blocking the SSN.[16–18] Furthermore, use of lesioning techniques such as pulsed radiofrequency (RF) to provide sustained analgesia has also been described in the literature.[19,20] Despite these developments, the place of SSNB in pain management is not clearly defined.

In this review, the basic anatomy of the SSN and different approaches of SSNB will be briefly described. The outcomes of SSNB in the management of acute and chronic shoulder pain will be reviewed. The possible complications of SSNB will be discussed. A summary of the evidence level for the use of SSNB will be presented.

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REVIEW METHODS

We performed a literature search for journal articles written in English in the PubMed database from January 1986 to December 2010. The electronic search strategy contained the following medical subject headings and free text terms: suprascapular nerve block, pain management, and complications of suprascapular nerve block. We excluded trials before 1986 because these were deemed out of date and superseded by more recent studies in terms of clinical evidence. We excluded abstracts older than 3 years, isolated case reports (eg, cancer pain), and correspondence articles. Although we included articles involving a case series, we limited these to studies involving more than 10 patients unless the series contained some very interesting findings.

ANATOMY OF THE SSN

The SSN is a large peripheral nerve possessing both motor and sensory fibers. It originates from the ventral rami of the fifth and sixth cervical nerve roots.[21,22] In addition, there may be a variable contribution from the fourth cervical nerve root.[21,23] After its formation, the nerve emerges from the lateral aspect of the upper trunk of the brachial plexus. It then travels through the posterior triangle of the neck, courses deep to the trapezius and omohyoid muscles, and enters the supraspinous fossa via the suprascapular notch underneath the superior transverse scapular ligament (STSL; Fig. 1). The suprascapular artery and vein pass above this ligament.[24] In the supraspinous fossa, the nerve is in direct contact with bone and exits the suprascapular fossa to infrascapular fossa lateral to the spinoglenoid notch[24] (Fig. 2).

Shortly after passing through the suprascapular notch, the SSN emits 2 branches: one is the motor nerve for the supraspinatus muscle[24–26] and the other is known as the superior articular branch. The latter nerve is sensory and supplies the coracoclavicular, coracohumeral ligaments, the acromioclavicular joint, glenohumeral joint (posterior and superior aspects), and the subacromial bursa.[21,27,28] The main trunk then exits the suprascapular fossa by curving around the lateral border of the scapula spine through a fibro-osseous tunnel terminating in motor branches to the infraspinatus muscle[26,28] (Fig. 2). The fibro-osseous tunnel is formed by the spinoglenoid ligament and the spine of the scapula.[29] The number of terminal motor branches supplying infraspinatus is variable and ranges from 2 to 4.[24–26]

The anatomy of the suprascapular notch is important for several reasons. The nerve is susceptible to injury and impingement at the level of the notch as it passes beneath the STSL.[30,31] This site represents an attractive region for SSN blockade as the nerve has not divided yet. The variable shape of the notch has been described and has been categorized into different types[32,33] (Fig. 3). In the adult, the most common type is a U-shaped or semicircular notch (types 1 and 2 in Fig. 3).[32] In

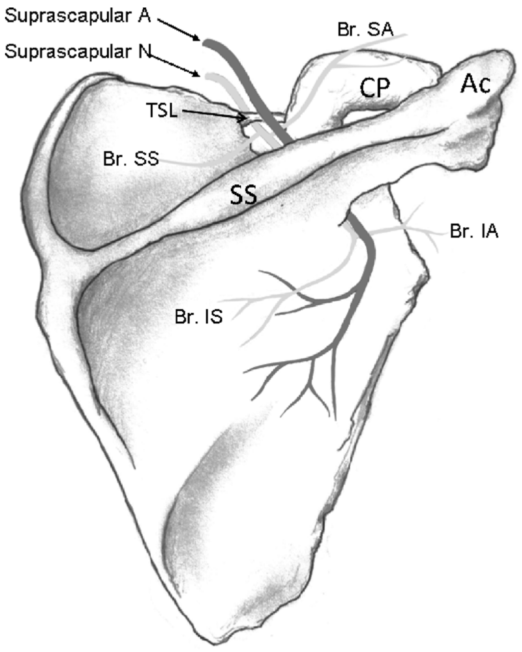

FIGURE 1. Suprascapular nerve and its branches of the left shoulder. Superior articular branch (Br.SA) supplies the coracohumeral ligament, subacromial bursa, and posterior aspect of the acromioclavicular joint capsule. Inferior articular branch (Br.IA) supplies the posterior joint capsule. Ac indicates acromion; Br.IS, branch to the infraspinatus muscle; Br.SS, branch to the supraspinatus muscle; CP, coracoid process; SS, scapula, spine; TSL, transverse scapula ligament. Reproduced with permission from Ultrasound for Regional Anesthesia (www.usra.ca).

one anatomic study of the scapula, the notch is absent or converted into a foramen by the ossified STSL in 15% of the specimens.[33]

TECHNIQUE OF LOCALIZING THE SSN

The details of the individual techniques will not be described here, but the two major approaches, superior and posterior, are compared below. In addition, the roles of various image-guided injections are discussed.

Approaches

Using surface landmarks, the SSN may be localized via a posterior or superior approach. While the posterior approach attempts to block the SSN at the level of the suprascapular notch,[2,34–37] the superior approach aims to block the SSN by surrounding the nerve with local anesthetic on the floor of the supraspinous fossa.[38,39]

Posterior Approach

The posterior approach is generally performed while the patient sits on the operating table with the ipsilateral arm lying at his or her side.[2,35,40] The superficial landmarks described in the posterior approach techniques serve to guide the needle to slide into the notch. As discussed in the anatomy section, the notch is not a defined structure in 15% of the population. Furthermore, the potential complication of this approach is pneumothorax as the trajectory of the needle is toward the thoracic cavity. The classic (Wertheim) approach is well described in the literature.[2] Modification of the landmarks for needle placement has been made by several authors.[34–37] To avoid the risk of pneumothorax, the scapula can be elevated from the posterior chest wall by repositioning the ipsilateral hand to the opposite shoulder, thereby increasing the potential distance the needle must travel from the skin to chest wall.[41]

To improve accuracy, the SSN has been localized using a nerve stimulator,[4,14] paresthesia,[41] and electromyography (EMG).[42]

Superior Approach

The superior approach[38,39] was initially described to permit SSNB performed in patients in the supine position, but the sitting position is the preferred position in clinical practice. In general, the needle is directed to the lateral half of the floor of the suprascapular fossa because the supraspinatus muscle is attached to the medial half. Potential advantages of this approach include ease of access, no reference to the notch, and extremely low risk of pneumothorax.[38,39]

Comparison of Blind Approach

Despite the many approaches and techniques published to date, few studies have actually compared them. An old study on pulsed RF lesioning of the SSN[43] compared four commonly used blind techniques,[2,34,37,44] in the final position of the needle tip relative to the suprascapular notch with radiographic correlation. They found that the needle tip was usually a significant distance from the notch such that a heat lesion would not affect the SSN in all techniques. When comparing the blind methods, they found that the approach suggested by Granirer[37] offered the best approximation of "needle tip to notch."[43]

Methods to Improve the Accuracy

Techniques using imaging guidance such as fluoroscopy,[45] computed tomography (CT),[46] and, more recently, US[16,17,47] have been described.

