Evaluation of Pain Relief and Opioid Consumption With the Addition of an Erector Spinae Plane Catheter Block After an Interscalene Nerve Block in Arthroscopic Rotator Cuff Repair

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Background: The effects of the erector spinae plane (ESP) block and interscalene nerve block (ISNB) on arthroscopic rotator cuff repair (RCR) have been investigated separately.

Purpose: To evaluate whether additional catheterization for the ESP block can decrease acute postoperative pain and opioid consumption above the ISNB and multimodal oral analgesics in patients after arthroscopic RCR.

Study Design: Cohort study; Level of evidence, 3.

Methods: Included were patients who underwent primary arthroscopic RCR between January 1 and December 31, 2021, and received either ISNB (ISNB group) or additional ESP block catheterization (ESP block group) as part of their pain management. Patients who underwent concomitant shoulder procedures were excluded. Patient characteristics, surgical details, pre- and postoperative numerical pain rating scale (NPRS) scores, rescue analgesic use, and possible opioid-related side effects were recorded. The primary outcome was the NPRS score immediately after surgery; secondary outcomes included rescue opioid use and opioid-related side effects until patients were discharged the next day. The Mann-Whitney *U* test or the chi-square test was used for between-group comparisons. Multiple linear regression analysis was conducted to examine predictors for total opioid consumption.

Results: A total of 54 patients were included—21 in the ISNB group and 33 in the ESP block group. The ESP block group exhibited significantly lower postoperative NPRS scores (2 $\pm$ 0.3 vs 3 $\pm$ 1.6 for ISNB; $P = .003$), reduced opioid consumption during hospitalization (0.5 $\pm$ 1.3 vs 6.1 $\pm$ 8.3 morphine milligram equivalent [MME] for ISNB; $P < .001$), and fewer opioid-related side effects (0 vs 3 for ISNB; $P = .022$). Multiple linear regression analysis indicated that the analgesic protocol ($\beta = 5.750$; $P < .001$) and the number of anchors used ($\beta = 1.609$; $P = .022$) were independently correlated with higher opioid consumption. Subgroup analysis revealed that additional ESP block significantly reduced opioid consumption during repairs involving $\geq$2 tendons (7.6 $\pm$ 9 vs 0.5 $\pm$ 1.4 MME; $P < .001$).

Conclusion: The study findings indicated that additional catheterization for the ESP block reduced postoperative pain, opioid consumption, and opioid-related side effects during the acute postoperative period of arthroscopic RCR when the ISNB and multimodal oral analgesics had already been administered. Future studies are needed to evaluate this treatment protocol.

Keywords: erector spinae plane block; interscalene nerve block; multimodal analgesics; opioid consumption; rotator cuff repair

Arthroscopic rotator cuff repair (RCR) effectively relieves pain and improves function in patients who fail conservative treatment after a rotator cuff tear. The volume of

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arthroscopic RCR is increasing with the aging of our society and the spread of arthroscopic techniques.[7,11,24] Although arthroscopic RCR results in only small incisions, its acute postoperative pain forces 85% of surgeons to include morphine in pain management regimens.[40]

Side effects of opioids include postoperative nausea and vomiting, urinary retention, dizziness, constipation, sedation, and hypotension.[22] Side effects of opioids bother the aged population more,[22] and patients with rotator cuff tear are often in this age group. The use of opioids may decrease patient satisfaction,[38] prolong hospitalization after orthopaedic surgery,[33] and potentially lead to drug abuse. Opioid misuse led to >47,000 deaths in 2017 alone, and the opioid epidemic continues to worsen.[39] While orthopaedic surgeons were surprisingly the third-highest prescribers of opioids among all specialties,[29] postoperative prescription opioids are often not completely used.[3] Therefore, orthopaedic surgeons strive to perform opioid-free surgeries.

Several studies have explored pain relief methods after rotator cuff surgeries, focusing on various regional nerve blocks—such as interscalene, suprascapular, axillary, and supraclavicular nerve blocks, and continuous nerve block catheterization.[4,5,9,21,26,28,32] Different analgesic agents—such as liposomal bupivacaine and bupivacaine—have also been discussed.[23,35] Over time, both surgical and anesthetic techniques have evolved. The erector spinae plane (ESP) block is a newer method that takes 5 to 10 minutes to administer and has shown effectiveness in shoulder surgeries with minimal complications, notably avoiding phrenic nerve involvement and preventing hemidiaphragm paralysis.[6,13,18,37] Although the benefit of postoperative interscalene catheterization after preoperative single-shot interscalene nerve block (ISNB) is established,[27,34] it remains unclear whether adding postoperative ESP catheterization offers additional benefits for patients already receiving preoperative single-shot ISNB and multimodal oral analgesics during arthroscopic RCR.

