

Nerve Block for Pain Relief During Arthroscopic Rotator Cuff Repair

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Background: Although arthroscopic rotator cuff repair (ARCR) often results in good outcomes, some patients have severe pain postoperatively. This study investigated the efficacy of nerve block for ARCR.

Methods: This study was retrospective, and consent was obtained from all patients. We divided 50 patients who had undergone ARCR into 4 groups: continuous interscalene nerve block was performed for 11 patients (continuous-injection group), single interscalene nerve block for 10 (single-injection group), suprascapular nerve block for 8 (suprascapular group), and intravenous analgesic administration for 10 (intravenous group). Eleven patients received no nerve block (control group). We evaluated diclofenac sodium and pentazocine dosing, visual analog scale (VAS) scores, and perioperative complications in each group. VAS scoring was done immediately after surgery and 1 and 6 hours and 1, 2, 3, 7, and 14 days postoperatively.

Results: The doses of diclofenac sodium and pentazocine did not differ between groups. VAS scores immediately after surgery and at 1 and 6 hours after surgery were significantly lower in the single-injection and continuous-injection groups than in the suprascapular, intravenous, and control groups. VAS score at 1 day postoperatively was significantly lower in the continuous-injection group than in the other groups. One patient in the continuous group reported temporary paralysis of the fingers and drug solution leakage.

Conclusion: Interscalene nerve blocks yielded good pain relief for ARCR. Although continuous interscalene nerve block produced continuous pain relief, complications are a concern.

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Key words: Arthroscopic rotator cuff repair, Anesthesia, Interscalene brachial plexus block, Suprascapular nerve block, Intravenous administration of analgesic

Introduction

Many patients who undergo arthroscopic rotator cuff repair (ARCR) complain of severe pain. Some centers administer analgesics intravenously, despite the uncertain effectiveness of such drugs¹. A combination of general anesthesia and local anesthesia was effective for pain relief after upper limb surgery². However, although various methods of pain management after shoulder joint surgery have been described, no method has been established. Among local anesthesia techniques, interscalene nerve block, which blocks the brachial plexus at C5 through T1 and nerve branches emanating from cervical nerve roots, and suprascapular nerve block are useful an-

esthesia techniques for shoulder joint surgery. Although there are several drugs for local anesthesia, no study has compared them. We compared the postoperative analgesic effects of interscalene nerve block, suprascapular nerve block, and intravenous administration of analgesic in patients who underwent ARCR. Our hypotheses were that single-injection and continuous-injection interscalene nerve block would produce good pain relief and that the effects would be longer for continuous interscalene nerve block than for a single injection.

Materials and Methods

Fifty shoulders of 50 patients who underwent ARCR be-

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Table 1 Characteristics of the patients

group	control	single-injection	continuous injection	supra-scapular	intra-venous
number of cases	11 cases	10 cases	11cases	8 cases	9 cases
mean age	64.1yrs ± 5.9yrs	65.1yrs ± 9.5yrs	60.0yrs ± 5.7yrs	67.8yrs ± 10.3yrs	69.0yrs ± 6.9yrs
gender	female: 5 male: 5	female: 4 male: 6	female: 7 male: 4	female: 5 male: 3	female: 4 male: 5
Type of tears	small: 6 medium: 5	small: 4 medium: 6	small: 8 medium: 3	small: 6 medium: 2	small: 5 medium: 4
Operation time	72.3±9.9 min	69.8±7.3 min	70.3±9.5 min	78.8±15.9 min	68.9±11.0 min

tween April 2014 and June 2014 were studied. This retrospective study was approved by the ethics committee at our hospital, and consent was obtained from all patients for the research (the type of anesthesia was decided by the anesthesiologist in charge). We included patients who underwent arthroscopic rotator cuff repair for small and medium-sized rotator cuff tears (DeOrio & Cofield classification³) and excluded those with contracture (passive range of motion: flexion <90 degrees, abduction <90 degrees, external rotation <30 degrees, and internal rotation <L5), those with atrophy or fatty infiltration of the rotator cuff on MRI (less than grade 1 of Goutallier classification), and those who used anticoagulants preoperatively. All ARCR operations were performed by the same experienced surgeon.

