Original Research

Portal-site epinephrine injections improve visualisation in arthroscopic rotator cuff repair

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ABSTRACT

Objectives: The aim of this study was to evaluate if portal-site injections of 1:200,000 epinephrine improve intraoperative visualisation in arthroscopic rotator cuff repair.

Methods: Patients with partial-thickness supraspinatus tears were selected for the study. They were assigned consecutive numbers and were divided into two groups—control group and intervention group. The surgeries were done by a single surgeon. Every odd-numbered patient was injected. Johnson's visibility classification, surgeon 5-point ordinal Likert scale (LS), and other parameters were recorded.

Results: A total of 221 participants (58.4 ± 6.1 years) were selected. Intraoperative visibility was better in the intervention group according to Johnson's classification—satisfactory visibility was achieved in 68 of 110 patients (62%, control group) compared to 89 of 111 patients (80%) (p = 0.003). Surgeon LS was superior in the intervention group, with a notable decrease in worsened visibility cases. The operative time did not alter statistically significantly—82.2 ± 14.4 min for the control group, compared to 80.9 ± 10.8 min in the intervention group (p = 0.056). No injection-associated complications were recorded.

Conclusions: Portal-site injection of diluted epinephrine solution is safe and improves intraoperative visualisation in arthroscopic rotator cuff repair. This addition does not increase operative time.

Level of evidence: Level 3, case–control study.

What are the new findings?

- A portal-site injection of diluted epinephrine solution improves intraoperative visualisation in arthroscopic rotator cuff repair.
- A portal-site injection of diluted epinephrine is a safe method and does not increase operative time.
INTRODUCTION

Altered vision has oftentimes plagued arthroscopic shoulder surgeons. This is not only due to the fact that no tourniquet can be utilised but also because an essential part of surgical procedures is done extracapsularly—in the subacromial space (rotator cuff surgery) [1].

Ignoring the vascular anatomy may cause damage to these structures and lead to active bleeding [2].

Despite the advances in arthroscopic surgical instrumentation and the satisfactory work of the anaesthesiologist, intraoperative bleeding in the subacromial space alters the visibility during shoulder arthroscopy [3]. This in turn causes a delay in the operative technique and provokes the surgeon to cauterise, increasing the risk of iatrogenic injury.

Improving intraoperative visualisation allows the orthopaedic surgeon to perform the desired procedure in a safe and controlled manner. Primary and secondary outcome measures have been developed to evaluate the degree of visibility [4]. Various evidence-based solutions are proposed— intra-articular/intravenous tranexamic acid (TXA), and irrigation with epinephrine/TXA [5–7]. Additionally, portal-site injections with epinephrine have been shown to effectively improve visualisation during knee arthroscopy [8]. To our knowledge, no comparative studies exist in regard to shoulder arthroscopy.

The aim of this study was to evaluate if portal-site injections of 1:200,000 epinephrine improve intraoperative visualisation in arthroscopic rotator cuff repair.

It was hypothesised that portal-site injections of diluted epinephrine improve visualisation and operative time in shoulder arthroscopy.

METHODS

A prospective, blinded comparative study was carried out to evaluate if portal-site injection of 1:200,000 epinephrine solution improves the intraoperative visibility in arthroscopic rotator cuff repair. Approval was obtained from the institutional review board (IRB 499/04.01.21) at the University Hospital of Orthopaedics “Prof. B. Boichev”, Sofia, Bulgaria.

Patients who were about to undergo elective arthroscopic surgery for a partial-thickness supraspinatus tear were selected. Ellman Grade 2 and Neer Stage 3 tears were included. Patients with a history of diabetes mellitus, nonsteroidal anti-inflammatory drugs (NSAIDS) overdose, coagulative disorders, and a preoperative thrombocyte count of below 150,000 platelets per microlitre of blood were excluded.

The participants were assigned consecutive numbers and were divided into two groups—control group (no injection) and intervention group (injection). Informed consent was taken at the point of administration to the hospital—both written and verbal. The surgeries were made by a single surgeon at a single institution.

All participants were under general anaesthesia and received a preoperative interscalene brachial plexus block (IBPB). The patient positioning was the same in all surgeries—the lateral decubitus position. The base settings for arthroscopic pump pressure and flow rate were set at 70 mmHg and 100 ml/min, respectively.

