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Original Research Article

Intravenous tranexamic acid and perioperative blood loss in lumbar spine fixation surgery: a prospective study

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ABSTRACT

Background: Lumbar spine fixation may be accompanied by substantial perioperative bleeding and a need for allogeneic blood transfusion. Tranexamic acid (TXA) inhibits fibrinolysis and may reduce blood loss. The aim is to assess the effect of intravenous TXA on blood loss and transfusion requirements during elective lumbar spine fixation.
Methods: This prospective study included 60 adults undergoing lumbar fixation at two hospitals in Hyderabad. Thirty patients received TXA, 10 mg/kg intravenously after anaesthetic induction followed by 1 mg/kg/hour until skin closure. Thirty patients received no TXA. Intraoperative blood loss, first-24-hour drain output, total blood loss, postoperative haemoglobin and packed red blood cell (PRBC) transfusion were assessed. Statistics were recalculated from the thesis's patient-level master chart.
Results: Mean intraoperative blood loss was 618.53±205.95 mL with TXA versus 830.23±208.87 ml in controls. Postoperative loss was 133.00±45.12 versus 269.80±68.27 ml. Recorded total loss was 750.33±238.97 versus 1100.03±249.33 ml; all differences had $p<0.001$. Postoperative haemoglobin was higher with TXA (10.95±2.09 versus 9.25±1.98 g/dL). Five TXA recipients and 15 controls received PRBCs.
Conclusions: TXA was associated with lower perioperative blood loss. Transfusion findings require source-record verification.

Keywords: Tranexamic acid, Lumbar spine fixation, Perioperative blood loss, Blood transfusion, Antifibrinolytic agents

INTRODUCTION

Lumbar spine fixation exposes vascular bone surfaces and the paraspinal and epidural venous plexuses. Bleeding may continue after surgery through wound drains, adding to the intraoperative loss. For patients undergoing multilevel fixation, substantial cumulative blood loss can contribute to postoperative anaemia and the need for allogeneic blood transfusion.[1,2] Reducing bleeding while maintaining adequate surgical visibility is consequently an important perioperative objective.

Tranexamic acid (TXA) is a synthetic lysine analogue with antifibrinolytic activity. It inhibits the binding of plasminogen to fibrin and thereby limits degradation of the developing clot.[3] This mechanism provides a rationale for administering TXA before surgical bleeding becomes established and continuing treatment throughout the operation. Evidence from adult spinal fusion and posterior lumbar procedures suggests that intravenous TXA can reduce perioperative blood loss.[4-6] Systematic reviews have reached broadly similar conclusions, although their included studies differ in surgical procedures, doses,

outcome definitions and transfusion practices.[7,8] Individual trials have also reported less favourable results, particularly for transfusion outcomes.[9] These differences make it useful to describe both blood loss and transfusion separately within a defined surgical population.

The present study evaluated the association between perioperative intravenous TXA and blood loss in adults undergoing elective lumbar spine fixation. Secondary outcomes were postoperative haemoglobin, packed cell volume and PRBC transfusion.

METHODS

Study design and setting

This prospective study was conducted between January 2021 and October 2022 at Owaisi Hospital and Research Centre and Princess Esra Hospital, Hyderabad. Sixty adults scheduled for elective lumbar spine fixation under general anaesthesia were included. The thesis describes assignment to two groups of 30 patients each as random; however, it does not describe how the allocation sequence was generated or concealed.

Study population

Patients aged 30–60 years with American Society of Anaesthesiologists physical status I or II were eligible if they were scheduled for fixation involving at least two lumbar levels and provided written informed consent. Patients were excluded if they had pre-existing renal or hepatic disease, a bleeding diathesis, abnormal coagulation tests or platelet count, malignancy, coronary artery disease, or a thromboembolic event during the preceding year. Other exclusion criteria were acute infection, current antiplatelet or anticoagulant treatment, haemoglobin below 8 g/dL, and uncontrolled hypertension.

