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Tranexamic acid for the Latarjet procedure: a randomized controlled trial

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Background: Tranexamic acid (TXA) is commonly used in orthopedic surgery to reduce perioperative bleeding and the need for transfusion. The purpose of the study was to assess whether TXA could reduce the incidence of postoperative swelling and hematoma formation and pain and opioid use in the early postoperative period following the Latarjet procedure.
Methods: A randomized controlled trial was conducted in 100 patients undergoing open Latarjet surgery for anterior shoulder instability by a single surgeon. Patients were randomized to receive either 1 g TXA or a placebo intravenously preoperatively. Outcomes measured during the perioperative period were (1) intraoperative blood loss, (2) postoperative blood loss (via drain output), (3) postoperative swelling/hematoma formation, (4) visual analog scale (VAS) score, and (5) postoperative opioid use (in morphine milligram equivalents).
Results: There was no significant difference in intraoperative blood loss (60.9 vs. 68.9 mL, $P = .18$). However, there was significantly lower postoperative blood loss with TXA (29.6 vs. 64.9 mL, $P < .01$). There was a significantly lower rate of painful postoperative swelling (4% vs. 32%, $P < .01$). Additionally, we found a significantly lower VAS score for pain (1.7 vs. 3.0, $P < .01$) and significantly less postoperative opioid use (9.4 vs. 22 mg, $P < .01$) in the TXA group. Postoperative swelling was shown to correlate with increased pain and opioid use ($P < .01$).
Conclusion: Our study found that TXA significantly reduced postoperative blood loss, painful postoperative swelling, and hematoma formation and subsequently reduced postoperative pain and opioid use following the Latarjet procedure.
Level of evidence: Level I; Randomized Controlled Trial; Treatment Study

Keywords: Latarjet; anterior shoulder instability; tranexamic acid; randomized control trial; hematoma; complications

The Latarjet procedure is a commonly performed procedure for patients with anterior shoulder instability, with low recurrence rates at long-term follow-up.[12] However, there are concerns regarding postoperative complications following the Latarjet procedure.[10,11] Hematoma formation occurs because of continued blood loss resulting in painful postoperative swelling. Painful postoperative swelling may necessitate increased postoperative opioid administration, cause delays in hospital discharge, and result in prolonged shoulder immobilization, whereas a clinically significant hematoma may even need surgical drainage.[16]

Tranexamic acid (TXA) is a synthetic derivate of the amino acid lysine that primarily inhibits plasminogen activation through blocking a lysine-binding site, stopping plasmin from binding to fibrin or fibrinogen following clot formation, leading to reduced fibrinolysis and stabilization

The study protocol was approved by the Sports Surgery Clinic Ethics Board of our institution, and registered at Clinicaltrials.gov (NCT03458468) prior to the start of the study.

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of physiological thrombi.[3] TXA is commonly used in orthopedic surgery to reduce perioperative bleeding and the need for transfusion.[1,8,14] The use of TXA in shoulder arthroplasty has been shown to have a significant effect not only on postoperative blood loss but also on postoperative pain levels.[9,14,16]

The purpose of the study was to assess whether TXA could reduce the incidence of postoperative swelling and hematoma formation, pain, and opioid use in the early postoperative period following the Latarjet procedure. Our hypothesis was that TXA would reduce the risk of postoperative hematoma formation, painful swelling, and subsequently pain levels.

Methods

All patients scheduled to undergo the Latarjet procedure for anterior shoulder instability by one fellowship-trained shoulder surgeon between March 2018 and March 2019 were considered for inclusion in the study. Exclusion criteria were refusal to participate in the study, revision shoulder stabilization, known allergy to TXA, anticoagulative medication, history of arterial or venous thromboembolic events, coagulopathy, hematologic disorders, or history of seizures. Informed consent was obtained from all included patients.

A priori power analysis was performed based on the visual analog scale (VAS) score as the primary endpoint, which revealed that a minimum of 39 patients would be required in each group to detect a clinically important difference in the VAS score (1.4) with a power of 0.8.[17] Thus, 50 patients each were recruited for the intervention and placebo groups for a total of 100 patients to allow for a 20% loss to follow-up. Randomization was performed according to a computerized random number sequence generator. An investigator not involved in the procedure informed the anesthetist of the patient's allocation, and both the surgeon and patient remained blinded to the group allocation. In the control group, 100 mL saline was administered 15 minutes before skin incision, whereas in the intervention group (TXA group), 1 g TXA (Pfizer Inc., New York, NY, USA) was administered intravenously in 100 mL saline 15 minutes prior to skin incision.

