

# The efficacy of periarticular injection intraoperatively for mini-open rotator cuff repair: A comparative study

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## Abstract

**Background:** The optimal postoperative analgesia after open rotator cuff repair surgery remains unclear. This study compared the use of a multimodal pain regimen including periarticular injection (PAI), with a control condition. We hypothesized that PAI leads to decreased opioid consumption and lower pain scores.

**Methods:** The perioperative analgesic regimen was standardized and implemented from January 1, 2017 to December 31, 2017. The PAI was administered from July 1, 2017 to December 31, 2017. The historical control group was enrolled from January 1, 2017 to June 30, 2017. The evaluation items included assessments of pain using a 10-point visual analog scale (VAS) before and after the mini-open rotator cuff repair and on postoperative days 1, 2, and 3. The dose of ketorolac suppository and its side effects were also evaluated.

**Results:** The VAS score on the day of the operation was significantly low in the PAI group and less incidence of night pain. The time point of the rescue drug was longer in the PAI group than the control group (12.7 hours vs. 0.62 hours;  $p < 0.01$ ). No cardiac or central nervous system toxicity was observed.

**Discussion:** In our study, PAI in the shoulder after mini-open rotator cuff repair showed effective pain control on the day of the surgery, postponed the time of the first dosage of intravenous pain medication, and reduced the total dosage of the intravenous pain medication.

**Keywords:** Mini-open rotator cuff repair; Opioid consumption; Pain; Periarticular injection

## 1. INTRODUCTION

As the trend of arthroscopic repair of a rotator cuff tear, the mini-open rotator cuff repair has become less performed.<sup>1</sup> However, there are still some advantages of using a mini-open technique for rotator cuff repairs such as shorter operating time and lower costs.<sup>2</sup> Recent study showed the mini-open repair has better integrity of the repair and function of the shoulder than the arthroscopic rotator cuff repair of the rotator cuff tear.<sup>3</sup>

Although there are some advantages of using a mini-open repair, some surgeons are hesitant to perform mini-open surgery citing concerns about post-operative pain.<sup>4</sup> As a result, pain control may be an issue for mini-open repair and there is few studies to dedicate the pain-control protocol for the mini-open repair.

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Traditionally, we use opioid medication and require large dosages that may have a variety of side effects. Currently, the drug combination for periarticular injection (PAI) was to achieve different mechanisms of the analgesics in orthopedic surgery.<sup>5,6</sup> In our study, we use the intraoperative PAI for mini-open repair to demonstrate the efficacy of the pain control in mini-open surgery.

## 2. METHODS

### 2.1. Study population

This retrospective study was conducted at a single institution, and the protocol of this study was approved by the ethics committee of the institution. We included patients whose surgeries were performed by a single experienced surgeon. The protocol of intraoperative PAI in the shoulder was implemented from July 1, 2017 to December 31, 2017. We also enrolled a historical group from January 1, 2017 to June 30, 2017. The inclusion criteria were patients with documented rotator cuff tears who underwent mini-open rotator cuff repair. Patients with documented massive rotator cuff tears, with concomitant adhesive capsulitis of the ipsilateral shoulder, and who underwent revision rotator cuff repair were excluded (Fig. 1). The charts of all the patients were reviewed.

### 2.2. Treatment protocol of periarticular injection of shoulder after mini-open rotator cuff repair

We included the patient who received the mini-open rotator cuff repair. About the surgical approach, the incision was made from

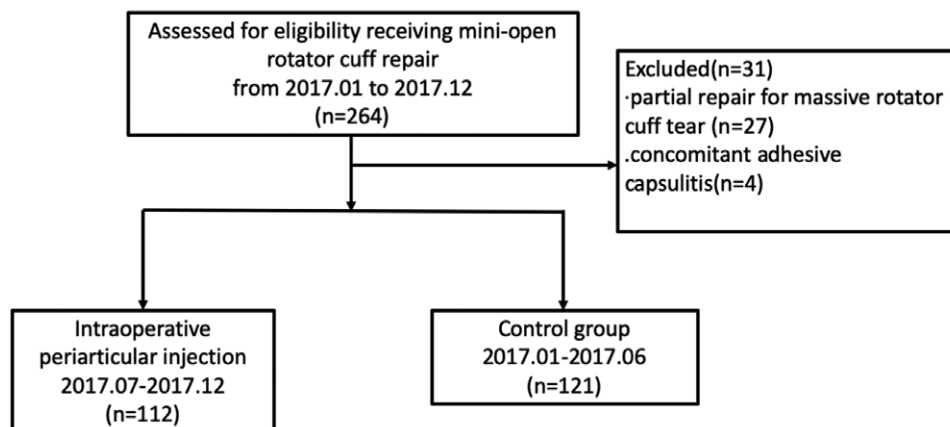


Fig. 1 Consort diagram.