Conventional Imaging

Fluoroscopy and CT have been described to locate the suprascapular notch.[45,46] For the fluoroscopic technique, the patient is placed in the prone position. A C-arm is then used to identify the notch.[45] The suprascapular notch will be seen superior to the spine of the scapula, medial to the coracoid process, and lateral to the rib margins (Fig. 4).[45] To obtain an optimal

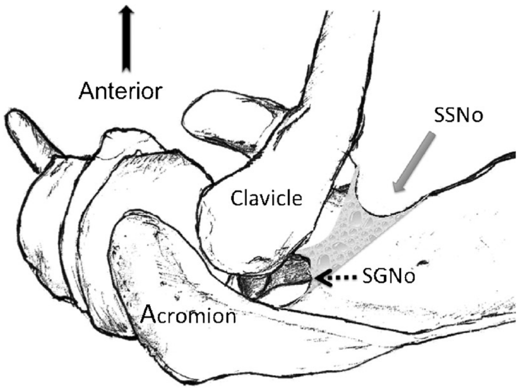

FIGURE 2. Superior view of the left shoulder. The course of the suprascapular nerve (shaded) enters the suprascapular fossa through the suprascapular notch (SSNo) and then enters the infrascapular fossa through the spinoglenoid notch (SGNo). Reproduced with permission from Ultrasound for Regional Anesthesia (www.usra.ca).

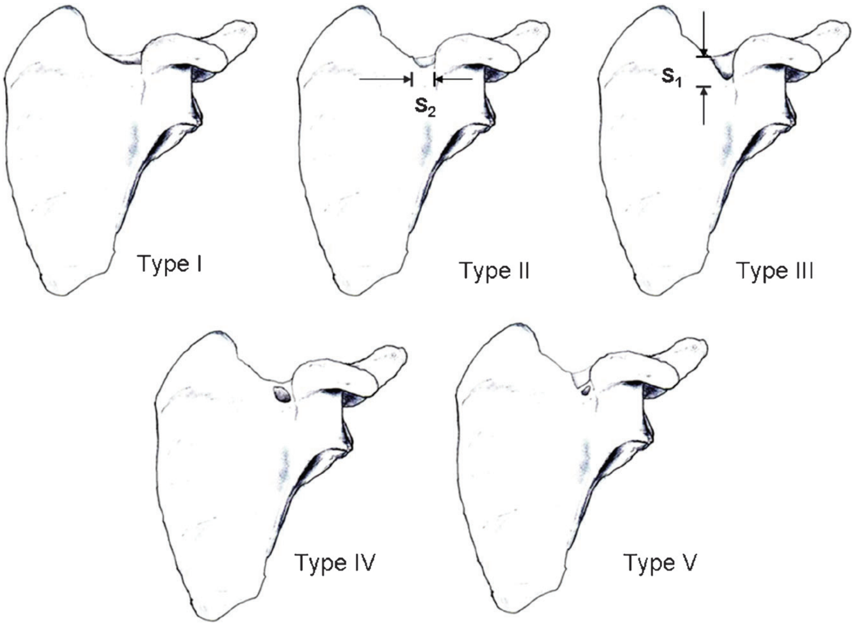

FIGURE 3. Variation of morphology of the suprascapular notch. Type I indicates no notch (8.3%); type II, notch with greater transverse diameter, S2 (41.85%); type III, notch with greater vertical diameter, S1 (41.85%); type IV, bony foramen (7.3%); type V, notch with bony foramen (0.7%). Adapted from Natsis et al.[33] Reproduced with permission from Ultrasound for Regional Anesthesia (www.usra.ca).

image, the C-arm will often need to be obliquely angled away from the side of the proposed block and in the cephalocaudad orientation.[45]

Ultrasound-Guided SSNB

Recently, several articles have been published describing the technique of US-guided SSNB.[16,17,47,48] As US-guided SSNB is a more recent technique and offers the visualization of the SSN, suprascapular artery, and the muscle layers, it will be discussed in further detail.

The ideal site to perform SSNB with US is at the floor of the suprascapular fossa, between the suprascapular notch and the spinoglenoid notch[17] (Figs. 2 and 5A, B). At this site, the SSN runs along the floor of the suprascapular fossa covered by the fascia of supraspinatus in a natural compartment, which will contain the spread of the local anesthetic or injectate. Applying a US-guided injection technique approximated the needle tip to the nerve and has been shown to achieve a complete block with a reduced volume of local anesthetic.[49] A small volume (5 mL) of injectate will result in adequate flooding of the nerve[50] with minimal spread to the brachial plexus.[51] Furthermore, this target is independent of the suprascapular notch, which can be absent in some individuals. The risk of pneumothorax is substantially reduced because of the direction of the needle.[52]

Imaging and EMG to Improve Needle Localization of the SSN

Despite multiple techniques being published describing assistance in needle localization, few data exist to guide the clinician on the effectiveness of this technology. In EMG guidance, 1 randomized clinical trial compared landmark-based to EMG-guided SSNB.[42] The patient population consisted of patients with chronic pain with adhesive capsulitis.[42] Although pain scores and shoulder range of motion (ROM) improved after SSNB in both groups, the investigators found that the EMG group had significantly lower pain scores than the landmark-based injection group. However, the follow-up was short, only 60 mins after procedure. It is unclear how relevant this finding is for a chronic pain problem.

One randomized single-blind trial compared the blind approach to SSNB with a CT-guided approach.[9] This study did not

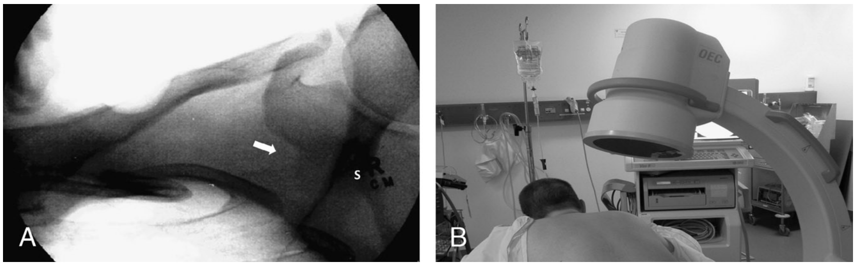

FIGURE 4. A, Radiograph of the right suprascapular notch. S indicates spine of scapula. White arrow points to the suprascapular notch. B, C-arm positioning for imaging the suprascapular notch. The patient is placed in prone position. The C-arm is positioned over the shoulder. To image the suprascapular notch, the C-arm is rotated oblique to the treated side and angled cephalocaudal. Reproduced with permission from Ultrasound for Regional Anesthesia (www.usra.ca).