In this study, we aimed to evaluate whether additional catheterization for the ESP block decreases acute postoperative pain and opioid consumption in patients undergoing arthroscopic RCR when ISNB and multimodal oral analgesics have already been given. We hypothesized that additional catheterization for ESP block could achieve better postoperative analgesia and reduce the need for rescue opioids.

METHODS

The protocol for this study was approved by the institutional review board of our hospital. We retrospectively reviewed patients who underwent primary arthroscopic RCR performed by a single experienced surgeon (the senior author; W.-R.S.) at a tertiary medical center between January 1 and December 31, 2021. At the outpatient clinic, we provide patients with a range of pain control options to supplement general anesthesia—including preoperative single-shot ISNB (USD 100), preoperative single-shot ISNB with an additional postoperative ESP catheter block (USD 300), and various forms of postoperative intravenous patient-controlled analgesia (USD 200-400). Patients are given the autonomy to choose or decline any of these additional chargeable pain relief options after they are thoroughly explained by the anesthesiologists. The inclusion criteria for this study were patients undergoing primary arthroscopic RCR who had received and completed their preoperatively selected pain control protocols—including either the protocol for multimodal oral analgesics with the ISNB or the protocol for multimodal oral analgesics with the ISNB and additional catheterization for the ESP block. The exclusion criteria for this study were as follows: (1) patients who underwent concomitant shoulder procedures other than RCR and biceps tenotomy (eg, biceps tenodesis, acromioplasty, or shoulder manipulation); (2) patients who opted for a pain control protocol other than 1 of our 2 included protocols; and (3) patients who encountered complications unrelated to orthopaedic surgeries or their selected pain control protocols. No patient received preoperative opioids within 3 months before surgery.

All patients were kept overnight and discharged in the morning after arthroscopic RCR. The 1-day hospitalization was driven by the national health insurance system and prevailing medical norms in our country, not related to the present study or nerve block catheters.

Surgical Technique and Rehabilitation

All patients in this study were administered general anesthesia with an additional ISNB performed by a team of anesthesiologists at our hospital, and some patients underwent additional ESP catheterization block after the surgery. All participating anesthesiologists (including

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Ethical approval for this study was obtained from the National Cheng Kung University Hospital (reference No. B-ER-112-232).

TABLE 1
Preoperative, Intraoperative, and Postoperative Analgesic Protocols[a]

	ISNB Protocol	ESP Block Protocol
Preop	The night before surgery: Celecoxib 200 mg PO	2 hours before surgery: Pregabalin 75 mg PO, celecoxib 200 mg PO, lansoprazole 30 mg PO
Intraop	• ISNB before surgery (2% lidocaine 10 mL and 0.5% bupivacaine 10 mL) • Dexamethasone 1 g IVD	• ISNB before surgery (2% lidocaine 10 mL and 0.5% bupivacaine 10 mL) • Dexamethasone 1 g IVD • Acetamol 1 g IVD • Granisetron 0.02 mg/kg • C7 ESP catheterization after surgery
Postop	• Acetaminophen 500 mg PO QID • Celecoxib 200 mg PO Q12H • Hydrocortisone 100 mg IVD Q12H • Morphine 3-5 mg IVD PRN	• Acetaminophen 500 mg PO QID • Celecoxib 200 mg PO Q12H • Pregabalin 75 mg PO HS • Hydrocortisone 100 mg IVD Q12H • C7 ESP nerve block (2% lidocaine 10 mL and 0.5% bupivacaine 10 mL Q12H) • Morphine 3-5 mg IVD PRN

[a]C7, level of seventh cervical spinous process; ESP, erector spinae plane; HS, at bedtime; Intraop, intraoperatively; ISNB, interscalene nerve block; IVD, intravenous drip; PO, by mouth; Postop, postoperatively; Preop, preoperatively; PRN, as needed; QID, 4 times daily; Q12H, every 12 hours.