Patients were divided into 5 groups as follows: those who received ultrasound-guided, single-injection interscalene nerve block before surgery (n = 10, single-injection group), those who received ultrasound-guided, continuous interscalene nerve block for 2 days after surgery through a catheter placed under ultrasound guidance (n = 11, continuous-injection group), those who received suprascapular nerve block before surgery (n = 8, suprascapular group), those who received intravenous analgesic after surgery (n = 10, intravenous group), and those received no nerve block before or after surgery (n = 11, control group) (Table 1). All patients were treated with loxoprofen sodium after surgery, and supplemental interscalene nerve blocks were performed for the single-injection and continuous-block groups.

Single-injection and continuous interscalene nerve blocks were performed after induction of general anesthesia, with the patient in supine position. To perform single-injection interscalene nerve block, the location of the brachial plexus (neurovascular sheath), which runs between the scalenus anterior and the scalenus medius, was identified on an ultrasound monitor by directing ultrasound waves at the intersection of the straight line

projecting laterally from the cricoid cartilage with the interscalene groove. Local anesthetic (10 mL of 0.75% ropivacaine) was injected into the site with a 24-G needle, and infiltration of the anesthetic was observed on the ultrasound monitor. To perform continuous interscalene nerve block, a local anesthetic (0.25% ropivacaine, 4 mL/h) was administered for 2 days after surgery through a catheter placed in the neurovascular sheath, which was identified under ultrasound guidance in the same manner used for single-injection block (Fig. 1)⁴. The type and volume of injection was decided in accordance with previous reports⁵⁻¹⁰.

Suprascapular nerve block was performed after induction of general anesthesia, with the patient in supine position. Following the simplified approach (placement of the index finger on the dimple between the clavicle and scapular spine and insertio of the needle at the index fingertips), the clavicle and scapular spine were used as landmarks, and 10 mL of 0.75% ropivacaine was injected with a 24-G needle¹¹. For intravenous injection of analgesic, the analgesic (1.25 mg droperidol, 0.5 mg fentanyl citrate for injection, and 39.5 mg physiological saline at 2 mL/h) was injected intravenously after surgery. The surgery was performed by the same experienced shoulder surgeon, with the patient in lateral decubitus position. Anesthesia, including block, was performed by the same experienced anesthesiologist. When a patient requested pain relief during the hospital stay, transanal diclofenac and intravenous pentazocine were administered.

Diclofenac sodium and pentazocine doses and visual analog scale (VAS) scores were compared between groups. On the VAS, the left end of a 100-mm line indicated "no pain" and the right end indicated "worst pain". Patients were asked to mark the scale to indicate their pain intensity. VAS scores were recorded soon after the operation, 1 and 6 hours later, and at 1, 2, 3, 7, and 14 days postoperatively. All data are shown as mean and SD. One-way analysis of variance and the Tukey-Kramer

