

# Efficacy of arthroscopically placed pain catheter adjacent to the suprascapular nerve (continuous arthroscopically assisted suprascapular nerve block) following arthroscopic rotator-cuff repair

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**Background:** Rotator-cuff surgery is well recognized to be a painful procedure.

**Objectives:** The purpose of this study was to examine the effectiveness of an arthroscopically placed perineural catheter at the scapular notch to provide a continuous block of the suprascapular nerve (continuous arthroscopically assisted suprascapular nerve block [ca-SSNB]) following arthroscopic rotator-cuff repair (ARCR).

**Materials and methods:** This level II, prospective, randomized, controlled trial without post-operative blinding included 40 patients, who had a 48-hour pain pump, with 0.2% ropivacaine infusion and a continuous rate of 3 mL/hour, placed via an arthroscopically placed catheter following ARCR with arthroscopic release of the superior transverse ligament: 21 patients had a ca-SSNB, and 19 patients had a continuous subacromial bursal block (SAB). The visual analog scale (at 6 hours and on the first, second, and third postoperative days) and the total number of additional pain-reduction attempts during the 3 postoperative days were calculated.

**Results:** The respective visual analog scale scores (mm) obtained from the ca-SSNB and SAB groups were 62.4 and 67.6 ( $P=0.73$ ) before surgery, 9.1 and 19.4 ( $P=0.12$ ) at 6 hours after surgery, 24.4 and 44.6 ( $P=0.019$ ) on the first postoperative day, 19.4 and 40.4 ( $P=0.0060$ ) on the second postoperative day, and 18.5 and 27.8 ( $P=0.21$ ) on the third postoperative day. Total additional pain-reduction attempts recorded for the ca-SSNB and SAB groups during the 3 postoperative days were 0.3 times and 1.2 times ( $P=0.0020$ ), respectively.

**Conclusion:** ca-SSNB was highly effective in controlling postoperative pain after ARCR.

**Keywords:** shoulder, rotator cuff tear, postoperative pain control, continuous suprascapular nerve block, arthroscopic rotator cuff repair

## Introduction

Rotator-cuff surgery is well recognized to be a painful procedure.<sup>1,2</sup> Recent widespread use of arthroscopic techniques has decreased the level of postoperative pain; however, Wilson reported that a third of patients will experience severe pain on the first postoperative day following arthroscopic rotator-cuff repair (ARCR), even with administration of multimodal analgesia.<sup>2</sup>

Management of postoperative pain is important, and studies have shown that it allows for faster rehabilitation and recovery. An increase in pain also correlates with a delay in return to work and lower clinical scores 6 weeks after surgery.<sup>3</sup> An increase in postoperative pain is correlated with a decrease in patient quality of recovery in the immediate postoperative period, a delayed return to work, and lower clinical scores 6 weeks after surgery.<sup>3,4</sup>

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There are several modalities designed to decrease postoperative pain. Opioid analgesics are helpful, but there are several adverse effects associated with their use, including nausea and vomiting, pruritus, sleep disturbance, constipation, and opioid-induced hyperalgesia.<sup>5</sup> The infiltration of local anesthetics to the subacromial bursa (SAB block) used to be a popular technique with encouraging initial results; nevertheless, recent studies have demonstrated that the technique is associated with marginally better pain relief compared with that using placebo. Consequently, this technique is not regarded as first-line therapy for pain relief associated with rotator-cuff procedures.<sup>1</sup>

Single-injection nerve blocks have an important place in the management of pain following shoulder surgery. The interscalene nerve block (ISB) is the most popular procedure, and is being widely used in combination with general anesthesia.<sup>1</sup> The major limitation of administering a single injection (including ISB) is that the anesthetic usually has a short duration of action. Recently, several authors have recommended the continuous interscalene block (CISB) as the gold standard for most shoulder procedures.<sup>1,6,7</sup> Numerous clinical trials have been published evaluating the efficacy of CISB for postoperative pain management.<sup>1</sup> However, CISB techniques are more technically challenging compared with the single-shot ISB.<sup>1,8–11</sup> Potential side effects of ISBs, such as Horner's syndrome, hoarseness, and phrenic nerve block (diaphragmatic paralysis), might be more prolonged in the setting of CISB than in single-shot ISB, which might be more severe and distressing for patients.<sup>1</sup>