S.-C.L.) in this study were qualified by the National Board of Anesthesiology to perform ultrasound-guided peripheral nerve blocks. All surgeries were performed in a standardized setting by the senior author—an experienced shoulder arthroscopy specialist. The patients were placed in a lateral decubitus position using a 3-point arm traction system (Arthrex). Standard posterior and anterior portals were created for the diagnostic arthroscopic examination and glenohumeral joint debridement, respectively. Biceps tenotomy was performed in patients with a degenerative biceps tendon or superior labral anterior-posterior lesions. Subscapularis lesions were repaired using 1 or 2 suture anchors, depending on the size of the lesion. After glenohumeral joint procedures, the scope was shifted to the subacromial space, the lateral and anterolateral portals were established, and the bursa was partially resected. After confirming the tear size, tendon retraction, tendon quality, and delamination of the rotator cuffs, the adhesions were lysed to ensure sufficient mobility of the retracted supraspinatus and infraspinatus. Footprints of the greater tuberosity were decorticated and the supraspinatus and infraspinatus tendons were repaired using a modified double-pulley rip-stop suture bridge technique.[12]

Patients were observed at our clinic at 2 weeks, 4 weeks, 6 weeks, 12 weeks, and 6 months postoperatively. A shoulder abduction arm brace was applied for 4 to 6 weeks. Shoulder passive range of motion (ROM) exercises were taught before surgery by our physical therapists and were advised while the shoulder brace was still applied. Twelve weekly visits to our physical training center were arranged after patients weaned off their shoulder brace. Active-assisted exercises were followed by active ROM exercises, which patients were taught during these visits.

Analgesic Protocols

All included patients chose their postoperative analgesic protocol before surgery and adhered to it afterward. The detailed protocols are presented in Table 1.

For the ISNB protocol, 200 mg celecoxib was orally administered 2 hours before surgery. An interscalene regional nerve block with 2% lidocaine (10 mL) and 0.5% (10 mL) bupivacaine was administered before surgery. Intraoperatively, dexamethasone (5 mg) was administered intravenously in addition to inhalation anesthetics to prolong regional nerve block and reduce postoperative nausea and vomiting.[19,42] After surgery, oral acetaminophen (500 mg) was administered 4 times daily, along with celecoxib (200 mg) every 12 hours. In addition, hydrocortisone (100 mg) was administered every 12 hours intravenously to reduce postoperative nausea and vomiting.[19] An additional 3 to 5 mg of intravenous rescue morphine was administered to patients upon request for postoperative breakthrough pain.

If the patient chose the additional ESP catheterization block protocol, they underwent catheterization of the ESP at the level of the spinous prominens (C7 ESP) at the end of surgery. Using the vertebra prominens (spinous process of C7) as our reference point, we systematically identified each cervical spinous process. Employing a 6- to 15-MHz linear probe ultrasound, we located the C7 spinous process and then scanned laterally to detect the transverse process of C7. We used an *in-plane* approach with the ultrasound to administer isotonic sodium chloride (20-25 mL) for hydrodissection of the erector spinae fascial plane. This process elevated the erector spinae muscles, allowing for the smooth cephalad threading of the catheter (FlexBlock) past the tip of the Tuohy needle. If resistance

was encountered before reaching the estimated distance, the catheter was withdrawn, and further hydrodissection of the ESP was performed under ultrasound guidance before reattempting catheter placement. To conclude the procedure, 2% (10 mL) lidocaine and 0.5% (10 mL) bupivacaine were injected through the catheter under ultrasound visualization to confirm proper spread in the ESP.[17] A bolus regional nerve block, with 2% lidocaine (10 mL) and 0.5% (10 mL) bupivacaine, was administered every 12 hours from the established catheter after surgery. In addition, pregabalin[2] (75 mg) was administered 2 hours before surgery and before sleep after the procedure.

Pain Rating and Rescue Intravenous Morphine

The pain was evaluated using the numerical pain rating scale (NPRS) as evaluated by the nursing team at 1, 2, and every 4 hours postoperatively until the patient fell asleep. NPRS scores ranged from 0 (no distress) to 10 (agonizing pain). Since patients finished their surgery at different time points, the initial postoperative pain score evaluation was always at 9 PM on the evening after surgery. The patients were reminded of the pain control protocol, and an optional salvage analgesic, intravenous morphine, was explained to them. At the patient's request, 3 or 5 mg (cutoff at 80 kg of body weight) of salvage intravenous morphine was administered at an interval of at least 4 hours.