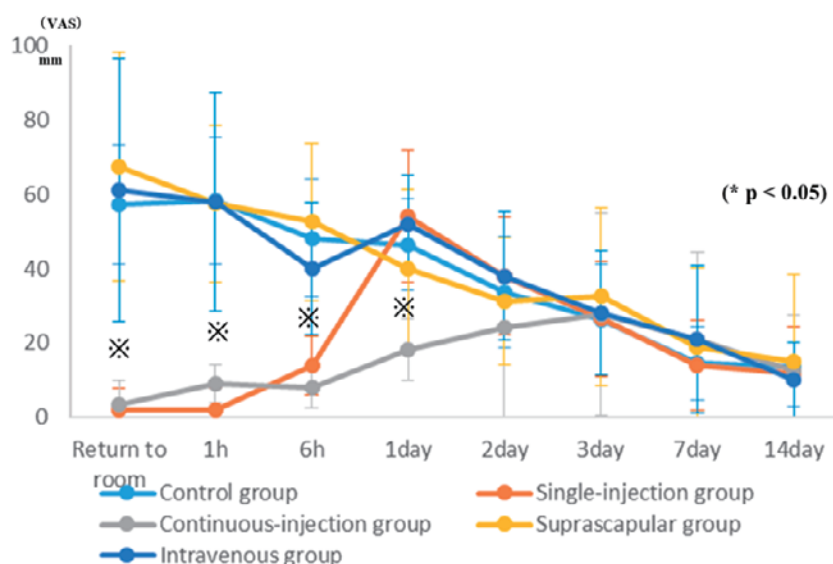


Fig. 1 Change in visual analog scale (VAS) scores, by group. VAS scores immediately after surgery and at 1 and 6 hours postoperatively were significantly lower in the single-injection group and continuous-injection group than in the other groups. The VAS score at 1 day was significantly lower in the continuous-injection group than in the other groups.

Table 2 Details of diclofenac sodium and pentazocine dosing

	control	single-injection	continuous injection	supra-scapular	intra-venous
Amount of diclofenac sodium (p=0.2401)	56.8±49.0 mg	40.0±30.0 mg	50.0±55.4 mg	53.1±66.6 mg	45.0±61.0 mg
Amount of pentazocine injection (p=0.9078)	1.5±4.3 mg	7.5±10.0 mg	4.1±5.7 mg	2.0±5.0 mg	1.5±4.5 mg

(N.S)

test were used for statistical analysis, and the significance level was set at less than 5%. Statistical analysis was performed with IBM SPSS statistical software.

Results

There were no significant differences in age, sex, type of tear, or operation time in each group (Table 1). The doses of diclofenac sodium (p=0.2401) and pentazocine (p=0.9078) did not differ between groups (Table 2). The highest VAS score and the time point at which it was recorded were as follows: control group, 58 ± 17 mm at 1 hour after patients had returned to their room; single-injection group, 54 ± 17.9 mm at 1 day after surgery; continuous-injection group, 28 ± 27.1 mm at 3 days after surgery; suprascapular group, 68 ± 30.7 mm when patients had returned to their room; intravenous group, 61 ± 35.3 mm when patients had returned to their room (Fig. 1). Scores improved after these time points. The recorded scores soon after patients had returned to their

room and at 1 and 6 hours postoperatively were 57 ± 16 mm, 58 ± 17 mm, and 48 ± 15.9 mm for the control group, 2.0 ± 6 mm, 2.0 ± 6 mm, and 14 ± 8 mm for the single-injection group, 3.6 ± 6.4 mm, 9.1 ± 5.1 mm, and 8.2 ± 5.7 mm for the continuous-injection group, 68 ± 30.7 mm, 58 ± 21.1 mm, and 53 ± 21.1 mm for the suprascapular group, and 61 ± 35.3 mm, 58 ± 29.2 mm, and 40 ± 17.9 mm for the intravenous group, respectively. Scores were significantly lower in the single-injection and continuous-injection groups than in the control, suprascapular, and intravenous groups. The VAS score at 1 day after surgery was 46 ± 12.3 mm in the control group, 54 ± 17.9 mm in the single-injection group, 18 ± 8.3 mm in the continuous-injection group, 40 ± 21.2 mm in the suprascapular group, and 52 ± 13.3 mm in the intravenous group; the score was significantly lower in the continuous group than in the other groups. Although complications such as infection, vascular damage, and pneumothorax were not observed in any patient, temporary

finger paralysis and leakage of the drug solution were noted in one patient in the continuous-injection group.

Discussion

Interscalene nerve block can provide adequate pain relief for shoulder joint injuries because it blocks nerve branches emanating from cervical nerve roots¹². Interscalene nerve block is useful for patients undergoing arthroscopic rotator cuff repair because the cricoid cartilage, which is used as a landmark, is palpable even in obese patients, and the block can be performed without considering the position of the upper limbs. The procedure is safe because the needle is not inserted toward the pulmonary apex or major blood vessels, and placement of a catheter is possible^{12,13}. However, complications related to phrenic nerve paralysis and recurrent nerve paralysis are a concern.