The suprascapular nerve block (SSNB) is another type of peripheral nerve block used to provide shoulder-pain relief.<sup>12–29</sup> The suprascapular nerve (SSN) provides sensory fibers to 70% of the shoulder joint, including the superior and posterosuperior regions of the shoulder joint, the capsule, and the overlying skin.<sup>13</sup> The single-injection SSNB is an established anesthetic technique that is safe and effective, but is limited by a short duration of action, similar to other single-injection blocks.<sup>1</sup> Continuous SSNB theoretically prolongs the analgesia period. However, continuous SSNB is technically challenging, and very few such cases have been reported.<sup>15,20,21</sup>

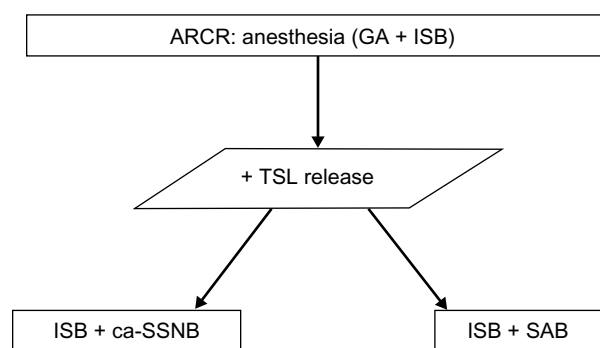
We developed a new continuous SSNB technique using a perineural catheter placed arthroscopically at the scapular notch to provide a continuous block to the suprascapular nerve. The use of arthroscopy ensures the proximity of the catheter placement to the SSN and decreases the risks related to the SSNB (ie, nerve damage by the needle, intravascular injection, and pneumothorax). The purpose of this study was to assess the analgesic efficacy of continuous arthroscopically

assisted SSNB (ca-SSNB) in patients undergoing ARCR under general anesthesia. We hypothesized that ca-SSNB would reduce the level of postoperative pain.

## Materials and methods

The institutional review board approved this study, and all patients participating in the study provided informed consent. From June 2010 to January 2011, patients classified according to American Society of Anesthesiologists status as class I–II were scheduled for ARCR concomitant with a transverse scapular ligament (TSL) release for SSN decompression, and were entered into this prospective randomized trial (Figure 1). Patients were randomly divided into two groups: patients who received ca-SSNB, and patients who received SAB with the infiltration of a continuous local anesthetic to the subacromial bursa. The following patients were excluded from the study: patients with a history of shoulder injury or shoulder surgery, those receiving daily pain medication for problems not associated with the shoulder, those with medical contraindications to regional anesthesia, and those with a subscapularis tear requiring repair. Our indications for TSL release in patients undergoing rotator-cuff repair were: 1) a large or massive rotator cuff tear, and 2) a medium tear with posterior shoulder pain and with a narrow suprascapular notch, as evidenced by three-dimensional computerized tomography.

Evaluation methods included rating via the visual analog scale (VAS; 0–100 mm) at 6 hours and on the first, second, and third postoperative days. In addition, the total number of additional pain-reduction attempts was calculated during the 3 postoperative days. The total time required for TSL release (ie, from the time when debridement medial to the acromioclavicular (AC) joint was initiated until the time



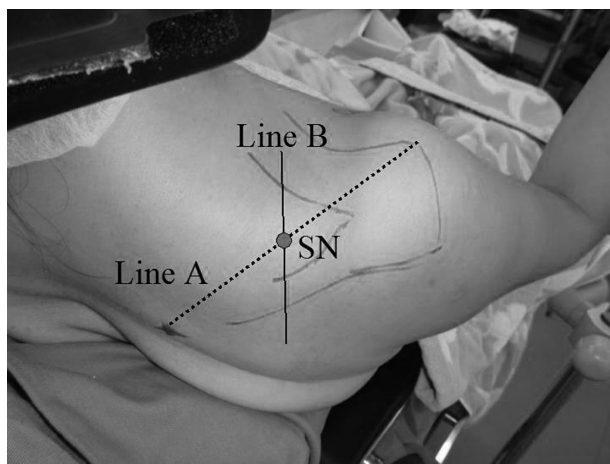
**Figure 1** Patient flowchart.

