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Original Article

Is it advantageous to add epinephrine to the arthroscopic infusion solution for the treatment of rotator cuff injury?

Marco Antônio de Castro Veado,[1,*] *Bruno de Souza Teixeira,*[2] *Nathalia Coelho de Castro,*[3] *Luciano Assis Costa*[3]

[1]*Assistant Professor of Faculdade de Ciências Médicas de Minas Gerais; Surgeon from the Shoulder and Elbow Group of Hospital MaterDei, Belo Horizonte, MG, Brazil.*
[2]*Physician; Orthopedist; Shoulder and Elbow Surgeon at Hospital Semper and Hospital Evangélico de Belo Horizonte, Belo Horizonte, MG, Brazil.*
[3]*Sixth-year Medical Students at Faculdade de Ciências Médicas de Minas Gerais, Belo Horizonte, MG, Brazil.*
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ABSTRACT

Objective: To evaluate the use of epinephrine in arthroscopic infusion serum as a measure to improve the quality of surgical viewing during procedures for treating rotator cuff tears. *Methods:* This was a prospective randomized double-blind comparative study in which 49 arthroscopic repair procedures on rotator cuff tears were evaluated. Patients presenting ASA I and II surgical risk were included. The patients were placed into two groups: the first with epinephrine (1 mg/L) in the infusion serum and the second with pure physiological solution. A single surgeon was responsible for the procedures, without knowledge of the medication usage. The surgeon rated his quality of viewing during the operation, on an increasing scale from 0 to 10. Interscalene block or suprascapular nerve block was chosen randomly and used in association with general anesthesia. The anesthetist issued final report relating to possible intercurrences. *Results:* The group with epinephrine received an average score of 9.29 and the group without epinephrine received an average score of 7.16. The difference was statistically significant ($p < 0.05$). There was no important clinical alteration relating to use of this drug. *Conclusion:* As well as being safe, addition of epinephrine at a concentration of 1 mg/L to the infusion serum was shown to be effective for improving the visual field during arthroscopy to repair rotator cuff injuries..

Corresponding author at: Av. Celso Porfírio Machado, 104, Bairro Belvedere. CEP: 30320-400. Belo Horizonte, MG, Brasil.
Phone: (+55 031) 32863156.
E-mail: marcoveado@gmail.com

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Introduction

The increased use of arthroscopic treatment for shoulder pathologies is well supported in the orthopedic literature, as it has been shown to be safe and effective. Despite the broad use of such procedures, there are still several difficulties faced by the surgeon during the surgical procedure.

During a shoulder arthroscopy, particularly those involving the subacromial space, bleeding is a frequent complication that limits the surgeon's field of view and affects the operative technique. Additionally, the duration of surgery can be greatly increased as a result of such complications. An understanding of the aspects related to bleeding may improve the control of bleeding, either by avoiding vulnerable areas or by taking precautions to circumvent an adverse event. The use of epinephrine in arthroscopic infusion solution is one possible measure to reduce bleeding in the subacromial field. This practice, although routine in many other procedures, has been the subject of scientific research, but a consensus regarding its use remains elusive.

The aim of this study was to evaluate the efficacy of adding epinephrine to the arthroscopic infusion solution at a fixed concentration; the efficacy was determined by the field of view observed by the surgeon during rotator cuff repair surgery.

Materials and Methods

The present study aimed to investigate the results of the addition of epinephrine to the arthroscopic infusion solution during the surgical treatment of rotator cuff injuries. The study was submitted to and approved by the ethics committee of the hospital.

A total of 49 arthroscopic procedures performed for the treatment of rotator cuff ruptures were evaluated; these were divided into two randomized groups. One of the groups received epinephrine in the arthroscopic infusion solution and the other did not. For this purpose, the procedures were standardized at all stages. An attending physician was responsible for group randomization, and the support staff in the operating room provided the infusion solutions (with or without epinephrine); thus, the surgeon could not discriminate between the two conditions. Randomization was carried out so that neither the surgeon nor the patient knew whether epinephrine was used or not (double-blind study). The arthroscopic visualization was evaluated by the surgeon using a score provided at the end of each step; these scores ranged from 0 to 10, with 10 being the best possible visualization. The scores of the two groups were compared for statistical purposes.

The sample consisted of 49 patients, 17 men and 32 women with a mean age of 59.6 years (37-81). Patients were undergoing arthroscopic procedure for the treatment of rotator cuff diseases (total or partial rotator cuff rupture of a high degree with subacromial impingement syndrome) diagnosed through a preoperative clinical and imaging assessment (ultrasound/MRI). Patients underwent preoperative clinical evaluation, and those with surgical risk ASA I and II, according to the classification of the American Society of Anesthesiology, were included in the study.

General anesthesia was always associated with another anesthetic method: interscalene block (ISB), performed by the anesthesiology team using the Stimuplex® device, or suprascapular nerve block (SNB), performed by the surgeon before the procedure.

The surgeries were performed with the patient in lateral decubitus, and a single surgeon was responsible for all procedures using a standardized surgical technique and sequence. The addition of epinephrine, when used, was at a limited concentration of 1 mg/L, and the pressure in the infusion pump was 55 mmHg. The posterior portal was used for visualization, and the anterior and lateral portals were used for instrumentation. Initially, the glenohumeral joint was assessed, and the subacromial space was then approached with bursectomy and tendon injury evaluation. The decisions to repair the injuries and to perform tuberoplasty and acromioplasty were made according to the specific indications for each case.

