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The Injection of Tranexamic Acid Alone is Not Effective in Reducing Transfusion Requirements Following Total Joint Arthroplasty

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ABSTRACT

A retrospective study was conducted to evaluate the need for perioperative autotransfusions and the amount of blood loss by comparing patients receiving different tranexamic acid (TXA) regimens following total joint replacement (TJR). A total of 1675 patients undergoing TJR were included: 76 did not receive TXA administration (group A); 77 received IV TXA (group B); 1510 received IV followed by IA administration of TXA (group C); and 12 received IA TXA administration alone (group D). Significant between-group differences were observed in intraoperative and postoperative blood loss ($p<0.05$). Blood autotransfusion and allogeneic transfusion rates were significantly higher in group D compared with the other treatment strategies ($p<0.001$) and with the control group of patients who did not receive TXA ($p<0.05$). IV combined with IA TXA administration represents the most effective way to prevent blood loss following TJA surgery. Conversely, isolated IA administration of TXA did not reduce the need for postoperative transfusions.

Keywords: Anesthesiology, blood management, injections, surgery, tranexamic acid.

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INTRODUCTION

For individuals with end-stage osteoarthritis, total joint arthroplasty (TJA) represents the elective surgical treatment. TJA procedures are becoming more common because they can help elderly patients live better lives by reducing joint pain and improving their quality of life.[1] However, TJA is often associated with a significant risk of blood loss, which can lead to anemia and increased rates of autologous and allogeneic blood transfusions, which may be related to perioperative complications such as transfusion reactions and surgical wound infections, thus prolonging hospital stays and increasing costs for health care systems.[2] Consequently, perioperative blood management techniques aim to reduce blood loss and the requirement for blood transfusions. Reducing bleeding around the knee improves functional results following surgery by lowering hemarthrosis, limb edema, and postoperative discomfort.[3]

Tranexamic acid (TXA) is an antifibrinolytic agent that helps minimize blood loss in patients undergoing TJA.[4] It has shown an excellent safety profile without increasing the risk of side effects, such as thromboembolism during the perioperative period.[5] Moreover, numerous studies have

Table 1. Blood loss and transfusion rates in patients undergoing total joint replacement

	Group A (No TXA administration) (n=76)	Group B (Double intravenous TXA administration) (n=77)	Group C (Double intravenous TXA administration+ intraarticular TXA administration) (n=1510)	Group D (Intraarticular TXA administration) (n=12)
Intraoperative blood loss, mean (SD), mL	250.4 (101.3)	225.3 (84.8)	150.5 (90.8)	260.8 (119.4)
Postoperative blood loss, mean (SD), mL	275.5 (144.4)	264.3 (134.8)	239.1 (125.1)	270.4 (137.4)
Autotransfusion, No. (%)	9 (11.8%)	3 (3.9%)	24 (1.6%)	2 (16.7%)
Allogeneic transfusion, No. (%)	17 (22.4%)	8 (10.4%)	73 (4.8%)	3 (25.0%)

TXA: Tranexamic acid; SD: Standard deviation.

demonstrated that TXA use can significantly lower the need for transfusions after joint replacement surgery.[6–9] Nevertheless, no consensus exists on administration regimens for TXA in joint replacement surgery. Significant differences in TXA administration have been reported, with protocols varying from single- to multiple-dose regimens, with or without IA administration, which is sometimes used alone.

A retrospective study was conducted to evaluate the need for perioperative auto- and allotransfusions by comparing patients with different TXA regimens following joint replacement.

The study hypothesis was that IV administration of TXA combined with IA administration reduces the need for perioperative transfusions following TJA more effectively compared with other treatment regimens.

METHODS

A total of 1702 patients who had undergone primary TJA at the Minimally Invasive Articular Surgery Center of our institute between January 2023 and December 2023 were retrospectively reviewed. Of the original study group, 1675 patients (98.4%) whose medical records could be retrieved were included in the present research. Seventy-six did not receive TXA administration (group A); 77 received a preoperative IV dose of 15 mg/kg TXA followed by a second postoperative IV dose of 15 mg/kg TXA (group B); 1510 received a preoperative IV dose of 15 mg/kg TXA followed by a second postoperative IV dose of 15 mg/kg TXA and IA administration of TXA (group C); and 12 received IA administration of TXA alone (group D). Primary outcomes were the percentage of transfusions (autologous or allogeneic) within the perioperative period and the amount of intraoperative and postoperative blood loss (within 24 hours). Secondary outcomes included major complications occurring during the hospital stay, such as thrombotic events, infections, and adverse events. Blood reinfusion was administered at a hemoglobin threshold of 8 g/dL in patients without comorbidities and a threshold of 10 g/dL in patients with preexisting cardiac pathology, according to international guidelines.[10,11]

Ethical approval was not required for the present study, an observational analytic study with a retrospective design on a well-established surgical procedure, as the patient-reported outcomes used are part of routine follow-up at the authors' institution.

Continuous data are presented as mean±standard deviation (SD). The Shapiro-Wilk test was used to assess data distribution. Differences between the groups were tested using Friedman's test and Dunn's post hoc test for pairwise comparisons in cases of non-normal data distribution or repeated-measures one-way ANOVA with Tukey's post hoc test for multiple comparisons of Gaussian-distributed data. SPSS software (IBM SPSS Statistics version 21, IBM Corp., Armonk, NY, USA) was used. Statistical significance was established at $p<0.05$.