Data Collection

Patient characteristics—including age, sex, height, and body weight—were collected from the medical records. The operation notes were reviewed for specific torn tendons, repaired tendons, number of anchors used, repaired constructs, accompanying procedures, and surgical time. The pain control protocols, the NPRS score from the evening before the day of surgery, the NPRS score at 9 PM from the evening after surgery, rescue analgesics used in addition to the originally selected protocol, and any records of discomfort or complaints during hospitalization were collected from the chart review. The primary outcome of this study was the NPRS score from the evening after surgery. These results were compared using the minimal clinically important difference (MCID) for acute pain after surgery, which is comparable to 0.99 on the NPRS.[30] Secondary outcomes included the total consumption of opioids and side effects related to opioids until patients were discharged the next day.

Statistical Analysis

Quantitative variables were presented as means and standard deviations, while qualitative variables were reported as frequencies and percentages. Demographic and surgical data between the ISNB and ESP catheterization block groups were compared using the Mann-Whitney U test for continuous variables and the chi-square test for categorical variables. Pre- and postoperative outcomes such as NPRS scores were compared using the Wilcoxon signed-rank test. Statistical significance was set at $P < .05$.

Subsequently, factors with $P \leq .1$ or those considered clinically significant were included in a multiple linear regression model to examine their relative contributions to postoperative pain and total opioid consumption. Unstandardized coefficients were calculated to quantitatively assess the effects of the predictors. A 2-tailed $P < .05$ was considered statistically significant in the multiple regression analysis. In addition, a subgroup analysis was performed on patients who underwent repair of only 1 tendon compared with those who underwent repair of $\geq$2 tendons. All data were analyzed using SPSS Version 17 (SPSS Inc).

Post Hoc Power Analyses

A post hoc power analysis was performed using G*Power Version 3.1.9.7 (Heinrich Heine-University of Dusseldorf) to calculate the achieved power using the available sample sizes and data of postoperative NPRS as well as opioid consumption in both groups. The alpha value of the model was set to .05.

RESULTS

A total of 81 arthroscopic RCRs were performed by the senior author in 2021. Of these patients, 17 were excluded, leaving 64 patients, of whom 21 opted for the ISNB protocol (ISNB group), 35 for the additional ESP block protocol (ESP block group), and 8 patients for other inconsistent analgesic methods, and thus were excluded. Of the 35 patients in the ESP block group, 2 patients were excluded—1 patient received different analgesic regimens because of a history of allergy to nonsteroidal anti-inflammatory drugs, and 1 patient refused to follow the protocol because he experienced no postoperative pain. Ultimately, 21 patients in the ISNB group and 33 patients in the ESP block group were included. A summary of the patient enrollment process is shown in Figure 1.

After inputting the actual sample sizes, postoperative NPRS scores, opioid consumption in both groups, and an alpha of .05 for the post hoc power-analysis models, the powers achieved for the postoperative NPRS score and opioid consumption were calculated as 81.5% and 88.7%, respectively.

Comparison of Outcomes

No significant differences were observed in the demographic and surgical details between the ISNB and ESP block groups (Table 2). The NPRS score from the evening before surgery was not significantly different. However, the NPRS score from the evening after surgery was significantly lower in the ESP block group versus the ISNB group (2 ± 0.3 vs 3 ± 1.6; $P = .003$) (Table 3). This

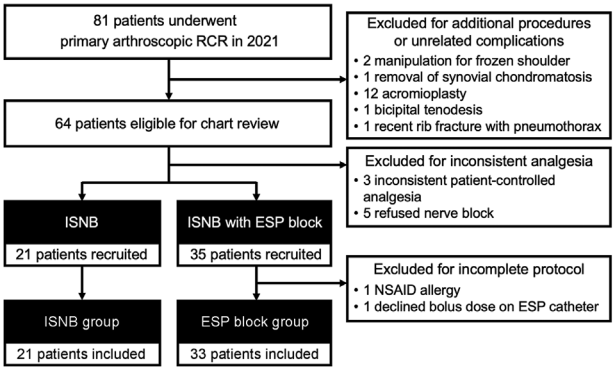

Figure 1. A flowchart of patient enrollment in the study. ESP, erector spinae plane; ISNB, interscalene nerve block; NSAID, nonsteroidal anti-inflammatory drug; RCR, rotator cuff repair.