**Abbreviations:** ARCR, arthroscopic rotator-cuff repair; ca-SSNB, continuous arthroscopically assisted suprascapular nerve block; GA, general anesthesia; ISB, interscalene nerve block; TSL, transverse scapular ligament; SAB, subacromial bursal block.

of completion of the ligament release) was recorded and analyzed. Patient demographic data were compared using an unpaired *t*-test for age, weight, height, and duration of surgery, along with a  $\chi^2$  analysis for sex ratio, the rate of arthroscopic subacromial decompression (ASAD), and the tear size. The VAS score and the elapsed time for TSL release were analyzed using the Mann–Whitney *U* test. Statistical significance was set at  $P < 0.05$ . Statistical analyses were performed with Microsoft Excel software (Microsoft, Redmond, WA, USA).

## Surgical technique

A single surgeon performed all the surgical procedures. Patients were administered an interscalene block with 10 mL of 0.75% ropivacaine without the use of a nerve stimulator or ultrasound guide, but relying on palpation of the cervical muscles. No paresthesia was explored nor reported in any patient. Next, standardized general anesthesia was induced with intravenous administration of propofol (2–2.5 mg/kg). Anesthesia was maintained with oxygen and end-tidal sevoflurane, with airway management using laryngeal mask airway and spontaneous respiration. Once general anesthesia was accomplished, the patient was positioned in the beach-chair position with the arm held in flexion and with 1–3 kg longitudinal traction according to the patient's body weight. The superficial anatomy of the shoulder was identified, and the skin was marked to outline the clavicle, acromion, scapular spine, and the coracoid process. Two reference lines were drawn (Figure 2): one connected the medial edge of the scapular spine and the anterolateral



**Figure 2** Drawing before the surgery. Two reference lines are drawn: one connected the medial edge of the scapular spine and the anterolateral acromion (line A), and the other was drawn to divide it midway (line B). The suprascapular nerve (SN) portal is created at the intersecting point of line A and line B. No portal should be created medially beyond this line B, to avoid injury to the accessory nerve.

acromion (line A), and the other was drawn to divide it midway (line B). A standard viewing portal, approximately 1 cm medial and 2 cm inferior from the posterolateral corner of the acromion, was established, and the arthroscope was introduced. The arthropump was turned on, and the pressure was set at 50 mmHg. Diagnostic arthroscopy was performed, and the torn rotator cuff was repaired using suture anchors. Both single-row and double-row anchor techniques were utilized according to the tear size and torn cuff mobility. For medium tears, the double-row repair technique was utilized as long as the tendon edge was easy to approximate to the cuff footprint; otherwise, the single-row technique was utilized: one to four anchors (mean 3.0) were used for medium tears, and three to six anchors (mean 4.3) were used for large-to-massive tears.

TSL release was performed at the end of the procedure after arthroscopic rotator-cuff repair. This was performed with or without arthroscopic subacromial decompression for each patient. Viewing was performed with the 30° arthroscope from the lateral portal, usually 2–4 cm from the lateral acromial edge in line with the bisecting line of the lateral acromial edge. The anterolateral portal was created at about 1–2 cm distal from the anterolateral edge of the acromion and about 2 cm anterior from the lateral portal if it was not yet created. By removing the soft tissue with the shaver or the radiofrequency device (VAPR®; DePuy, Raynham, MA, USA) from either the posterior or anterolateral portal, the medial border of the coracoclavicular ligament was identified. Once the medial border of the coracoclavicular ligament was adequate, the SN portal<sup>25</sup> was created at the intersecting point of a line linking the medial part of the scapular spine and the anterolateral edge of the acromion (line A) and another line dividing line A (line B). In addition, this line B was utilized as a medial limiting line. No portal was created beyond this line to avoid injury to the accessory nerve, which runs medial to the intersecting line between the vertebral spinous processes and the lateral tip of the acromion.<sup>30</sup> A 5 mm incision was made and a small-diameter switching rod introduced, and the TSL was palpated as a continuity of the coracoclavicular ligament. The TSL was demarcated after clarification from the surrounding fat tissue. Then, a pair of arthroscopic scissors was introduced from an accessory SSN portal, 1 cm lateral to the SSN portal, and the TSL was released.