Data on gender, age and comorbidities were collected. Data characterizing the injuries and major therapeutic procedures of the surgery were also recorded. The following data were recorded during the procedure: duration of surgery, infusion volume, type of anesthesia, heart rate and mean arterial pressure, cardiac abnormalities and visualization score given by the surgeon.

For the qualitative data (gender and type of anesthesia), the chi-square test was used to assess the association between these and the use of epinephrine, and a significant association was considered when $p < 0.05$. Student's t test was used for the other variables, to compare the means of the two groups.

Results

The collected data demonstrated there was a homogeneous gender ($p = 0.44$) and age ($p = 0.39$) distribution between the two groups. The same was observed in relation to the distribution of types of anesthesia ($p = 0.75$) (Table 1).

When comparing the results of the two groups, no significant differences were found in relation to the following variables: duration of surgery, infusion volume, heart rate and mean arterial pressure (Table 2).

When the scores were separated into two groups according to the type of anesthesia, General + SNB and General + ISB, the statistical analysis showed no significant differences ($p = 0.16$) and the mean score for General + SNB was 7.93 and for General + ISB was 8.55.

However, regarding the score, there was a statistically significant difference ($p = 0.00$) between the means of the group receiving epinephrine (9.29) and the group that did not receive epinephrine (7.16) (Table 3).

Table 1 - Distribution between genders.

	Women	Men
Without epinephrine	30.61%	20.41%
With epinephrine	34.69%	14.29%

Table 2 - Statistical assessment results.

	Group with epinephrine	Group without epinephrine	p-value
Surgery time (minutes)	82.2	73.69	p = 0.12
Infusion volume (liters)	18.76	15.21	p = 0.09
Mean heart rate (bpm)	63.32	65.04	p = 0.20
Mean blood pressure (mm Hg)	75.76	77.17	p = 0.37

Table 3 - Distribution of the type of anesthesia.

	General + SNB	General + ISB
Without epinephrine	30.61%	20.41%
With epinephrine	24.49%	24.49%

Discussion

The evolution of surgical techniques for the treatment of rotator cuff injuries has made significant progress with the development of shoulder arthroscopy. This practice has become increasingly used and has resulted in an improvement of the understanding of injuries, techniques and surgical materials.[1-3]

The correct performance of the arthroscopic technique requires appropriate visualization through a video camera. Among the many factors that can negatively impact the visual field, bleeding is significant, and the possible causes of bleeding and measures that can be taken to mitigate bleeding deserve attention.

Potential methods to decrease bleeding include hypotensive anesthesia, infusion pressure control, use of electrocautery and the addition of epinephrine to the infusion solution[4,5], which is the subject of the present study.

Knowledge concerning the primary aspects related to bleeding is important both to prevent and circumvent potential difficulties during arthroscopy. Yepes et al.[6] concluded that there is a predictable anatomical pattern of vascularity in the subacromial space. The primary local irrigation is performed by the acromial branch of the thoracoacromial artery.[8-12]

The main points of subacromial bleeding are the anteromedial and posterior aspects.[6] The infusion pressure and fluid flow are also factors related to the amount of bleeding.[6]

The use of epinephrine during the arthroscopic shoulder procedure is quite common. This practice is based on the potent vasoconstrictor effect of the drug,[7] which acts directly on the local vessels. However, there is no standardization for the use of epinephrine, as the optimal concentration has yet to be established. In a detailed study, Jensen et al.[7] safely used a concentration of 0.33 mg/L of solution, but they mentioned that the efficacy of higher or lower concentrations should be further studied. Our study used a concentration of 1 mg/L, and in agreement with the literature, showed no significant systemic effects. The drug concentration was based on experience accumulated over a long period using different procedures, including those performed by the surgeon, but it lacked the rigor of a scientific study.

There is concern about potential systemic side effects caused by absorption of epinephrine in the subacromial space. This study agrees with the literature, as no significant side effects were observed after the use of epinephrine. Although there was increased serum epinephrine during the arthroscopy, no significant systemic effects were detected.[7]

The patient's blood pressure levels are also related to the amount of bleeding; thus, the use of hypotensive anesthesia is important during the surgical procedure. All patients received general anesthesia, which was associated with interscalene block (ISB) or suprascapular nerve block (SNB). Both anesthetic modalities are safe, as long as they are carried out using adequate technique. There were no anesthesia-related complications in our study sample.

Placing the patient in lateral decubitus was the standard position in all procedures, according to the surgeon's experience. There were no known complications related to positioning.[13]

Because only one surgeon was in charge of all surgeries, it was possible to establish an arthroscopy routine. All procedures were performed without any significant clinical alterations attributable to the drug; thus, we can also conclude that the concentration used was safe from a systemic perspective for this patient group (surgical risks ASA I and II). Cases that had a higher surgical risk classification were not included in the study for safety reasons related to the possible effects of epinephrine; in those cases, patients received arthroscopic treatment without the drug. Further studies can be performed with other groups of patients.

The differences regarding the time of surgery and infusion volume would suggest that the group receiving epinephrine corresponded to more complex cases. However, in addition to being a double blind study, there was no statistically significant difference between the groups, as shown in Table 2.

The results showed that the objective of evaluating the use of epinephrine was achieved. The average scores of the two groups showed that the addition of epinephrine to the arthroscopic saline infusion at a concentration of 1 mg/L significantly improved visualization during the rotator cuff repair procedures. The assessed practice is one of several

potential methods to control bleeding during arthroscopic shoulder surgery, and it is the surgeon's responsibility to understand these occurrences and avoid them.

Conclusions

In addition to being safe, the addition of epinephrine to the infusion solution at 1 mg/L was shown to be effective in improving the visual field during arthroscopy for the repair of rotator cuff injuries.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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