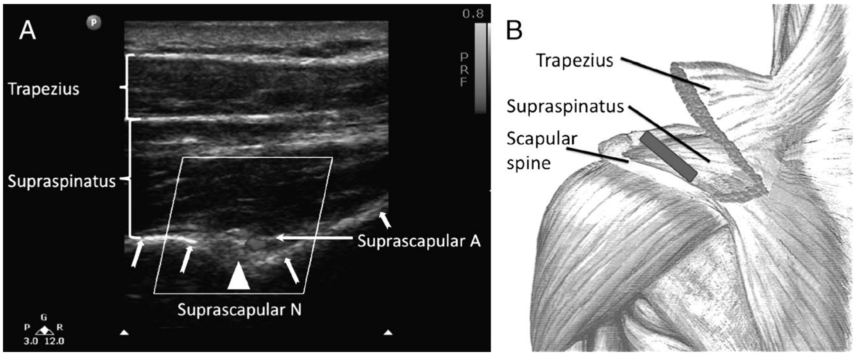

FIGURE 5. A, Ultrasonographic image of the suprascapular nerve on the floor of the scapular spine between suprascapular notch and spinoglenoid notch. Both suprascapular nerve and artery run underneath the fascia of supraspinatus muscle. Suprascapular A and N indicate suprascapular artery and nerve. Bold arrows outline the floor of the scapula fossa. B, Approximate position of the ultrasound probe (dark rectangle). The patient can be in sitting or in prone position. Ultrasound scanning is performed with a linear ultrasound probe (7–13 MHz) placed in a coronal plane over the suprascapular fossa with a slight anterior tilt. The probe is place in an orientation such that it is in the short axis to the line joining coracoid process and acromion (reflecting the position of the spinoglenoid notch). The trapezius muscle was removed to show the underlying supraspinatus muscle. Reproduced with permission from Ultrasound for Regional Anesthesia (www.usra.ca).

find any significant difference between the blind or CT-guided SSNB in pain scores, disability.[9] Both groups showed significant improvement after SSNB.[9] There were no significant adverse effects in either group, and patient satisfaction scores were high.[9]

Recently, the efficacy of US-guided SSNB was compared with the landmark-based technique.[18] In this study, patients with chronic nonspecific shoulder pain were randomized with 25 patients in each group. The investigators found that, initially, both groups improved in terms of pain relief. However, the analgesic effect was better sustained at 1 month in the US-guided group compared with the control group.[18] Furthermore, although there were no complications in the US-guided group, the control group recorded 2 cases of arterial puncture and 3 cases of direct nerve injury with neurologic deficit.[18]

In summary, various approaches have been described for the blockade of SSN. Disadvantages of the approach using the notch as a landmark are the potential absence of the notch in some individuals and the potential risk of pneumothorax. The superior approach may negate these disadvantages. On limited evidence, these studies would suggest that US is useful in approximating the block needle near the SSN and thereby in increasing efficacy and reducing complications of SSNB.

SUBSTANCES USED FOR BLOCKADE OF THE SSN

When the needle is placed near the SSN, several methods of nerve blockade have been published. The commonly used methods include local anesthetic, steroids, pulsed RF, and chemical neurolysis. These may be used alone or in combination. Bupivacaine is the popular local anesthetic agent, either in the concentration of 0.25%[12,38,41] or 0.5%[7,8,14,39] described in the literature. Epinephrine (1:200,000) is commonly added to the local anesthetic solution to increase the duration of action.[8] Injectate volume is highly variable in the literature. However, some authors argue that 5 mL is the optimal volume based on morphologic evidence.[50]

For the treatment of chronic shoulder pain, injectable steroid (methylprednisolone) is usually added to the local anesthetic solution. However, the value of this practice has been questioned by a double-blinded study[8] demonstrating that the addition of methylprednisolone fails to confer any benefit.

Suprascapular nerve blockade achieved with RF or cryolesion provides a long-lasting effect that can endure for up to 18 months.[20,43,53] Furthermore, one of these studies demonstrated a significant reduction in pain, improvement in function, and a reduction in analgesic medication (81% of study patients) after pulsed RF of the SSN.[20]

The use of chemical neurolysis for SSNB has mainly been in the form of case reports.[43,54] Injection of phenol causes protein coagulation and necrosis when applied directly to the nerve, thereby alleviating pain. A larger study involved 16 patients with shoulder pain secondary to rheumatoid arthritis. These patients received SSNB with prilocaine (4 mL) and 6% aqueous phenol (4 mL) with significant reduction in pain and improved shoulder ROM at 13 weeks of follow-up.[55]

SUPRASCAPULAR NERVE BLOCKADE IN CLINICAL PRACTICE

Suprascapular nerve blockade has been used in acute and chronic pain states. For acute pain, SSNB has been mainly achieved using long-acting local anesthetic solutions alone.

Acute Pain

The studies investigating the efficacy of SSNB in acute pain states are summarized in Table 1.

Suprascapular nerve blockade has been used successfully for the control of postoperative pain after open and arthroscopic shoulder surgery (Table 1).[4,14,56,57,62] It has been used as the sole regional anesthetic technique[4,56,57] but also in combination with other nerve blocks.[3,15,61] Although shoulder arthroscopy recently has become popular as an outpatient procedure, it remains one of the most painful of the same-day surgical procedures.[63] Use of interscalene block had been shown to reduce the unanticipated readmission rate due substantially to pain.[63] At present, interscalene brachial plexus block (ISB) is the usual regional technique used for analgesia during and after shoulder surgery.[64–66] Blockade of the brachial plexus provides more complete analgesia of the shoulder joint. Because the SSN supplies 70% of the sensory input to the shoulder joint, SSNB allows good control of severe postoperative pain after this notoriously painful procedure. Suprascapular nerve blockade decreases pain scores at rest and with movement in the early postoperative period and alleviates pain at 24 hours on shoulder abduction.[4] Furthermore, a significant reduction in analgesic dose and demand, discharge time, and the incidence of nausea has been reported.[4]

TABLE 1. Suprascapular Nerve Block for Acute Pain Control

Study Authors	Type of Acute Pain	Study Design	No. Participants	Results	Conclusions
SSNB as the only form of regional anesthesia					
Jerosch et al (2008)[56]	Arthroscopic shoulder surgery: mixed	Prospective, nonrandomized study. Comparison of 2 consecutive cohorts.	260 patients Received SSNB = 130 No nerve block = 130	No difference in baseline VAS scores. Postoperatively, significant reduction in VAS scores at 24, 48, and 72 hrs in the SSNB group. No complications of SSNB.	SSNB is effective in reducing postoperative shoulder pain in arthroscopic shoulder surgery. SSNB is associated with minimal complications.
Singelyn et al (2004)[57]	Arthroscopic shoulder acromioplasty	Prospective, randomized, blinded study	120 patients randomized to 4 treatment groups: SSNB = 30 IALA = 30 ISBPB = 30 Control (no regional analgesia) = 30	No significant difference in pain scores between control and IALA groups. SSNB and ISBPB reported significantly less pain than the other 2 groups. The ISBPB group had significantly less pain on movement than the SSNB group. Only the ISBPB group recorded significantly less morphine consumption and higher satisfaction.	ISBPB is the most efficient regional technique for arthroscopic shoulder acromioplasty. SSNB improves analgesia for arthroscopic acromioplasty but is less efficient than ISBPB. When ISBPB is contraindicated, SSNB is a clinically appropriate alternative.
Ritchie et al (1997)[4]	Arthroscopic shoulder surgery	Randomized, double-blind, placebo-controlled study	50 patients randomized to: Placebo = 25 SSNB = 25	VAS significantly lower in the SSNB group at 120 and 180 mins. VPS score significantly lower in SSNB group at 120, 180, and 240 mins. Significantly reduced morphine consumption (SSNB group) on the day of surgery. Significantly less nausea and vomiting in the SSNB group. Reduced stay in ambulatory surgical unit.	SSNB is an effective regional anesthetic technique for arthroscopic shoulder surgery in improved analgesia, reduced opioid requirements, and less nausea and vomiting.
Martinez-Barenys et al (2010)[58]	Ipsilateral postthoracotomy shoulder pain	Randomized, single-blinded study	74 patients. First group: phrenic group (PNI) received 10 mL of 2% lidocaine into perinephric fat pad before closure = 37. Second group: SSNB with 10 mL of 0.5% bupivacaine at completion of surgery = 37.	Shoulder pain intensity was significantly lower in the PNI group compared with the SSNB group.	Shoulder pain after horacotomy does not seem to arise from the shoulder joint. This study suggests that pain arises from diaphragmatic irritation. Therefore, routine preemptive blockade of the suprascapular nerve is not recommended.