TABLE 2
Comparison of Demographic Data and Surgical Details Between Groups[a]

Variable	ISNB Group (n = 21)	ESP Block Group (n = 33)	*P*
Age, y	60.9 ± 11	60.6 ± 8	.551
Sex, male/female, No.	10/11	13/22	.329
BMI, kg/m^2	25.8 ± 2.6	24.9 ± 4	.147
Preop NPRS score	1.3 ± 0.9	1.2 ± 0.9	.536
No. of torn tendons	2.3 ± 0.7	2.1 ± 0.7	.348
No. of repaired tendons	2 ± 0.8	1.8 ± 0.8	.369
No. of anchors used	3.7 ± 1.6	4 ± 1.5	.586
Surgery time, min	130.8 ± 28	127.6 ± 36	.762

[a]Data are expressed as mean ± SD unless otherwise indicated. BMI, body mass index; ESP, erector spinae plane; ISNB, interscalene nerve block; NPRS, numerical pain rating scale; Preop, preoperatively.

between-group difference met the MCID for acute postoperative pain, which was comparable to an NPRS score of 0.99.[30]

Multiple linear regression analysis suggested that the selected pain control protocol ($P < .001$) and the number of anchors used in the surgery ($P = .022$) were independently correlated with postoperative opioid consumption (Table 4). Subgroup analysis showed a similar total morphine equivalent use between the ISNB group (1.2 ± 2.9) and additional ESP block group (0.5 ± 1.3) when only one tendon was repaired during surgery ($P = .898$), whereas significantly less total morphine equivalent was used in the additional ESP block group (0.5 ± 1.4) compared to the ISNB group (7.6 ± 9.0) when two or more tendons were repaired during surgery ($P < .001$).

DISCUSSION

The major finding of our study was that additional catheterization for ESP block reduced acute postoperative pain

TABLE 3
Comparison of Primary and Secondary Outcomes Between Groups[a]

	ISNB Group (n = 21)	ESP Block Group (n = 33)	*P*
Postop NPRS score	3 ± 1.6	2 ± 0.3	**.003**
Opioid consumption, MME	6.1 ± 8.3	0.5 ± 1.3	**<.001**
Opioid-related complications, n	3	0	**.022**

[a]Data are expressed as mean ± SD. Bold *P* values indicate statistically significant differences between groups ($P < .05$). ESP, erector spinae plane; ISNB, interscalene nerve block; NPRS, numerical pain rating scale; MME, morphine milligram equivalent.

TABLE 4
Multiple Linear Regression Model for Factors Contributing to Acute Postoperative Opioids Consumption[a]

	Unstandardized Coefficients		
	β	Standard Error	*P*
Age	0.108	0.085	.210
Sex	0.902	1.480	.545
BMI	0.345	0.198	.088
Analgesia	5.750	1.417	< .001*
Anchor number	1.609	0.452	.022*

[a]BMI, body mass index. *$P < .05$ was considered statistically significant.

(2 ± 0.3 vs 3 ± 1.6 for ISNB; $P = .003$), opioid consumption (0.5 ± 1.3 vs 6.1 ± 8.3 MME for ISNB; $P < .001$), and opioid-related side effects (0 vs 3 for ISNB; $P = .022$) in patients undergoing arthroscopic RCR when ISNB and multimodal oral analgesics had already been administered. In addition to the nerve block method, the number of anchors during surgery was also independently correlated with higher opioid consumption. Subgroup analysis indicated significantly less total opioid consumption in the ESP block group compared with the ISNB group when ≥2 tendons were repaired (0.5 ± 1.4 vs 7.6 ± 9 MME, respectively; $P < .001$).

Postoperative pain management is an important issue after arthroscopic RCR, and several studies have suggested some effective protocols in clinical practice.[3,4,21,28] In recent years, synergistic analgesic effects of combining multimodal analgesics for postoperative pain control have been promoted.[41] However, there is still a lack of research on the effect of additional catheterization for ESP block in patients undergoing arthroscopic RCR who have already received ISNB and multimodal oral analgesics. The results of this study support the use of catheterization for ESP block in addition to ISNB and multimodal oral analgesics after arthroscopic RCR.

The benefits of adding interscalene catheterization after single-shot ISNB for patients undergoing arthroscopic

RCR have been documented.[27,34] However, the effects of additional ESP catheterization after single-shot ISNB on arthroscopic RCR have not yet been explored. Forero et al[14,15] demonstrated that a T2 ESP block disperses anesthetic to the C3 to C7 levels. In our study, we positioned the ESP catheter at the C7 level, confirming that the block effectively reaches the C3 level. This is crucial, as the cutaneous innervation around the shoulder is provided by the cervical plexus (C3-C4).[31] The interscalene nerve block primarily affects the brachial plexus (C5-T1),[16] making the C7 ESP block a reasonable complementary procedure. Although less potent than ISNB,[25,37] the efficacy of ESP block in shoulder surgeries has been reported.[1,10,20] Our study supports the benefits of ESP catheterization after single-shot ISNB in patients undergoing arthroscopic RCR.