RESULTS

None of the patients who completed TXA therapy reported adverse events during the perioperative period. A detailed overview of blood loss and transfusion rates is reported in Table 1.

Blood autotransfusion and allogeneic transfusion rates were 11.8% (9/76) and 22.4% (17/77) in group A, respectively. Autotransfusion was administered to 3 patients (3.9%), and allogeneic transfusion was administered to 8 patients (10.4%) in group B. In group C, 24/1510 patients (1.6%) and 73/1510 patients received autologous or allogeneic transfusion, respectively, while autotransfusion and allogeneic transfusion rates were 16.7% (2/12) and 25.0% (3/12) in group D. Significant differences between the groups were observed ($p<0.001$).

Similarly, mean intraoperative blood loss in group A (250.4 mL, SD: 101.3) and group D (260.8 mL, SD: 119.4) was significantly higher compared with group B (225.3 mL, SD: 84.8, $p<0.001$) and group C (150.5 mL, SD: 90.8, $p<0.001$). Similarly, regarding

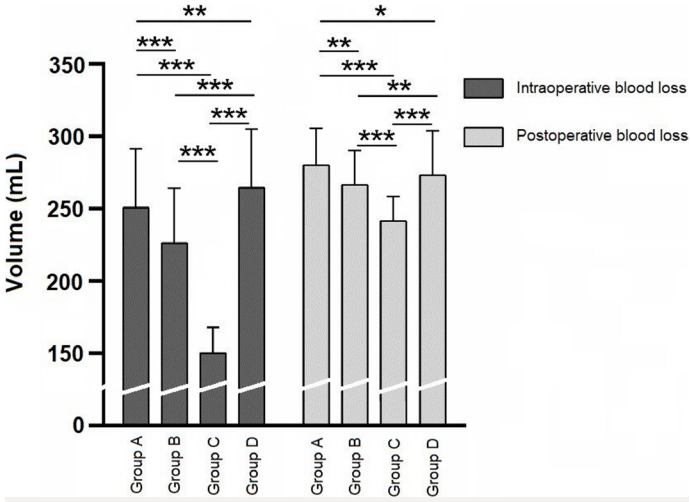

Figure 1. Box plots showing differences in blood loss between groups. The bottom and top of the boxes represent the interquartile range (25th and 75th percentiles), and the top whisker represents the maximum value.

*: P<0.05; **: P<0.01; ***: P<0.001.

postoperative blood loss, higher average values were reported in group A (275.5 mL, SD: 144.4) and group D (270.4 mL, SD: 137.4) compared with group B (264.3 mL, SD: 134.8) and group C (239.1 mL, SD: 125.1) (Fig. 1).

DISCUSSION

According to our findings, IV combined with IA TXA administration represents the most effective way to prevent blood loss following TJA surgery. The use of IV TXA infusion also reduces the need for postoperative transfusions. On the other hand, isolated IA administration of TXA did not reduce the need for postoperative transfusions compared with the control group, in which no TXA was administered. Similar results were reported for intraoperative and postoperative blood loss. The secondary outcomes, including complication rates, were comparable between groups.

Numerous studies have reported that TXA can be safely and effectively used to decrease blood loss and reduce transfusion requirements.[4,5] In our case series, no venous or arterial thromboembolic events occurred, and consistent with previous experience reported in the literature, among patients undergoing joint arthroplasty, treatment-related reductions in transfusion requirements were associated with IV administration of TXA.[6–9]

The administration of TXA after joint replacement surgery varies greatly, with dosage regimens ranging from 10 to 135 mg/kg and treatment durations ranging from one injection to several injections or continuous infusion for up to 3 days.[12]

Because of this, the ideal dosage of TXA for joint replacement surgery is still unknown, and opinions about the best time to begin using TXA, its administration techniques, and its volume of use remain divided.[13]

Different TXA administration dosing regimens—one intravenous, one intravenous combined with intraarticular, and one intraarticular alone—were examined in this study and compared with a control group in which no TXA was administered.

According to a recent meta-analysis, after total knee replacement, the combined treatment of IV and IA TXA was comparatively more successful in lowering postoperative hemoglobin decline, transfusion rate, total blood loss, and drain output.[14] Similarly, Fakharian et al.[15] reported reduced intraoperative blood loss in patients undergoing total knee arthroplasty treated with combined intraarticular and intravenous TXA compared with the intraarticular and intravenous alone groups.

According to our findings, using an intravenous double-dose regimen appreciably reduces the overall volume of blood lost after surgery, with or without the addition of intraarticular administration. On the other hand, group A had a lower transfusion rate than group D, showing that isolated intraarticular administration of TXA did not reduce the need for postoperative transfusions compared with the control group. However, caution must be used when interpreting these results because of the limited sample size.

Major study limitations include its retrospective nature, nonrandomized design, and absence of a power analysis. The imbalance in group sizes may affect the reliability of these findings. The smaller sample size in group D, due to blood management strategies adopted at our institution, could reduce the statistical power to detect true differences among groups.

Further prospective randomized studies with more balanced group sizes are needed to substantiate these findings.

Ethics Committee Approval: Ethical approval was not required, an observational analytic study with a retrospective design on a well-established surgical procedure, as the patient-reported outcomes used are part of routine follow-up at the authors' institution.

Informed Consent: Written informed consent was obtained from the patients.

Conflict of Interest: The authors have no conflicts of interest to declare.

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