Saha et al (2010)[59]	Ipsilateral postthoracotomy shoulder pain	Retrospective case review of postthoracotomy patients	178 patients after thoracotomy. New-onset shoulder pain after thoracotomy = 92 (51%). 34 patients (27%) with localizing signs suggestive of musculoskeletal origin underwent SSNB.	29 of 34 patients reported satisfactory pain relief after SSNB.	In patients with postthoracotomy shoulder pain and whom have localizing signs suggestive of musculoskeletal origin, SSNB is an effective treatment. However, SSNB is not the treatment per se for postthoracotomy shoulder pain because the musculoskeletal system is responsible for less than one third of cases.
Tan et al (2002)[60]	Ipsilateral postthoracotomy shoulder pain	Double-blinded, randomized, placebo-controlled study	44 patients who had undergone thoracotomy under general anesthesia and midthoracic epidural. 30 patients experienced shoulder pain within 2 hrs after surgery and were randomized to: SSNB with 10 mL of 0.5% bupivacaine = 15 Control: SSNB with 10 mL of 0.9% saline = 15	No significant decrease in VAS or VRS in patients receiving SSNB with bupivacaine	SSNB not effective for ipsilateral shoulder pain after thoracotomy.
SSNB in combination with another regional technique					
Checucci et al (2008)[3]	Arthroscopic shoulder surgery	Case series	20 consecutive patients each patient received an SSNB and an axillary nerve block as the sole anesthetic for the operation, with midazolam sedation.	All patients were able to have surgery under the combination block. No patients required opioids, analgesics or general anesthesia. Postoperative pain control was effective with negligible use of nonopiate analgesics. No opiate analgesic was required postoperatively.	SSNB in combination with axillary nerve block is sufficient for arthroscopic shoulder surgery.
Price (2007)[61]	Shoulder surgery: arthroscopic and open. Postoperative analgesia in patients who had ISBPB failure	Retrospective case series	40 patients with ISBPB failure received combined SSNB and axillary nerve block	57% of cases required no morphine in PACU. 83% of cases required no morphine overnight. Complications: radial nerve blockade which resolved (2/70 cases)	If ISBPB fails, combined SSNB and axillary nerve block is effective in providing postoperative analgesia for shoulder surgery.
Neal et al (2003)[15]	Ambulatory nonarthroscopic shoulder surgery	Prospective randomized study.	50 patients. SSNB and ISBPB–general anesthesia = 25. Sham injection and ISBPB–general anesthesia = 25.	Addition of SSNB significantly delayed the time to first significant report of pain. However, addition of SSNB did not improve PACU measures, 24-hr assessment of pain, supplemental analgesic use, or QOL measures.	SSNB combined with ISBPB does not significantly improve outcomes in ambulatory nonarthroscopic shoulder surgery.

IALA indicates intra-articular local anesthetic; ISBPB, interscalene brachial plexus block; PACU, post anesthesia care unit; PNI, phrenic nerve infiltration; QOL, quality of life; SSNB, suprascapular nerve block; VAS, visual analog scale; VPS, verbal pain scale; VRS, verbal rating scale.

TABLE 2. Suprascapular Nerve Block for Chronic Pain Conditions

Study Authors	Type of Chronic Pain	Study Design	No. Participants	Results	Conclusions
Eyigor et al (2010)[53]	Chlronic shoulder pain >3 mo; heterogeneous etiology.	Single-blinded, randomized, comparative clinical trial Outcome measures: Pain scores using VAS at rest and movement. Range of motion (ROM) of shoulder joint. Shoulder Pain and Disability Index (SPADI) Short-Form 36 Beck Depression Inventory Medication requirements Complications	50 patients Intra-articular injection of corticosteroid = 25 PRF applied to the SSN = 25	Improvements in pain, ROM of shoulder joint, and quality of life in both groups. In the SSN PRF group, improvement lasted for 12 wk in VAS, ROM and SPADI. Pain reduction was superior in the intra-articular group compared with the SSN PRF group.	Both intra-articular steroids and AAN PRF reduced pain and improved function. Intra-articular steroids showed a greater reduction in pain throughout the study period.
Gorthi et al (2010)[18]	Chronic shoulder pain	Prospective randomized comparative study.	50 patients SSNB under US guidance (treatment group) = 25 SSNB blind technique (control group) = 25	Both groups recorded significantly reduced pain (VAS) and improved function (CSS) after procedure. The group SSNB US group showed significantly superior VAS and CSS scores compared with the control group.	Performing SSNB under US guidance results in greater efficacy of block in pain and shoulder function measures. In addition, US reduces the risk of vascular and neurologic complications.
Mitra et al (2009)[71]	Adhesive capsulitis	Retrospective chart review over 3 y	28 consecutive patients Received SSNB as part of a protocol for adhesive capsulitis management. The protocol also included intra-articular steroid, volume dilation of the joint, and, finally, manipulation of the shoulder	After protocol, patients demonstrated significant improvements in ROM being flexion and abduction	SSNB as part of a multimodal therapy protocol improves shoulder function.
Liliang et al (2009)[20]	Chronic shoulder pain for 3 mo	Prospective case series	11 patients, total of 13 shoulder joints Treatment: PRF of the SSN	Significant pain relief in 10/13 joints at 1 mo. And 9/13 shoulders at 6 mo. Decreased SPADI scores at 6 mo and 9/11 patients reduced their analgesic medication.	SSN PRF reduces shoulder pain and disability in a range of shoulder pathologic diseases. Furthermore, patient's analgesic consumption is reduced.
Di Lorenzo et al (2006)[52]	Rotator cuff tendinitis	Prospective, randomized, crossover investigation	40 patients Treatment: SSNB and standard rehabilitation treatment Control: Standard rehabilitation treatment alone	The SSNB group reported significantly less pain at rest, activity, and with rehabilitation exercises compared with the control group.	SSNB and standard rehabilitation for rotator cuff tendinitis is superior to standard rehabilitation alone for pain control and functional improvement.