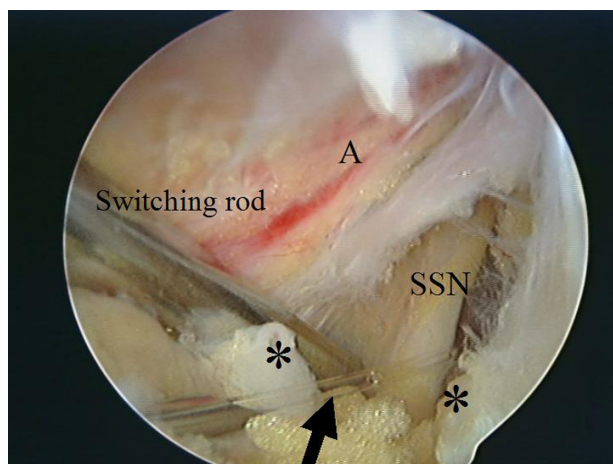
Once the TSL was released, the study groups were selected by a random drawing. Each envelope contained a marker of ca-SSNB or SAB. Once a patient was randomized to a group, a 20-gauge epidural catheter was inserted either

into the subacromial space 1–2 cm away from any portals through an 18-gauge spinal needle (SAB group) or into the suprascapular notch, introducing the catheter adjacent to SSN (ca-SSNB group, Figure 3, Supplementary material). After the catheter was arthroscopically confirmed to be in the accurate location, it was connected to a patient-controlled analgesia pump unit and a 200 mL bag of 0.2% ropivacaine. The pump was set to deliver 3 mL/hour, with a bolus of 10 mL at the end of the surgery. A nurse or a physician removed the pump at 48 hours. To relieve the extra pain, patients were instructed to use a suppository (50 mg diclofenac) or to request a 15-mg pentazocine injection, and the total number of attempts/requests for pain relief were recorded. Postoperative physiotherapy was identical for both the groups. The operated shoulders were protected with an UltraSling (DJO Global, Vista, CA, USA) for 4–6 weeks, depending on the tear size.

## Results

A total of 42 consecutive patients were enrolled in the study. Two patients were excluded from the study because of premature pump removal. Of the 40 remaining patients, 21 received a ca-SSNB, and 19 patients had a continuous local anesthetic infiltration to the subacromial bursa (SAB group). No surgical complications were reported for any of the 40 patients. Demographic data – age, sex ratio, weight, height, duration of surgery, rate of ASAD, and tear size – were similar for both the groups (Table 1).

The following VAS scores were obtained from the ca-SSNB group and the SAB group, respectively:  $62.4 \pm 22.3$  and  $67.6 \pm 25.9$  ( $P=0.73$ ) before surgery,  $9.1 \pm 15.9$  and  $19.4 \pm 23.4$



**Figure 3** A pain catheter is set adjacently to the suprascapular nerve (SSN; continuous arthroscopically assisted suprascapular nerve block).

**Notes:** \*Transverse scapular ligament (cut); A, suprascapular artery; the arrow indicates the epidural catheter.

**Table 1** Patient demographics

	ca-SSNB (n=21)	SAB (n=19)
Age (years)	66±8.8	59±9.1
Sex ratio (male:female)	14:7	12:7
Weight (kg)	60.4±12.0	63.2±9.8
Height (cm)	161±0.1	165±0.09
Duration of surgery (minutes)	114±31	128±22
ASAD	18 (86%)	16 (84%)
Tear size		
Medium	15 (71%)	13 (68%)
Large–massive	6 (29%)	6 (32%)