the anterior border of the acromion to the acromion tip. The deltoid muscle was splitting and the bursectomy was done. After the cuff was repaired, the PAI was arranged before the wound closure. Our cocktail of the PAI Bupivacaine 300 mg, Morphine 5 mg, Ketolac 50 mg, and Epinephrine 0.3 mg. We injected evenly four distributed five points of the shoulder (Fig. 2). After returning to the ward, the rescue analgesics (Ketolac) via intravenous injection was given if intolerable pain in the 6-hours interval. In addition, oral acetaminophen (500 mg) was also prescribed four times a day.



Fig. 2 The trajectory and injection point of the periarticular injection. Clockwise (right) or counterclockwise(left) injection of the points in order: coracoid process, anterior border of acromion, subacromial space, posterior border of acromion, and suprascapular notch.

### 2.3. Outcome measurement

We recorded the shoulder pain preoperatively; postoperatively at the postanesthesia care unit (PACU); and on postoperative days (PODs) 1, 2, and 3 based on the visual analog scale (VAS) before the patients were discharged.

The incidence of pain at night was also recorded preoperatively, on the day of the surgery, and on PODs 1 and 2. In addition, we also collected the time point of the first dose of intravenous bolus pain medication after the surgery and the total dosage of Ketolac during hospitalization.

### 2.4. Statistical analysis

Data were analyzed using SPSS software (version 17.0, SPSS Inc., Chicago, IL, USA). Data were represented as means, ranges, and SDs for continuous variables or numbers and percentages for categorical variables. Fisher's exact test was used to assess differences between the two groups for each discrete variable because one or more of the cells in the contingency table had an expected frequency of less than five. The chi-square test was utilized to compare the relationships between the groups for each category's statistics. The Student's t-test was used to compare the differences between the groups for each continuous variable. In all statistical tests,  $p$  values of 0.05 or less were considered significant.

## 3. RESULTS

We analyzed the PAI group ( $n = 112$ ) and the control group ( $n = 121$ ) and the mean age was  $61.6 \pm 5.6$  years old in the PAI group and  $60.9 \pm 3.2$  years old in the control group ( $p = 0.248$ ). There was no difference between PAI group and the control group in the gender proportion ( $p = 0.752$ ) and the laterality ( $p = 0.067$ ). The tear size was  $1.85 \pm 0.90$  cm in the PAI group and  $1.64 \pm 0.80$  cm in the control group ( $p = 0.06$ ). Operative time and wound size were similar in the PAI group and the control group. (Table 1)

In the perioperative assessment, there was no significant difference in the preoperative status of the VAS for pain. There was less pain at the PACU just after the surgery and POD 1 (A.M.) in the PAI group than in the control group ( $5.3 \pm 3.10$  vs.  $7.2 \pm 3.20$ ;  $p < 0.001$  and  $5.3 \pm 2.37$  vs.  $6.2 \pm 2.38$ ;  $p = 0.003$ , respectively). There was no significant difference at POD1 (P.M.), POD2, and POD3 of the VAS for pain. The night pain incidence was no different between the two groups. (Table 2)

The rescue pain medication started at the time point in the PAI group is longer than in the control group ( $12.7 \pm 4.40$  hours

**Table 1**  
Demographic characteristics

	Periarticular injection (PAI) group	Control group	p
	(n = 112)	(n = 121)	
Patients (no.)	112	121	
Mean age ± SD (yr)	61.6 ± 5.6	60.9 ± 3.2	0.248
Male sex (no. [%])	56 (50%)	63 (52%)	0.15
Right site injury (no. [%])	76 (68%)	68 (56%)	0.39
Cause of tear (no.)			
Heavy lifting	7	13	
Fall injury	8	9	
Unknown	97	99	
Tear size (cm)	1.85 ± 0.90	1.64 ± 0.80	0.06
Surgery time (min)	37.9 ± 12.3	41 ± 15.4	0.09
wound size (cm)	3.1 ± 1.2	3.3 ± 1.1	0.187