Intervention

Patients in the TXA group received 10 mg/kg intravenous TXA over 15 minutes after induction of anaesthesia and before surgical incision. A maintenance infusion of 1 mg/kg/hour was then continued until skin closure. Patients in the control group did not receive TXA. The thesis describes general anaesthesia and routine monitoring in both groups, including electrocardiography, non-invasive blood pressure, oxygen saturation, capnography, temperature and urine output. Patients were positioned prone for surgery.

Outcome assessment

Intraoperative blood loss was estimated from blood retained in swabs and collected in suction containers. Swab blood loss was calculated by subtracting dry swab weight from wet swab weight. The volume of irrigation fluid was subtracted from the suction-container volume. Postoperative blood loss was measured from surgical drain output during the first 24 hours. The study recorded total blood loss as the sum of intraoperative and postoperative loss. It also documented the number of PRBC units transfused. Haemoglobin and packed cell volume were assessed before surgery and approximately 12 hours postoperatively.

Statistical analysis

For this manuscript, means and sample standard deviations were recalculated from the 60 patient entries in the thesis master chart. Continuous outcomes were compared between groups using two-sided Welch independent-samples t tests. The proportions receiving any PRBC transfusion were compared using a two-sided Fisher exact test. A p value below 0.05 was considered statistically significant. Recalculation was necessary because the thesis's summary tables contain discrepancies. The patient-level data have been retained as recorded; no additional patients or measurements have been introduced.

RESULTS

Baseline characteristics

All 60 patients were represented: 30 in the control group and 30 in the TXA group. Mean age, body weight, preoperative haemoglobin, and preoperative packed cell volume were similar between groups (Table 1). Mean surgery duration was 162.73 minutes with TXA and 171.03 minutes in controls, a difference of 8.30 minutes.

Perioperative blood loss

Mean intraoperative blood loss was 618.53 ml in the TXA group compared with 830.23 mL in controls, an absolute difference of 211.70 ml. Mean first-24-hour postoperative drain output was 133.00 mL with TXA and 269.80 mL in controls, an absolute difference of 136.80 ml. Both comparisons favoured TXA (Table 2). Recorded mean total blood loss was 750.33 ml in the TXA group and 1100.03 ml in controls. The difference of 349.70 ml represents a 31.8% reduction relative to the control mean. The total-loss comparison was statistically significant ($p<0.001$).

Postoperative laboratory outcomes

Postoperative haemoglobin was higher in the TXA group than in controls: 10.95±2.09 versus 9.25±1.98 g/dL ($p=0.002$). Postoperative packed cell volume was also higher with TXA: 33.01±6.39% versus 27.74±5.87% ($p=0.002$). Postoperative international normalised ratio did not differ significantly between groups (Table 3).

PRBC transfusion

The master chart records PRBC transfusion in 15 controls (50.0%) and five TXA recipients (16.7%). A two-sided Fisher exact test using these counts gives $p=0.013$. The

thesis, however, reports p=0.362 for its transfusion analysis. The original transfusion records and statistical output must therefore be reviewed before interpreting this difference as a confirmed study finding.

Table 1: Baseline characteristics and duration of surgery.

Variable	Control (n=30)	TXA (n=30)	P value
Age (years)	54.33±5.73	54.73±5.78	0.789
Body weight (kg)	70.17±11.23	69.33±8.51	0.747
Preoperative haemoglobin (g/dL)	13.72±1.68	14.00±1.42	0.488
Preoperative packed cell volume (%)	41.10±5.01	41.86±4.22	0.528
Duration of surgery (minutes)	171.03±10.25	162.73±12.92	0.008

Table 2: Perioperative blood loss.

Outcome	Control (n=30)	TXA (n=30)	P value
Intraoperative blood loss (ml)	830.23±208.87	618.5±205.95	<0.001
Postoperative drain loss for first 24 hours, (ml)	269.80±68.27	133.00±45.12	<0.001
Recorded total blood loss (ml)	1100.03±249.33	750.33±238.97	<0.001

Table 3: Postoperative laboratory outcomes.