**Note:** Data are expressed as means ± standard deviation n(%).

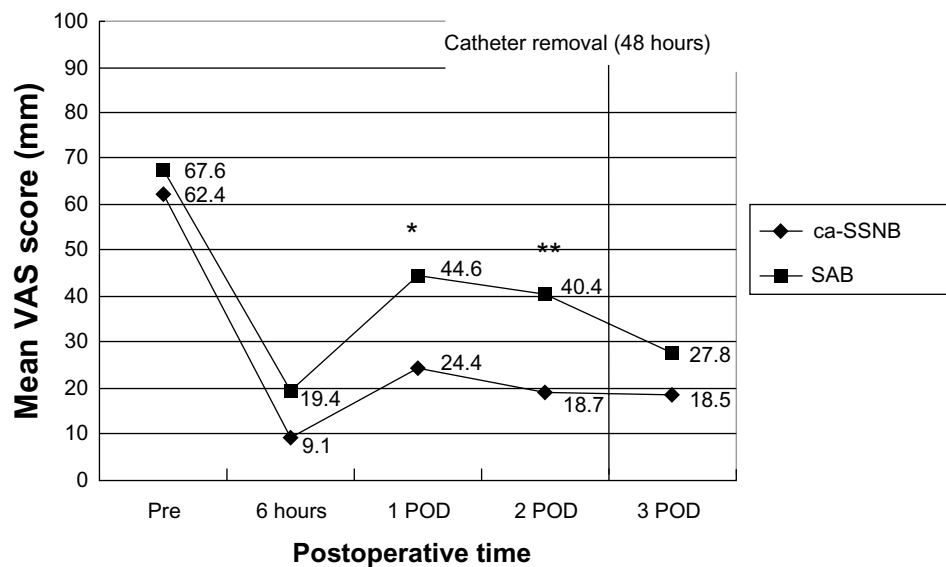
**Abbreviations:** ca-SSNB, continuous arthroscopically assisted suprascapular nerve block; SAB, subacromial bursal block; ASAD, arthroscopic subacromial decompression.

( $P=0.12$ ) at 6 hours after surgery,  $24.4 \pm 17.5$  and  $44.6 \pm 31.9$  ( $P=0.019$ ) on the first postoperative day,  $18.7 \pm 15.4$  and  $40.4 \pm 28.6$  ( $P=0.0060$ ) on the second postoperative day, and  $18.5 \pm 19.8$  and  $27.8 \pm 22.1$  ( $P=0.21$ ) on the third postoperative day (Figure 4). The total number of additional pain-reduction attempts recorded for the ca-SSNB and SAB groups at the third postoperative day were  $0.3 \pm 0.7$  times and  $1.2 \pm 1.5$  ( $P=0.0020$ ), respectively (Figure 5). The times for TSL release required in the ca-SSNB and SAB groups were  $14.6 \pm 12$  minutes (range 4–42 minutes) and  $13.8 \pm 12$  minutes (range 5–42 minutes), respectively ( $P=0.76$ ).

## Discussion

This study revealed that ca-SSNB using an arthroscopically placed catheter decreased postoperative pain. The VAS scores at the first and second postoperative days and the total number of pain-reduction attempts were significantly lower in the ca-SSNB group than in the control group. In other words, the ca-SSNB covered the painful period from the time the single-shot ISB was no longer effective.

The innervation of the shoulder joint is primarily supplied by the suprascapular, axial, and lateral pectoral nerves. The SSN is reported to comprise 70% of the sensory innervation of the shoulder joint. The SSN originates from the upper trunk (C5, C6) of the brachial plexus, runs under the TSL at the suprascapular notch, and then supplies motor fibers to the supraspinatus and sensory fibers to the joint capsule. The nerve then runs around the inferior notch under the spinoglenoid ligament and terminates with the motor fibers to infraspinatus. There are many reports indicating that SSNB is efficient in relieving shoulder pain in many conditions, including the postoperative state.<sup>12–29</sup> However, there are very few reports regarding the efficacy of the continuous



**Figure 4** Visual analog scale (VAS) during the 3 postoperative days.

**Notes:** \* $P < 0.05$ ; \*\* $P < 0.01$ .

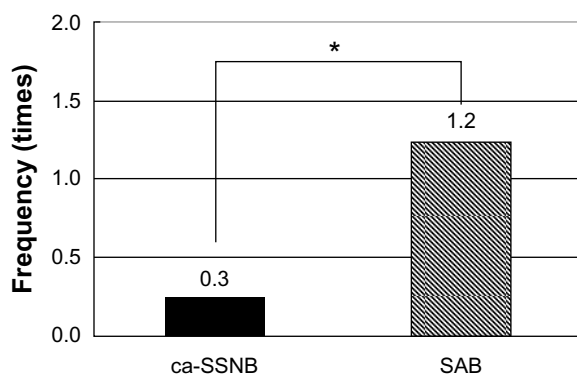
**Abbreviations:** ca-SSNB, continuous arthroscopically assisted suprascapular nerve block; SAB, subacromial bursal block; POD, postoperative day; VAS, visual analog scale.