The most valuable characteristic of the ESP block is its ability to spare the phrenic nerve, unlike the commonly used interscalene block, which carries a risk of phrenic nerve involvement and potential hemidiaphragm paralysis.[6,13,37] The ESP block, administered on the posterior surface of the spinal transverse process, diffuses into the paravertebral and epidural spaces, avoiding the phrenic nerve.[6,13,37] Combining the more potent pain control of a preoperative single-shot ISNB with the safety of a postoperative ESP catheter block is a reasonable approach for intensive anesthetic care during RCR. Our study findings suggest that regular bolus doses through the ESP catheter are safe and reduce postoperative pain, opioid consumption, and opioid-related side effects. Despite the 1-day hospitalization required by our national health insurance system, the rationale for this combination is even stronger for outpatient surgeries.

In addition to statistical significance, it is important to assess the findings in terms of clinical significance and determine whether differences surpass the relevant MCID. Myles et al[30] assessed acute postoperative pain intensity using a visual analog scale (VAS) and determined the MCID for acute postoperative pain to be 9.9 mm out of 10 mm, which is comparable to 0.99 on the NPRS. In the present study, the postoperative NPRS score was significantly lower in the ESP block group (2 ± 0.3) than in the ISNB group (3 ± 1.6). This difference met the MCID for acute postoperative pain,[30] suggesting clinical relevance. Although we also noted a between-group difference in opioid consumption in the present study, the MCID for postoperative opioid consumption remains unclear.

Notably, the number of anchors used, indicating the number of repaired tendons, was independently correlated with postoperative opioid consumption in our multiple linear regression model. These findings seem reasonable, as patients undergoing additional surgical procedures (eg, tendon manipulation, suturing, and implantation of suture anchors) could potentially experience more postoperative pain. In contrast to the findings of the present study, Cuff et al[8] reported that numbers of anchors were not related to the VAS pain score on a postoperative day 1 after arthroscopic RCR. As all patients in the study of Cuff et al underwent concomitant subacromial decompression, and as Singh et al[36] reported that subacromial decompression may increase postoperative pain, we believe that the pain caused by subacromial decompression could potentially overshadow the pain caused by implanting additional anchors, leading to the divergent findings in results.

The results of the subgroup analysis indicated that patients undergoing arthroscopic repair of multiple cuff tendons benefitted more from additional catheterization. For patients undergoing single-tendon repair, additional catheterization for ESP block after ISNB did not decrease opioid consumption. In contrast, for patients undergoing multiple tendon repair, additional catheterization for ESP block after ISNB contributed to lower opioid consumption. As shared decision-making plays a vital role in managing pain,[43] the findings from the present study can be applied to patients before arthroscopic RCR, especially those who are anticipated to undergo repairs for $\geq$2 rotator cuff tendons.

Limitations

This study has some limitations. First, although the surgeries were performed by a single surgeon, and the analgesic protocols were selected preoperatively and conducted by the same group of medical personnel, the study was retrospective. The possible selection bias between the 2 groups could not be ignored. Second, the regimens of multimodal oral analgesics for both groups were not entirely identical (see Table 1). Since the present study was conducted using a retrospective design, this factor could not be controlled. Third, the follow-up period was relatively short. Based on our study, we do not know whether there would be differences in the pain scale, opioid consumption, or side effects on the days after catheter removal. Fourth, our patients had an overnight stay at the hospital after the surgery, which contrasts with the current trend of outpatient arthroscopic RCR. The 1-day hospitalization was driven by the national health insurance system and prevailing medical norms in our country, unrelated to the present study or nerve block catheters. While it is entirely feasible to apply a nerve block catheter after outpatient surgery,[27,34] it is essential to note that the hospital admission setting differs significantly from being at home. Fifth, no patient in the present study population received preoperative opioids within 3 months before surgery. Therefore, the results of our study may only apply to opioid-naïve patients. Sixth, our sample size was relatively small. Although the present study achieved sufficient power, further randomized controlled trials based on current surgical and anesthesiologic knowledge and techniques are needed to confirm the benefits of catheterization for ESP block in patients undergoing arthroscopic RCR.

CONCLUSION

The study findings indicated that additional catheterization for ESP block reduced postoperative pain, opioid consumption, and opioid-related side effects during the acute

postoperative period of arthroscopic RCR when ISNB and multimodal oral analgesics had already been administered. Future studies to evaluate this treatment protocol are needed to further assess pain relief after arthroscopic RCR surgery.

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