The preparation of the solution and the documentation were recorded by the attending anaesthesiologist. Approximately 30 ml of 1% lidocaine with 1:200,000 epinephrine was administered to every odd-numbered patient at the beginning of the operation by the assistant resident surgeon. A dose of 10 ml was applied to the anterior, anterolateral, and the lateral portal. The injections were subcutaneous but were also reached intramuscularly. No repeat injections were utilised. The control group received no injections. For blinding purposes, the senior surgeon was absent from the operating room at this point.

The primary outcome was intraoperative visibility. This was calculated by using Johnson’s visibility classification—satisfactory (excellent, no limitations) and unsatisfactory (good/fair/poor) for ease of statistical analysis [4]. A surgeon 5-point ordinal Likert scale (LS) was also used in the primary evaluation—the results were graded on a scale from one to five (Table 1).

Table 1

<table>
<thead>
<tr>
<th>Grade</th>
<th>Likert Score</th>
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<tr>
<td>Smooth</td>
<td>Excellent visibility throughout the operation.</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>Excellent visibility throughout most of the operation.</td>
</tr>
<tr>
<td>Worsened</td>
<td>Good visibility, but with altered moments — need to lower blood pressure/increase pump pressure.</td>
</tr>
<tr>
<td>Unsatisfactory</td>
<td>Can see the ‘big picture’, but no sharpness/cannot visualize details.</td>
</tr>
<tr>
<td>Poor</td>
<td>Lack of visibility whatsoever/surgeon unable to continue the operation arthroscopically.</td>
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The secondary outcomes were the following: the need to temporarily increase the arthroscopic pump pressure, asking the anaesthesiologist to lower the blood pressure, and operative time (in minutes). The outcome measures were recorded by the senior surgeon after the surgery. This was done digitally on a customised patient Excel worksheet. The video from the arthroscopy was watched the next working day to confirm the evaluation.

It was assumed that the visibility would be good in 98% of the cases in the intervention group and in 90% of the cases in the control group. To calculate if the sample size is sufficient (α = 5% and a power of 80%), based on previous studies, at least 108 individuals needed to be included per group [7,9]. The statistical analysis was performed with the SPSS program, version 14.0 (SPSS, Chicago, IL), and a P value of 0.05 was considered statistically significant. An independent-sample t-test and the chi-squared test (χ²) were used. The descriptive statistics included mean values and standard deviations. The Wilcoxon signed-rank test was used for the surgeon-score-ranked grades. The mean procedure duration between the two groups was compared using the Student t-test.

RESULTS

A total of 221 patients were included in the study. The control group and the intervention group consisted of 110 and 111 participants, respectively. There was no statistically significant difference in the demographic data between the two groups (Table 2). Eligibility was assessed for a timeframe of 4 years (from January 2019 until December 2022).

The intraoperative visibility in the control group (no injection) was rated satisfactory in 68 of 110 cases and unsatisfactory in 42 of 110 cases, whereas the intervention group (injection) showed a satisfactory result in 89 of 111 cases and unsatisfactory in the other 22 of 111 patients. The intraoperative visibility was better in the injection group (p < 0.05, chi-square test) (Fig 1).

The biggest conversion in surgeon LS scores was from Grade 3 to Grade 2 for the intervention group (Table 3). The epinephrine portal-site injections also influenced the lower grade—14/110 and 13/110 Grade 4, 5 (no injection) versus 10/111 and 9/111 in the injection group (p = 0.002, Wilcoxon signed-rank test).

In the cases where the visibility was rated poor/unsatisfactory, the surgeon needed to temporarily increase the arthroscopic pump pressure.

Table 2

| Mean demographic values. No statistically significant difference in demographic data between control group and intervention group. BMI – Body Mass Index, Pre-Thr – preoperative thrombocyte count. |
|-------------------|-------------------|
| Total (N = 221)   | Control group     | Intervention group |
| Age               | 58.4 ± 6.1 years  | 57.8 ± 5.7 years  | 59 ± 6.3 years  |
| Sex               | 173 male (78.3 %) | 91/110 male       | 82/111 male     |
| BMI               | 27.9 ± 3.2 kg/m²  | 29.5 ± 2.6 kg/m²  | 27.1 ± 3.9 kg/m² |
| Pre-Thr           | 184 × 10⁶/L       | 188 × 10⁶/L       | 181 × 10⁶/L     |

Abbreviations: BMI – Body Mass Index, Pre-Thr – preoperative thrombocyte count.
In 14 of 110 patients for the control group, compared to 10 of 111 in the intervention group. The blood pressure was lowered in 9 of 110 cases (control group) versus 6 of 111 cases (intervention group).