Surgical technique

All patients underwent surgery under general anesthesia and were placed in the beach-chair position. A 4-cm-long skin incision was placed in extension of the axillary fold, starting approximately 2-3 fingers distal to the tip of the coracoid. Following development of the deltopectoral interval, the coracoid and the conjoint tendons were exposed. The coracoacromial ligament laterally and the pectoralis minor insertion medially were then released off the coracoid. An osteotomy of the coracoid was then performed at the junction between its body and base with a 90°-angled saw, while aiming to harvest a minimum 20-mm-long graft. The donor area at the coracoid base was coagulated and sealed with bone-wax. The undersurface of the coracoid was then prepared with a high-speed burr and the first 2.5-mm drill hole was placed central, 5 mm proximal from the coracoid tip. A horizontal subscapularis split was performed at the junction between its middle and lower third to expose the capsule, which was then also split horizontally. After removal of any remnant osseous fragments and soft tissues, the anterior glenoid neck was freshened with a high-speed burr. An inferior 2.5-mm drill hole was then placed 5 mm superior to the inferior margin of the defect. After measuring and tapping, the coracoid graft was fixed to the glenoid with a standard 3.5-mm, partially threaded, cancellous screw. A second drill hole and screw were then placed approximately 10 mm superior to finally secure the graft. The graft was then contoured to be flush with the glenoid surface using a high-speed burr. Capsular closure was then performed with 2-3 nonabsorbable stitches. A drain was placed deep in the deltopectoral interval before wound closure and left in place for 24 hours. The arm was supported in a sling after surgery.

Data collection

At the time of surgery, intraoperative blood loss and operative time were recorded. Subsequently, patients were evaluated 1 day postoperatively for (1) hematoma formation and grade, (2) drain output, (3) VAS score, and (4) opioid consumption, by a single examiner, who was not directly involved in the procedures and blinded to the group allocation. Grading of hematoma formation and postoperative swelling was based on a previously published scale[16]: grade 0, no hematoma or swelling; grade 1, mild hematoma and swelling—visible but not painful on palpation; grade 2, moderate hematoma—visible swelling, painful on palpation; or grade 3, severe hematoma—progressively painful swelling or other accompanying symptoms (eg, neurologic signs) requiring operative drainage. Patients were followed for up to 4 months as part of our routine postoperative assessment for complications.

Statistical analysis

Statistical analysis was performed using SPSS Statistics for Macintosh, version 22.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated for all continuous and categorical variables. Continuous variables were reported as weighted mean and estimated standard deviation, whereas categorical variables were reported as frequencies with percentages. Fisher exact or χ^2 test was used to analyze categorical variables. The independent or paired t test for normally distributed variables, or the nonparametric Mann-Whitney U test or Wilcoxon signed-rank test was performed to compare continuous variables. A P value $<.05$ was considered statistically significant.

Results

Patient demographics

There was no significant difference in the baseline demographics between the groups receiving TXA and the placebo, regarding age, sex distribution, or BMI. The patient demographics are shown in Table I.

Clinical outcomes

TXA resulted in significantly lower levels of blood loss intraoperatively ($P < .05$). There was a significant

Table I Patient demographics

	TXA	Control	*P* value
Age, yr	25.1 ± 6.5	23.8 ± 3.4	.21
Sex, M/F	48:2	48:2	>.99
BMI	25.4 ± 2.3	24.8 ± 2.9	.6

M/F, male/female ratio; *BMI*, body mass index; *TXA*, tranexamic acid.

Table II Clinical outcomes

	TXA	Control	*P* value
Blood loss, mL	60.9 ± 21.5	68.9 ± 27.0	.18
Operation time, min	42.5 ± 7.2	45.2 ± 8.0	.08
Revisions	0	1	>.99
Drain output, mL	29.6 ± 27.4	64.9 ± 37.8	<.001
VAS score	1.7 ± 1.5	3 ± 1.5	<.001
Hematoma grade			<.001
None	35	13	
Mild	12	21	
Moderate	2	16	
Severe	1	0	
Opioids, mg	4.7 ± 6.9	11 ± 10.2	<.001

VAS, visual analog scale; *TXA*, tranexamic acid.

difference at day 1 postoperatively in VAS score (3 ± 1.5 vs. 1.7 ± 1.5, $P < .001$). There was also a significant difference at day 1 postoperatively in total hematoma formation (74% vs. 30%, $P < .001$), with TXA also resulting in lower rates of moderate hematoma formation (32% vs. 4%, $P < .001$). There was a significant difference between the 2 groups in opioid consumption, with the TXA group requiring less opioids (9.4 ± 13.8 mg vs. 22 ± 20.4 mg, $P < .001$). Additionally, the grade of postoperative swelling was shown to correlate to increased VAS score and opioid use ($P < .001$). There was no difference in operative time ($P = .79$) between the groups.