Taskaynata et al (2005)[72]	Chronic shoulder pain	Prospective randomized study. Intra-articular steroid injection = 30 SSNB = 30	60 patients No significant difference between the 2 treatments. Complications in the intra-articular steroid group. No complications in the SSNB group.	Significant improvement in pain and ROM in both groups compared with baseline at 1 wk and 1 mo.	Both intra-articular steroids and SSNB are effective for managing shoulder pain and improving shoulder function. SSNB is safe with negligible risk of complications.
Shanahan et al (2004)[9]	Chronic shoulder pain due to degenerative joint/rotator cuff disease	Randomized, single-blind study	67 patients 77 shoulder randomized Group 1: SSNB via anatomic landmark approach Group 2: SSNB via CT guidance	Significant improvements in pain scores and disability in both groups. No significant differences between the 2 groups No significant complications in either group No significant adverse events in either group	Clinically, there is no significant difference between SSNB performed via anatomic landmarks or CT guidance in efficacy and complication rate.
Schneider-Kolsky et al (2004)[46]	Chronic shoulder pain, range of pathology	Case series	40 consecutive patients. Treated with CT-guided SSNB	Significant reduction in pain and disability at both short-term and long-term follow-up. At long term (>3 wk), 29% of patients had sustained analgesia and reduced disability.	CT-guided SSNB provides effective short-term pain relief in chronic shoulder pain.
Shanahan et al (2003)[5]	Chronic shoulder pain due to rheumatoid arthritis and/or degenerative disease	Randomized, double-blind, placebo-controlled trial	83 patients, 108 shoulders studied in total. Treatment group: SSNB = 56 Control/placebo group: 52	Treatment group compared with placebo: Significant reduction in pain in the treatment group at 12 wk of follow-up. Modest but significant reduction in shoulder disability at 12 weeks in treatment group. No difference in quality-of-life measures (SF-36) between the 2 groups	SSNB is more effective than placebo in reducing pain and disability at 3 mo of follow-up for chronic shoulder pain of degenerative causes. However, it does not significantly improve quality of life compared with placebo.
Karatas and Meray (2002)[42]	Adhesive capsulitis (frozen shoulder)	Single-blinded, randomized comparative clinical trial	41 patients randomized into 2 groups: Group A: SSNB via anatomic landmarks Group B: near-nerve EMG-guided technique	In both groups, improvements in pain scores and ROM scores from baseline were significant. VAS scores were significantly lowered in the EMG group compared with the blind technique at 60 mins.	EMG-guided SSNB provides more rapid analgesia that the blind approach in immediate postblock time.

(Continued on next page)

TABLE 2. *(Continued)*

Study Authors	Type of Chronic Pain	Study Design	No. Participants	Results	Conclusions
Dahan et al (2000)[13]	Frozen shoulder (adhesive capsulitis)	Double-blind randomized controlled trial	34 patients randomized into 2 groups: Treatment: 3 SSNB at 7-d intervals with 10 mL of bupivacaine 0.5% each block. Control: same as treatment group except 10 mL of normal saline used for SSNB	Significant reduction in pain in the treatment group (64%) compared with the control group (13%) at 1 mo. Nonsignificant improvement in shoulder function in treatment group. No improvement in shoulder ROM.	Repeated SSNB with local anesthetic alone reduces pain compared with placebo but does not improve shoulder function or shoulder ROM.
Jones and Chattopadhyay (1999)[73]	Frozen shoulder (adhesive capsulitis)	Randomized trial of 30 patients	30 patients randomized. First group: single SSNB Second group: course of intra-articular injections	SSNB produced a faster and more complete reduction in pain and restoration of ROM than intra-articular steroid	SSNB is superior to intra-articular steroid injection for pain reduction and improvements in shoulder ROM.
Lewis (1999)[55]	Chronic shoulder pain due to rheumatoid or osteoarthritis	Case series	16 patients Treated with combined SSNB and ACNb (4 mL of 1% prilocaine and 4 mL of 6% aqueous phenol)	Significant reduction in pain intensity (69%) and improvement in ROM (36%–67%) over mean follow-up of 13 wk.	The combined SSNB and ACNb with local anesthetic and phenol provides pain relief and improvement in shoulder ROM
Gado and Emery (1993)[8]	Chronic shoulder pain due to rheumatoid arthritis	Double-blind comparative study	29 patients (58 shoulders) First group: SSNB with local anesthetic (bupivacaine) alone Second group: SSNB with local anesthetic and steroid	Both groups recorded significant improvements in pain, stiffness and ROM up to 3 mo. Steroid did not improve outcomes. In fact, the bupivacaine-alone group responded better.	SSNB is effective for reducing shoulder pain and improving function. But the addition of steroid does not seem to confer added benefit.
Vecchio et al (1993)[11]	Chronic shoulder pain due to rotator cuff lesions tendinitis and tears	Randomized clinical controlled trial	28 patients Divided into tendinitis and tears Tendinitis 15 –Active injection = 10 –Placebo injection = 5 Tears –Active injection = 5 –Placebo injection = 8	Tendinitis group: Significant improvement in night pain up to 12 wk, movement pain significantly improved at 1 wk but no difference at later follow-up, no difference to placebo in rest pain. Improvement in ROM only until 4 wk Tear group: Significant improvement in night pain up to 12 wk, significant improvement in movement pain until 12 wk, no difference to placebo in rest pain. Only active abduction improved until 4 wk, other ROM parameters showed no difference from placebo.	SSNB improves the pain of rotator cuff pathology for at least a 3-mo period. Although there is an improvement in shoulder function, this is only short term.

Emery et al (1989)[7]	Chronic shoulder pain due to rheumatoid arthritis	Randomized study	17 patients with bilateral shoulder rheumatoid arthritis 34 shoulders in total In each patient: 1 shoulder: SSNB and sham intra-articular injection Second shoulder: Intra-articular steroid and sham SSNB	Compared with intra-articular steroids SSNB resulted in longer duration of pain relief, improvement in pain index and range of movement.	
Brown et al (1988)[43]	Chronic shoulder pain due to glenohumeral arthritis not suitable for and had been received conservative medical management.	Pilot study. Consecutive case series.	22 patients, 26 shoulders treated with RF heat lesion of the SSN.	Analgesia: 7 produced no relief, 10 obtained good pain relief. Duration: 9 produced good relief for 3 mo, 14 produced relief for 6 mo, 9 produced relief for >7 mo. Three in the last group had 18 mo of pain relief.	SSNB PRF can provide variable duration pain relief in patients with advanced glenohumeral arthritis who are not suitable for surgery.

ACNb indicates articular branches of the circumflex nerve; CSS, constant shoulder score; CT, computed tomography; EMG, electromyography; MPQ, McGill-Melzack Pain Questionnaire; PRF, pulsed radiofrequency; ROM, range of motion; SF-36, Short-Form 36 Health Survey; SPADI, Shoulder Pain and Disability Index; SSN, suprascapular nerve; SSNB, suprascapular nerve block; VAS, visual analog scale; US, ultrasound.

Singelyn et al[57] conducted a study comparing control group (no regional technique), ISB, intra-articular local anesthetic, and SSNB after arthroscopic acromioplasty. In the first 24 hours of follow-up after surgery, both ISB and SSNB provided significantly improved pain control compared with the control group.[57] Intra-articular local anesthetic was not significantly different from controls.[57] However, at 4 hours of follow-up, ISB provided superior analgesia to the SSNB.[57] Only ISB produced significant reduction in morphine consumption compared with controls.[57] The authors concluded that ISB provided the most effective and efficient analgesic technique but that SSNB was an appropriate alternative especially in patients with pulmonary compromise because SSNB does not affect pulmonary function.[57]

The superior analgesia with ISB compared with SSNB is no surprise because, at best, SSNB can only anesthetize 70% of the shoulder joint. The remaining sensory innervation is provided by the nerve to the subscapularis, axillary nerve, and lateral pectoral nerve.[1] To improve the success rate of this regional technique, several clinicians have combined SSNB with an axillary nerve block to provide increased coverage of the shoulder joint during shoulder surgery.[3,61,67] Only 1 comprehensive study has been performed, and this was limited to arthroscopic procedures for rotator cuff disorders.[3] With the combined SSNB and axillary nerve block technique, all the patients in the study were able to undergo the operation with only sedation.[3] No opioid analgesics or general anesthesia was required.[3] The major limitations of these studies have been that they are case series and not randomized controlled trials.