Outcome	Control (n=30)	TXA (n=30)	P value
Haemoglobin (g/dL)	9.25±1.98	10.95±2.09	0.002
Packed cell volume (%)	27.74±5.87	33.01±6.39	0.002
International normalised ratio	1.15±0.40	1.06±0.37	0.346

Table 4: Recorded PRBC transfusion.

PRBC units received	Control (n=30)	TXA (n=30)
None	15	25
1 unit	3	0
2 units	6	4
3 units	3	1
4 units	3	0
Any PRBC transfusion	15 (50.0%)	5 (16.7%)

DISCUSSION

This study found lower intraoperative, postoperative, and recorded total blood loss among patients who received intravenous TXA during lumbar spine fixation. The differences were accompanied by higher postoperative haemoglobin and packed cell volume. The approximately 350 mL difference in mean total blood loss is clinically relevant to consider in a procedure where bleeding may extend from the operation into the early postoperative period.

The findings are consistent with reports from other spine surgery populations. Wong and colleagues observed reduced perioperative blood loss in adults undergoing spinal fusion who received TXA.[4] In a randomised trial of posterior lumbar surgery for degenerative instability, Wang and colleagues reported a reduction in postoperative blood loss.[5] Endres and colleagues also described reduced bleeding in posterior lumbar surgery, although their retrospective design warrants caution when attributing the difference solely to treatment.[6] Broader evidence supports an antifibrinolytic benefit in spine surgery. Yang and colleagues' meta-analysis found lower intraoperative, postoperative, and combined blood loss with perioperative intravenous TXA.[7] Other reviews have assessed TXA across procedures of varying complexity and similarly reported reduced surgical bleeding.[8,9] Differences in operative exposure, dose, timing and outcome definitions mean that their pooled estimates should not be assumed to apply directly to every lumbar fixation procedure. Individual trials illustrate this variation. Farrokhi and colleagues evaluated a low-dose regimen in spinal fixation and did not find a statistically significant reduction in intraoperative blood loss or transfusion.[10] Studies involving scoliosis and more complex spine surgery have examined different regimens and patient populations.[11-15] The present study contributes data for adults undergoing elective lumbar fixation using a 10 mg/kg loading dose followed by a 1 mg/kg/hour infusion. The observed difference in postoperative haemoglobin is consistent with

the lower recorded blood loss. It should nevertheless be interpreted alongside transfusion exposure and perioperative fluid administration, both of which can influence postoperative measurements. The mean duration of surgery was also shorter in the TXA group. Longer operations may create more opportunity for bleeding, so the duration difference limits how confidently the entire blood-loss difference can be attributed to TXA.

The transfusion finding remains unresolved. The patient-level chart records transfusion in 15 controls and five TXA recipients, yielding p=0.013 by Fisher exact test. The thesis reports p=0.362. These results cannot both describe the same binary comparison of patients receiving any PRBCs. Differences in the original analysis method or an error in the recorded counts or reported statistic are possible; the source documents must establish which explanation is correct. A publication manuscript should make a definitive statistical claim about transfusion only after that check. Several other limitations should be acknowledged. The sample of 60 patients limits precision and does not provide a reliable assessment of rare thromboembolic or other adverse events. Although the thesis describes random assignment, the allocation procedure is not sufficiently detailed to assess its protection against selection bias.

Descriptions of masking and control treatment are also inconsistent. Swab and suction measurements are practical but may be affected by irrigation fluid and other sources of measurement error. Finally, one patient's recorded total blood loss differs from the sum of its recorded components by 36ml. This entry has been retained as recorded and should be checked before submission.

CONCLUSION

Among 60 adults undergoing elective lumbar spine fixation, intravenous TXA given as a 10 mg/kg loading dose followed by 1 mg/kg/hour until skin closure was associated with lower intraoperative, first-24-hour postoperative, and recorded total blood loss. Postoperative haemoglobin and packed cell volume were higher in the TXA group. The transfusion analysis and one total blood-loss entry require verification against the original records before the manuscript is submitted for publication.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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