Interscalene nerve block is classified as single-injection or continuous, depending on the duration of analgesia. Single-injection block, which enables widespread infiltration of anesthetic because of the single high-dose injection of local anesthetic, is a simple technique that does not require precise insertion of the needle near the brachial plexus and has been shown to have an analgesic effect in over 90% of cases^{13,14}. However, because the effects of single-injection block persist for about 6 to 8 hours, it is not suitable for continuous overnight pain management. Continuous block, in contrast, has an analgesic effect throughout the first postoperative day and beyond and is unlikely to cause anesthetic toxicity, as only a small dose of anesthetic is administered over a short period of time. However, as the extent of infiltration is slight when only a small dose of anesthetics is administered, the catheter must be placed precisely inside the neurovascular sheath. Continuous interscalene nerve block is complicated to perform and the success rate was reported to be about 75%¹⁵. Methods for determining the positioning of the needle or catheter when performing a nerve block include transarterial technique, electrical nerve stimulation technique, infiltration technique, and ultrasound-guided technique. Unlike the other techniques, ultrasound-guided technique allows the operator to determine both the relative position of the needle, in relation to nerves and surrounding tissues (e.g., blood vessels) after the intradermal needle is inserted, and the extent of infiltration of the anesthetic during injection, as indicated on an ultrasound monitor, which makes such blocks safer and more accurate. The most important present findings are that interscalene nerve block using ul-

trasound yielded good pain relief after ARCR and that neither suprascapular nerve block nor intravenous administration of anesthesia had an adequate postoperative analgesic effect. Using ultrasound for interscalene nerve block, we obtained satisfactory pain relief.

The intravenous group did not experience adequate pain relief, perhaps because this technique is insufficient for pain control after shoulder surgery, as was noted in previous studies, or because administration had to be discontinued for 4 patients who experienced nausea as a side effect¹⁶.

The suprascapular group also did not report adequate pain relief, perhaps because the anesthetic did not properly infiltrate the area around the suprascapular nerve when the commonly used simplified approach was selected. Some patients in the suprascapular block group reported no pain relief (i.e., a postoperative VAS score close to 100). This indicates that a more precise technique should be developed and established when suprascapular nerve block is used as supplemental anesthesia. Furthermore, because several patients in the suprascapular group reported slight but inadequate pain relief, suprascapular nerve block alone may not provide adequate pain relief for surgery around the shoulder joint, even when there is adequate penetration of the anesthetic, whereas a scalene block can block all the nerves around the shoulder. Indeed, Francois reported that interscalene nerve block was superior to suprascapular nerve block¹⁷.

In this study, VAS scores for the 3 groups showed that single-injection and continuous blocks performed with ultrasound-guided block technique provided adequate pain relief on the day of surgery for all patients in those groups, which indicates that the analgesic effect was more reliable than that in previous studies. There was no significant difference in the doses of diclofenac sodium and pentazocine used among groups, perhaps because patients in the single- and continuous-injection groups desired additional analgesia for relief of anxiety, even though their VAS scores were low. These findings indicate that ultrasound-guided interscalene nerve block is a very effective anesthesia technique for arthroscopic surgery for rotator cuff tears.

Furthermore, our finding that continuous interscalene block had an adequate analgesic effect throughout the first postoperative day and beyond suggests that extended continuous interscalene block could enable earlier rehabilitation and suppress muscle guarding caused by postoperative pain.

The limitations of this study are its retrospective de-

sign and small sample size. The number of patients was small because the procedure was limited to the same procedure, facility, operator, and anesthesiologist. Future studies should enroll more patients and evaluate other anesthesia techniques, such as cocktail injection.

Conclusion

Single-shot and continuous interscalene brachial plexus block were effective on the operation day for patients undergoing ARCR. In addition, continuous interscalene brachial plexus blocks yielded continuous pain relief. However, complications such as temporary finger paralysis and drug leakage are concerns.

Conflict of Interest: None.

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