The studies discussed previously are limited to arthroscopic shoulder surgery. For nonarthroscopic/open shoulder surgery, the role of SSNB is limited.[15] Neal et al[15] conducted a randomized clinical trial comparing standard ISB with ISB plus SSNB for nonarthroscopic shoulder surgery. They found that as an adjunct, SSNB provided more prolonged analgesia compared with ISB alone but did not affect other outcome measures such as supplemental analgesic use or quality-of-life outcomes.[15] They concluded that SSNB is less useful for nonarthroscopic shoulder surgery because these operations are usually anterior procedures that are outside the region of SSN sensory innervation compared with the posterior port stimulation of arthroscopic surgery.[15]

In summary, for pain associated with shoulder surgery, ISB is the most effective regional technique for analgesia and ambulatory outcome measures. Suprascapular nerve blockade will provide improved analgesia compared with a general anesthetic technique alone for arthroscopy but is inferior to ISB. Suprascapular nerve blockade combined with an axillary nerve block provides excellent operative and postoperative analgesia. For nonarthroscopic shoulder surgery, the role of SSNB as an adjunct to ISB is limited.

In addition to the management of acute pain associated with shoulder surgery, several studies have assessed SSNB for control of shoulder pain after thoracotomy.[58–60] These studies provided conflicting results. Whereas 1 retrospective study demonstrated a reduction in shoulder pain after thoracotomy in patients treated with SSNB,[59] two prospective randomized studies did not show any reduction in shoulder pain in patients receiving SSNB for shoulder pain after thoracotomy.[58,60] Furthermore, the most recent randomized controlled trial suggested that shoulder pain after thoracotomy is not musculoskeletal in origin but referred pain from diaphragmatic irritation.[58] The difference in results may be due to the selection of patients. The study demonstrating that SSNB was beneficial in screening postthoracotomy patients and only those with shoulder pain and localizing signs suggestive of musculoskeletal pain improved with SSNB.[59] If selected in this manner, then this study found that 85.3% of selected patients obtained satisfactory pain relief after SSNB.[59]

In summary, one may conclude that SSNB is not effective in all patients who develop ipsilateral shoulder pain after thoracotomy. However, in those patients who have localizing signs suggesting the shoulder pain is musculoskeletal in origin, SSNB is an appropriate intervention to relieve pain. This could be further investigated by a randomized clinical trial.

The efficacy of SSNB has been reported in a variety of other acute pain states[68–70]; these were limited to isolated case reports or small case series and, although promising, require further investigation.

Chronic Pain

For patients with chronic pain, SSNB may be both a diagnostic but more commonly a therapeutic procedure. To achieve more prolonged analgesia for chronic pain, local anesthetic is combined with steroid, phenol, or pulsed RF when SSNB is performed (Table 2).

Diagnostic Block for Suprascapular Neuropathy

Suprascapular neuropathy is believed to be the cause in 1% to 2% of patients with shoulder pain.[74] The suspicion of suprascapular neuropathy is suggested by posterior shoulder pain, a history of trauma or traction to the SSN, and weakness and atrophy of the muscles (supraspinatus, infraspinatus) supplied by the SSN.[29,75–77] Neuropathy of the SSN can be caused by traction or compression of the nerve at the spinoglenoid region or the suprascapular notch. The causes of traction or compression include trauma, repetitive use, and space-occupying lesions.[78,79] The differential diagnosis is broad. The diagnosis is often made based on clinical, investigative parameters (electrophysiologic and imaging studies) and on exclusion of other pathologic diseases, mainly rotator cuff pathology, cervical radiculopathy, and brachial plexopathy.[80] The optimal management of suprascapular neuropathy has not been determined. Studies have reported good to excellent results in either nonsurgical management[81,82] or surgical management.[74,75,77]

Owing to the difficulty in differentiating suprascapular neuropathy from other shoulder pathologic diseases, SSNB can be performed to aid in the diagnosis.[6] A diagnosis of SSNB is often based on clinical history and examination findings together with electrodiagnostic studies and magnetic resonance imaging.[6] In cases where the diagnosis is uncertain after electrodiagnostic studies, SSNB may be helpful. The test is positive if the pain is completely relieved.[78]

Chronic Shoulder Pain: General Considerations

Suprascapular nerve blockade has been widely investigated in a variety of chronic pain conditions (Table 2). A number of trials, which examined chronic shoulder pain in a heterogeneous group without looking at individual pathologic diseases, have been performed.[18,20,46,53,72] Of these trials, three were randomized.[18,53,72] Two of these randomized studies compared SSNB to intra-articular steroid for shoulder pain and function.[53] The other study compared SSNB under US to SSNB via surface anatomy.[18] In these trials, SSNB resulted in significant improvements in pain scores and shoulder function.

There is only 1 randomized controlled trial that investigated chronic shoulder pain of either degenerative disease or inflammatory in origin.[5] This investigation revealed a significant and sustained benefit in pain and disability scores as well as the range of movement at weeks 1, 4, and 12.[5] The remaining trials consisted of case series, which showed significant improvement in pain and disability in chronic nonspecific shoulder pain after SSNB.[20,46]

The most common pathologic diseases individually studied are chronic pain from rheumatoid arthritis or osteoarthritis, adhesive capsulitis (frozen shoulder), and persistent rotator cuff lesions.

Shoulder Joint Arthritis: Rheumatoid Arthritis and Osteoarthritis

A number of studies have assessed the efficacy of SSNB for the pain and disability of arthritis. Some have included both osteoarthritis and rheumatoid arthritis,[5,9,55] whereas others have focused on rheumatoid arthritis alone.[8,43]

Shoulder pain is common in patients with rheumatoid arthritis. Early in this disease process, 40% of patients have shoulder involvement, with nearly all eventually having shoulder pain and disability.[83] The causes of shoulder pain in this population include arthritis in the glenohumeral and acromioclavicular joint, rotator cuff disease, subacromial bursitis, tenosynovitis, and referred pain from cervical spine disease.[83] The goal of SSNB is to provide better shoulder pain control and movement in patients with long-standing rheumatoid arthritis.

Local intra-articular corticosteroid injection and gentle mobilization may improve rheumatoid shoulder in the early stages of disease.[83] However, when glenohumeral damage is advanced, this treatment option is not as effective.[84] Two randomized controlled trials have been published to suggest the efficacy of SSNB. One is a randomized controlled trial comparing the efficacy of intra-articular steroid injection with SSNB in patients with long-standing rheumatoid arthritis (mean, 17 years), SSNB provided prolonged pain relief (3 mos) and superior improvement in shoulder movement.[7] Another one is a double-blind placebo-controlled randomized controlled trial including patients experiencing rheumatoid shoulder that was performed recently.[5] A total of 108 subjects were randomized to receive an injection of 10 mL of bupivacaine 0.5% and 40 mg of methylprednisolone into the suprascapular fossa or a placebo injection of 5 mL of normal saline.[5] Suprascapular nerve blockade was performed using surface anatomic landmarks as described by Dangoisse et al.[39] At 3 months of follow-up, the active injection (local anesthetic and steroid) group recorded significantly superior pain reduction (visual analog scale) and functional improvement (Shoulder Pain and Disability Index, SF-36 scales) compared with the placebo group. A notable finding was that 67% of the patients receiving the active injection improved by at least 10 points on the Shoulder Pain and Disability Index, which is a significant clinical improvement.[85] The only adverse effects were minor including chest wall tenderness in one subject, which resolved, and minor bruising in another subject.[5]