The mean procedure duration was 82.2 ± 14.4 min for the non-injection group, compared to the 80.9 ± 10.8 min range in the intervention group (p = 0.056, Student t-test). No injection-associated complications were recorded.

**DISCUSSION**

The most important finding in this study was that portal-site epinephrine injections improved intraoperative visibility in patients with partial-thickness supraspinatus tears (Ellman Grade 2, Neer Stage 3) that require arthroscopic rotator cuff surgery.

Unlike portal-site injections, epinephrine irrigation is heavily studied in the literature. De Castro Veado et al. discovered that visual clarity was statistically improved when using 1-mg/L epinephrine irrigation for rotator cuff repair [6]. Van Montfoort et al. confirmed these findings for Superior labral anterior posterior (SLAP) tears and Bankart repairs, along with a statistically significant hastening in total operating time [7]. The authors used 0.33-mg/L epinephrine. Avery 3rd et al. also discovered a statistically significant improvement in visualisation for various shoulder procedures in a high-quality randomised controlled trial [10]. However, no change in operative time was noted. A much higher dose of epinephrine of 1 g/L was used than that used in the other studies.

Finally, a systematic review and meta-analysis from Kuo et al. confirmed the role of epinephrine in arthroscopic shoulder surgery with no apparent risks [11]. However, a scoping review of the complications by Abdelrehman et al. found association with hypertension and tachycardia [12]. This includes a case report of fatal cardiomyopathy after epinephrine irrigation. The portal-site injection approach is a safer alternative in our opinion. In addition, no injection-related complications were recorded.

Epinephrine in the irrigation fluid is also superior to other alternatives such as intravenous TXA. Old et al. found out in a randomised controlled trial that it does not improve intraoperative clarity and provides no additional benefit [5]. Nicholson et al. investigated cases with full-thickness rotator cuff tears and found no difference in visual analogue scale scores [13]. Additionally, Zhao et al. conducted a systematic review and meta-analysis of Level I and Level II studies on intravenous TXA. They discovered no statistically significant effect on improving visual clarity compared to epinephrine [9].

The portal-site-injections-only method improves visibility due to the specific vasoconstrictive actions of the epinephrine. The portals in which the solution is injected are in close proximity to the major arteries and the so-called “bleeding points” of the subacromial space—the acromial branch of the thoracoacromial artery (anterior wall) and Anastomoses between the lateral branches of the acromial artery and the posterior-medial acromial branch of the supraspinacular artery (posteralateral wall) [2].

TXA irrigation has also been described as a safe and reliable method for better visualisation. Bildik et al. demonstrated a statistically significant visual improvement and a hastened operative time for arthroscopic rotator cuff surgery [14].

In our opinion, there seems to be no superiority between TXA and epinephrine. Bayram et al. compared 0.33 mg/L epinephrine to 0.42 mg/L TXA irrigation and found neither method to be superior [15]. This was done in a high-quality double-blind randomised controlled trial.

TXA was not examined in this study because of economic and institutional reasons. Epinephrine is a more widely available drug and can be utilised in tertiary centres as a safe and useful alternative when TXA is not available.

For minimising confounding factors, a systolic blood pressure of approximately 100 mm Hg was maintained by the attending anaesthesiologist during the operations [16]. This value was picked for optimal visualisation during the procedures. Additionally, all patients received pre-operative IBPB with general anesthesia, as this is shown to be beneficial in maintaining the correct blood pressure in rotator cuff surgery [17].

To the authors’ knowledge, it is unknown whether pre-operative patient positioning has an impact on perioperative visualisation. However, all surgeries were carried out in the lateral decubitus position.

One limitation of this study is that no mean blood pressure was recorded during the cases. It may be a confounding factor or a hazard as high values may increase the epinephrine side effects. Another limitation is the lack of injection in Group A, which means that the study is not completely blind. This is not a randomised trial, but a case-control study.

**CONCLUSION**

Portal-site injection of diluted epinephrine solution is safe and improves intraoperative visualisation in arthroscopic rotator cuff repair. This addition does not increase operative time.
Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References