The clinical outcomes are shown in Table II, and the effect of postoperative swelling is shown in Table III.

Discussion

The most important finding from our study was that TXA reduces the risk of painful swelling and hematoma formation following the Latarjet procedure, subsequent postoperative pain levels, and opioid use. Postoperative swelling and hematoma formation was shown to correlate with increased pain levels and opioid use.

TXA is now used routinely throughout many areas in orthopedics, including hip, knee, and shoulder arthroplasty.[8,14] It has been found to reduce intraoperative blood loss, postoperative drain output, and decrease the need for transfusion, with topical, intravenous, and oral TXA all being equally efficacious.[6] Pauzenberger et al[16] performed a randomized controlled trial for shoulder arthroplasty and found a significant reduction in hematoma formation and pain scores when using TXA compared with a placebo. TXA is also being increasingly used in sports medicine surgery, as several studies have now evaluated its use to reduce hemarthrosis following anterior cruciate ligament reconstruction,[2,5,13] whereas Karaslaan et al[13] found that TXA also significantly reduced pain scores.

Our study found that postoperative hematoma formation and swelling was associated with a corresponding increase in pain and opioid use. This highlights the importance of hematoma formation as a significant source of postoperative pain. TXA was subsequently shown to decrease the incidence of swelling and hematoma formation, and subsequently decreased pain levels and opioid use. Orthopedic surgeons are thought to be responsible for approximately a 10th of opioid prescriptions and are the third biggest prescribers of opioids.[18] Kumar et al[15] found in a prospective analysis that a median of 60 opioid pills are prescribed following outpatient shoulder surgery. Given the recent and growing concern regarding overprescribing opioid medication postoperatively, we feel TXA could be a useful addition to perioperative pain management protocols in shoulder surgery.

Our results showed a 1% complication rate requiring revision surgery, which was comparable to those by Frank et al,[7] who found a 4.5% revision rate within 90 days of the Latarjet procedure. However, Griesser et al[10] performed a systematic review of the literature and found that 7% of patients undergoing the Latarjet procedure ultimately required a revision. The lower complication rate in our series may be attributable to the high volume of cases performed as shoulder surgeon volume has been shown to correlate with outcomes.[4,20]

Although the results from our study are promising, there are certain aspects regarding the use of TXA in the Latarjet procedure warranting further study. Our study only evaluated a single, standardized dose of TXA preoperatively, whereas repeated doses or weight-adjusted dosing regimens may further reduce postoperative hematoma and painful swelling. Wang et al[19] found that multiple doses further reduce blood loss following total hip arthroplasty, compared with a single preoperative bolus. Pauzenberger et al[16] used a pre- and postoperative TXA bolus in their study, evaluating hematoma formation following shoulder arthroplasty, and found no painful swelling in the TXA group. Further study of repeating or weight-adjusting TXA dosages in the Latarjet procedure are warranted to evaluate whether such measures could provide even greater reduction of postoperative hematoma formation, swelling, pain, and subsequently opioid consumption.

Limitations

There were some limitations in our study. First, postoperative swelling and hematoma assessment is subjective.

Table III Effect of hematoma grade

	None (n = 48)	Mild (n = 33)	Moderate (n = 18)	*P* value
Drain output, mL	22.5 ± 18.5	51.7 ± 28.7	76.4 ± 32.1	<.001
VAS score	1.2 ± 0.7	2.8 ± 1.3	4.3 ± 1.0	<.001
Opioids, mg	2.2 ± 3.8	9.8 ± 8.3	17.2 ± 9.5	<.001

VAS, visual analog scale.

However, assessment was performed by an examiner, who was blinded to the treatment group of the patients. Second, this study only assessed the benefits of a single TXA dose, although additional doses or a weight-adjusted dose could have potentially yielded greater effects. Third, this study evaluated only the first postoperative day, although it would be interesting whether the beneficial effects of TXA during that period translate to benefits during rehabilitation and in clinical outcomes.

Conclusion

Our study found that TXA significantly reduced postoperative blood loss, painful postoperative swelling, and hematoma formation and subsequently reduced postoperative pain and opioid use following the Latarjet procedure.

Disclaimer

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