Similarly, SSNB provided significantly better analgesia and superior movement in patients with long-standing rheumatoid arthritis who were unresponsive to intra-articular injection of steroid.[8,43] Interestingly, supplementation of the local anesthetic solution with steroid conferred no additional benefit.[8]

Adhesive Capsulitis (Frozen Shoulder)

Also known as adhesive capsulitis, frozen shoulder is characterized by significantly restricted shoulder movement in patients with shoulder pain.[12] This condition progresses from pain to pain accompanied by gradually worsening stiffness to reduced pain accompanied by profound stiffness. The last stage seems to be self-limiting and recovery is gradual and spontaneous, with an excellent chance of complete return of function within 1 to 2 years irrespective of therapy.[86,87] The goal of treatment in the early stage is to alleviate pain so that physiotherapy can be effective in restoring normal shoulder movement and activity.[87] A comparative clinical trial performing SSNB on patients with adhesive capsulitis demonstrated a significant improvement in pain and ROM scores, but follow-up was limited to only 90 minutes after SSNB with local anesthetic alone.[42] Furthermore, there was no placebo control.[42] A small randomized trial (30 patients) compared the effects of SSNB to intra-articular shoulder injections for adhesive capsulitis during a longer follow-up period.[73] The investigators found that SSNB produced faster onset and more effective analgesia compared with a series of intra-articular injections.[73] Furthermore, significantly improved shoulder function (measured by abduction and external rotation) was also observed.[73] These effects lasted up to 3 months.[73]

A later placebo-controlled trial examined the response of SSNB with bupivacaine compared with placebo.[13] There was a significant reduction in pain in patients receiving local anesthetic blockade up to 1 month of follow-up.[13] However, no significant improvement in shoulder function or range of movement was found. This study did not inject steroid medication as part of their treatment.[13]

Persistent Rotator Cuff Lesions

Rotator cuff tendinitis is a common cause of shoulder pain in adults and may result in considerable morbidity.[88,89] Many patients respond to conservative management, including avoiding activities likely to aggravate the lesion, use of nonsteroidal anti-inflammatory drugs, local injection of steroid, and physiotherapy.[88,89] However, significant symptoms may persist: in one retrospective, long-term follow-up study, symptoms of severe shoulder pain persisted in approximately 26% of patients after a mean duration of 12 months after the first presentation of pain.[89]

In this subset of patients with persistent symptoms, SSNB has been demonstrated to provide effective pain relief and improved ROM.[11] Although the therapeutic effect is temporary (4–12 weeks), it can be simply repeated in outpatient settings with minimal risk of complications. This block is also an effective way to control pain in patients awaiting surgery.[11]

Recently, pulsed RF of the SSN has shown promise in providing prolonged analgesia for those patients responding to SSNB (rotator cuff lesion identified on clinical and radiologic grounds) but where analgesia is not sustained.[19] After pulsed RF lesioning, a significant reduction in pain (visual analog scale) and improvement in shoulder function (Constant and Oxford shoulder scores) was reported, lasting until 3 months of follow-up.[19] These results are similar to those of Liliang et al[20] who, in addition to improvement in pain and function, also demonstrated a reduction in medication requirements in their study group. However, both injection and RF trials did not include a placebo control group, and further investigation is required to confirm the efficacy of the neural blockade or ablation technique in the management of rotator cuff tendinitis.

In summary, SSNB is effective for short-term pain relief and improvement in shoulder function in a variety of painful shoulder conditions. The main causes of shoulder pain studied were arthritic conditions, rotator cuff lesions, and adhesive capsulitis. Unfortunately, in many studies, the patient population was heterogeneous with regard to shoulder pathology. Therefore, interpreting specifically which pathologic disease responds best to SSNB is difficult to determine. Pulsed RF to the SSN has shown promise in providing more sustained analgesia and functional improvement. However, these studies have mainly involved case series.

SUPRASCAPULAR NERVE CATHETER

Although SSN catheters have been used, published reports are limited to isolated cases or small case series.[90,91] In one cancer case, prolonged analgesia from pain due to metastasis to the scapula was achieved by repeated injection through an epidural catheter, which was advanced into the suprascapular space.[91] The catheter was tunneled subcutaneously, exiting into the supraclavicular area, permitting treatment of breakthrough pain from scapular movement by repeated injection of 0.5% bupivacaine.[91] A more recent correspondence described placement of the catheter at the spinoglenoid notch during shoulder arthroscopy.[90] This is done under direct vision by the surgeon.[90] However, more outcome data are required to assess whether this would be beneficial for postsurgical pain compared with a single-shot SSNB.

COMPLICATIONS

The complication rate of SSNB is generally low (Table 3). Possible complications are discussed.

1. Pneumothorax

Although rare (incidence <1%[34]; Table 1), pneumothorax is the most serious complication of SSNB. It usually occurs with the posterior approach and is caused by advancing the needle deeper than recommended. The usual depth of needle at which bone contact is made is between 3 and 6.3 cm.[34,41,92] When inserted more than 5 cm, the needle is likely to be at the suprascapular notch or above the scapula border. To reduce the risk of pneumothorax, the needle should be withdrawn and redirected at a slightly different angle until the bone is reached. In addition, positioning the ipsilateral hand to the opposite shoulder will elevate the scapula away from the posterior chest wall, thereby increasing the potential distance between the skin and the chest wall[41] and minimizing the risk of unintentional pneumothorax.

Penetration of the intercostal space also is unlikely with the superior approach. For the superior approach,[39] the needle is advanced in a direction parallel to the scapula and away from the direction of the lung; with the anterior approach, the point of needle entry is away from the dome of the lung and the needle is advanced in a direction perpendicular to the ribs.[12]

2. Intravascular injection

The suprascapular artery and vein are separated from the nerve by the superior transverse ligament of the scapula.[22] Puncture of either vessel during needle insertion may produce a systemic toxic reaction after administration of local anesthetic. Thus, careful aspiration is essential before injection of the local anesthetic to ensure the absence of vascular puncture.

3. Residual motor block

Suprascapular nerve blockade reportedly has resulted in impaired motor function, but the duration and significance of this effect have not been defined or confirmed. In addition, the supraspinatus and infraspinatus are the only muscles supplied by the SSN, making profound motor blockade unlikely, in contrast to interscalene block.[93]

4. Local trauma

Repeated probing during localization of the suprascapular notch can result in significant trauma, particularly in