SSN block, because of technical difficulties encountered with the procedure.<sup>15,20,21</sup>

To our knowledge, there are no previous reports regarding a continuous SSN block via an arthroscopically placed catheter at the suprascapular notch. However, Coetzee et al described a technique utilizing an indwelling catheter placed at the spinoglenoidal notch in order to decrease postoperative pain after ARCR.<sup>31</sup> They placed the catheter arthroscopically from the subacromial bursa at the lateral edge of the scapular spine. Contrary to our technique, they did not identify the SSN, and nor did they report their outcome, because their technique was described in a letter to the editor. ca-SSNB described here has two advantages over their technique. First, compared to the block at the spinoglenoidal notch, the

SSN is blocked more proximally at the suprascapular notch. Second, our method involved placement of the catheter arthroscopically, and the SSN was identified arthroscopically as well, which ensured the proximity of the catheter to the SSN.

Nevertheless, there are several limitations to our study. First, we used this technique only in patients requiring ARCR and TSL release. The indication for SSN decompression in cases of TSL release is debatable, because SSN neuropathy associated with a rotator-cuff tear remains controversial.<sup>32–38</sup> As SSN palsy is considered a dynamic phenomenon,<sup>39–41</sup> existing diagnostic tools, such as electromyography and imaging studies (ie, radiography and magnetic resonance imaging), are not sufficient to demonstrate the relationship between a rotator-cuff tear and SSN palsy; therefore, the indication for performing TSL release is still under investigation. However, we believe that SSN neuropathy with a retracted rotator-cuff tear exists in significant frequency. Moreover, we believe that in cases where TSL exploration is performed, ca-SSNB should be recommended. After exploration, ca-SSNB placement is not difficult to perform, particularly with the indwelling catheter under arthroscopic visual control. Next, we evaluated each patient after surgery for only a short period; therefore, the lack of a long-term observation period precluded the long-term safety evaluation of the current technique as well as SSN decompression in terms of TSL release. Third, exploration of the TSL is a time-consuming process (ie, the mean time was 14 minutes in this study), although there is a learning curve associ-



**Figure 5** Total number of additional pain-reduction attempts during the 3 postoperative days.

**Note:** \*Represents statistically significant difference ( $P = 0.0020$ ).

**Abbreviations:** ca-SSNB, continuous arthroscopically assisted suprascapular nerve block; SAB, subacromial bursal block.

ated with performing such a procedure; therefore, the time required for the procedure is highly variable. We thus believe this procedure is not indicated in all ARCR cases; however, when the SSN is explored, ca-SSNB is an easy, efficient, and safe procedure under arthroscopic control. Finally, SSNB has imminent limitations in terms of the extent of blockade. As far as the extent of the block, ISB provides superior analgesia compared with SSNB. Some researchers advocate that continuous ISB is the new gold standard for shoulder surgery, considering its range and longevity. However, ISB gives motor/sensory blockade distally, which might frustrate both patients and clinicians. In addition, ISB has been inevitably linked to the development of respiratory distress because of the potential for phrenic nerve block.<sup>42–46</sup> This is much more a concern in continuous ISB. Nevertheless, SSN does not block motor/sensory supply distally, and does not cause phrenic nerve block. We feel this is an advantage for patient control. In particular, the greatest difficulty of continuous ISB is its technical difficulty and manageability. Therefore, ca-SSNB with a single-shot ISB would be an alternative to continuous ISB.

## Conclusion

ca-SSNB was highly effective in controlling postoperative pain after the anesthetic effects of ISB waned. When the SSN is explored and the TSL is released, we recommend the arthroscopic placement of a catheter adjacent to the SSN to provide effective pain relief to the shoulder.

## Disclosure

The author reports no conflicts of interest in this work.

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## Supplementary material

### [Video 1](#)

Left shoulder, viewed from the lateral portal. The shaver is introduced from the suprascapular nerve (SSN) portal to demarcate the transverse scapular ligament (TSL). Thereafter, the tip of the switching rod is placed in the scapular

notch to retract the SSN. A pair of arthroscopic scissors is introduced from an accessory SSN portal, 1 cm lateral to the SSN portal, and the TSL is released. A 20-gauge epidural catheter is inserted into the suprascapular notch, introducing the catheter adjacent to the SSN.

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