**Table 2**  
Perioperative pain assessment

	Periarticular injection (PAI) group	Control	p
VAS for pain			
Preoperative	3.88 ± 2.00	3.88 ± 1.94	1
PACU	5.3 ± 3.10	7.2 ± 3.20	<0.001
POD 1 (A.M.)	5.3 ± 2.37	6.2 ± 2.38	0.003
POD 1 (P.M.)	5.5 ± 2.11	5.7 ± 2.51	0.427
POD 2 (A.M.)	5.3 ± 2.50	4.9 ± 2.40	0.215
POD 2 (P.M.)	4.5 ± 2.21	4.6 ± 2.18	0.266
POD 3 (A.M.)	3.7 ± 2.37	3.7 ± 1.91	0.888
Night pain (no. [%])			
Preoperative	76 (68%)	92 (76%)	0.164
POD 0	54 (48%)	87 (72%)	<0.001
POD 1	54 (48%)	87 (72%)	<0.001
POD 2	54 (48%)	82 (68%)	0.002

POD = postoperative days; VAS = visual analog scale.

**Table 3.**  
Rescue intravenous pain control

	Periarticular injection (PAI) group (n = 112)	Control group (n = 121)	p
Time to first Keto (h)	12.7 ± 4.40	0.6 ± 0.05	<0.01
Total usage of IV Keto	2.1 ± 0.30	2.7 ± 0.31	<0.01

Keto = Ketolac 30 mg/vial.

vs. 0.6 ± 0.05 hours;  $p < 0.01$ ). The total dosage of the intravenous pain medication was smaller in the PAI group than in control group ( $p < 0.001$ ). (Table 3)

#### 4. DISCUSSION

In our study, PAI in the shoulder after mini-open rotator cuff repair showed effective pain control on the day of the surgery, postponed the time of the first dosage of intravenous pain medication, and reduced the total dosage of the intravenous pain medication.

The postoperative management of the rotator cuff repair was varied and the trend was tended to multimodal approach.<sup>7</sup> The rotator cuff repair is often with severe postoperative pain, especially during the first 48 hours.<sup>8</sup> Lots of administration methods of analgesia are used to reduce the postoperative pain for rotator cuff tear. In the conventional methods, intravenous opioid or

patient-controlled analgesia and regional nerve block have lots of drawbacks in terms of the side effect and risks.<sup>9,10</sup>

As a result, the PAI was based on combining the different drug effects to achieve the efficacy to reduce pain.

Although there is still debate about the comparable long-term outcome of the arthroscopic repair and mini-open repair of a rotator cuff tear, the arthroscopic repair showed a lower pain score within postoperative 2 days.<sup>8</sup> However, the mini-open repair has its own advantages.<sup>11</sup> Boss et al have conducted 42 patients undergoing rotator cuff repair with a subacromial injection or no injection. The results demonstrated no difference between the two groups.<sup>12</sup> Harvey et al have reported about the local injection of the lesion side decreased pain scores on postoperative days 1 and 2.<sup>13</sup> In our study, it has the efficacy for pain control on the first 24 hours with our regime.

Morphine's analgesic action will bind to central nervous system opiate receptors.<sup>14</sup> Among knee surgeries, PAI is widely applied after knee arthroscopy or total knee replacement.<sup>15</sup> This may be indicated the existence of specific receptors in the periarticular region. However, there were few studies to provide the result of the mini-open shoulder surgery.

There are concerns relating to the myotoxicity induced by subacromial analgesia.<sup>16</sup> However, the impact of local anesthetics on the rotator cuff has not been well-established. Prolonged or continuous intra-articular injection of high-dose bupivacaine can cause toxicity to the chondroid tissue; however, in our study, we used the single-dose with low concentration.

This study had some limitations. The study design was retrospective, which had inherent limitations and reduced the long-term outcomes that could be evaluated regarding pain and functional outcomes. In addition, the pain scores were collected prospectively but analyzed retrospectively, and we acknowledge the inherent bias.

In our study, PAI in the shoulder after mini-open rotator cuff repair conferred effective pain control on the day of the surgery, postponed the time of the first dosage of intravenous pain medication and reduced the total dosage of the intravenous pain medication.

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