TABLE 3. Complications of Suprascapular Nerve Block and Rhizotomy

Study Authors	Type of Study	No. Patients	Clinical Indication for SSNB or SSN Rhizotomy	Complications Reported (n)
Eyigor et al* (2010)[53]	R	50	Chronic shoulder pain	No complications reported
Gorthi et al (2010)[18]	R, C	50	Chronic shoulder pain	US group—no complications; Blind technique: arterial puncture (2), direct nerve injury (1)
Martinez-Barenys et al (2010)[58]	R	74	Ipsilateral shoulder pain after thoracotomy	No complications reported
Saha et al (2010)[59]	O	178	Ipsilateral shoulder pain after thoracotomy	No complications reported
Mitra et al (2009)[71]	O	28	Adhesive capsulitis	No complications reported
Liliang et al* (2009)[20]	O	11	Chronic shoulder pain	Puncture wound pain for 1 wk (1)
Kane et al* (2008)[19]	O	12	Painful cuff tear arthropathy in patients unfit for surgery	No complications reported
Checucci et al (2008)[3]	O	20	Patients undergoing arthroscopic procedures for rotator cuff disease	No complications reported
Jerosch et al (2008)[56]	R	260	Arthroscopic and shoulder surgery	No complications reported
Price (2007)[61]	O	40	Arthroscopic and open shoulder surgery	No complications reported from SSNB
Di Lorenzo et al (2006)[52]	R	40	Rotator cuff tendinitis	No major complications
Taskaynata et al (2005)[72]	R	60	Chronic shoulder pain	No complications reported
Singelyn et al (2004)[57]	R, C	120	Arthroscopic shoulder surgery	No complications reported
Shanahan et al (2004)[9]	R, SB	67	Degenerative joint or rotator cuff disease	No complications reported
Schneider-Kolsky et al (2004)[46]	O	40	Chronic shoulder pain	No complications reported
Neal et al (2003)[15]	R, DB, C	50	Acromioplasty, rotator cuff repair, or combination of both	No complications reported
Shanahan et al (2003)[5]	R, DB, C	83	Shoulder pain from rheumatoid arthritis and/or degenerative disease of the shoulder	Minor bruising (1)
Tan et al (2002)[60]	R, DB, C	44	Ipsilateral shoulder pain after thoracotomy	No complications reported
Karatas and Meray (2002)[42]	R, SB	41	Adhesive capsulitis	No complications reported
Dahan et al (2000)[13]	R, DB, C	34	Frozen shoulder	No major complications reported
Jones and Chattopadhyay (1999)[73]	R	30	Frozen shoulder	No major complications reported
Lewis (1999)[55]	O	16	Rheumatoid or osteoarthritis of shoulder	No complications reported
Ritchie et al (1997)[4]	R, DB, C	50	Arthroscopic shoulder surgery	No complications
Dangoisse et al (1994)[39]	O	12	Frozen shoulder (6 patients), others (6 patients)	Sensation of heaviness in arm (1), numbness and aching shoulder (1)
Gado and Emery (1993)[8]	R, DB	26	Rheumatoid arthritis	No complications reported
Vecchio et al (1993)[11]	R, C	28	Rotator cuff tendinitis	Mild aching in the injection area (16)
Wassef (1992)[12]	O	9	Frozen shoulder	No complications reported
Emery et al (1989)[7]	R, DB, C	17	Rheumatoid arthritis	No complications reported
Brown et al* (1988)[43]	O	22	Rheumatoid arthritis	Impaired abduction (1)

C indicates placebo-controlled; DB, double-blinded; R, randomized; No., number; SSNB, suprascapular nerve (SSN) block; US, ultrasound.
*Rhizotomy study.

muscular patients. In addition to aching at the needle insertion site (Table 1), the patient may also have a vasovagal response.[94]

SUMMARY AND FUTURE DIRECTIONS FOR RESEARCH

On review of the literature discussed here, the uses of SSNB and pulsed RF lesioning of the SSN can be summarized in Table 4.

Although the studies mentioned in this review demonstrate efficacy of SSNB in chronic shoulder pain, there is a lack of placebo-controlled trials to provide robust evidence. Many of the trials were either case series or compared SSNB to another intervention for shoulder pain (eg, intra-articular steroid injection). The beneficial effect of placebo in the reduction of pain has been well documented.[96] Therefore, future trials should incorporate a placebo control when studying SSNB or other methods of lesioning the SSN with the intent of reducing shoulder pain.

TABLE 4. Summary of Evidence on Suprascapular Nerve Block and Rhizotomy

Studied Uses of SSNB	Level of Evidence
SSNB is inferior to ISBPB for shoulder surgery	I
SSNB is not effective for reducing all cases of ipsilateral shoulder pain after thoracotomy	I
SSNB does not improve outcomes in ambulatory nonarthroscopic shoulder surgery when added to ISBPB	I
SSNB is effective for postoperative pain control for shoulder arthroscopic surgery and reduces opioid requirements and nausea and vomiting	II-1
SSNB is effective for providing short-term (3 mo) analgesia and improving function for chronic shoulder pain due to degenerative pathology or rotator cuff lesions	II-1
PRF of the SSN can provide longer lasting analgesia and improved shoulder function than single SSNB	II-2
SSNB combined with axillary nerve block is sufficient for arthroscopic shoulder surgery	II-3

Based on the Quality of Evidence Grading as recommended by the US Preventive Services Task Force (Appendix 1).[95]

ISBPB indicates interscalene brachial plexus block; PRF, pulsed radiofrequency; SSN, suprascapular nerve; SSNB, suprascapular nerve block.

Pulsed RF of the SSN has been proposed to provide more sustained analgesia than single-shot SSNB. Several trials have reported promising results but have been nonrandomized, comprised low numbers, studied a heterogeneous population, and have limited follow-up. Although this review has concentrated on SSNB, the importance of physical therapy in patients with chronic shoulder pain cannot be ignored. Future research would be helpful in identifying the best timing for SSNB in conjunction with physical therapy. Would SSNB performed earlier lead to improved results rather than waiting for a patient to fail standard conservative medical treatment? Furthermore, with the complication rate from SSNB being very low, is the benefit-to-risk ratio much improved by performing SSNB earlier in patients with chronic shoulder pain?

Perhaps the major limitation identified in reviewing the literature is that many trials did not differentiate the efficacy of SSNB on different shoulder pathologic diseases. Many trials were on heterogeneous populations experiencing chronic shoulder pain. This would include patients with osteoarthritis or rheumatoid arthritis, rotator cuff lesions, and myofascial pain. By including a heterogeneous population, the external validity of these studies is reduced. Future research should attempt to identify which specific shoulder pathologic diseases SSNB is effective for. This, in turn, would better assist the clinician to better select patients who should receive SSNB as part of their management.

CONCLUSIONS

Suprascapular nerve blockade is easy to perform and a safe technique for providing relief from various types of shoulder pain. Suprascapular nerve blockade permits effective, long-lasting analgesia for conditions affecting the shoulder or scapula, including rheumatologic disorders, cancer and trauma pain, and postoperative pain due to shoulder arthroscopy. Posterior, superior, and anterior approaches may be used, the most common being the posterior. Pneumothorax is the most significant, albeit rare, complication of SSNB, the risk of which can be minimized by vigilance to the depth of needle insertion and to contact with bone, positioning of the patient's ipsilateral hand to the contralateral shoulder, depositing injectate to the supraspinous fossa rather than the suprascapular notch, and using the superior rather than posterior the approach.

Future research should seek to better identify which shoulder pathologic diseases will respond to SSNB. In addition, the timing and place of SSNB as part of a multidisciplinary pain management program deserves further study.[97]

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APPENDIX 1
QUALITY OF EVIDENCE GRADING AS RECOMMENDED BY THE US PREVENTIVE SERVICES TASK FORCE

Level of Evidence	Description
I	Evidence from at least 1 properly designed randomized controlled trial
II-1	Evidence obtained from well-designed controlled trials without randomization
II-2	Evidence obtained from well-designed cohort or case-control analytic studies, preferable from more than 1 center or research group
II-3	Evidence obtained from multiple time series with or without the intervention
III	Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees