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Efficacy of Intravenous Tranexamic Acid in Reducing Perioperative Hemorrhage and Transfusion in Complex Spinal Fusions: Insights from a Standardized Inverse Probability Weighted Analysis

Ali K Ozturk, MD; Jang W Yoon, MD; William C Welch, MD; Mert Marcel Dagli, MD

Co-Director, Neurosurgery Complex Spine Fellowship
Director, Adult Spinal Deformity and Scoliosis Surgery
Associate Professor of Neurosurgery at the Pennsylvania Hospital

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Disclosures

None

Agenda

BACKGROUND

METHODS

RESULTS

CONCLUSIONS

Background

The volume of complex spine deformity surgeries with multilevel posterior spinal fusion (PSF) is increasing with the aging adult spinal deformity (ASD) population.

There are no established guidelines on the role of intravenous tranexamic acid (TXA) in spinal fusion and its ability to decrease both intraoperative blood loss and perioperative blood transfusion requirements is under investigation.

Objectives:

- Primary: Determining the efficacy and safety of IV TXA in multilevel PSF for ASD
- Secondary: Explorative analysis of postoperative outcomes

Methods

PART 1

Guidelines: STROBE

Data Source: retrospective review, institutional deformity database (DAC, charts)

Inclusion criteria: TLS PSF with 6+ vertebrae for ASD with min. 2-year follow-up (n=598), from Jan 1, 2013 to Dec 13, 2021

Data Cleaning and Handling of Missingness with Iterative Imputer with Random Forest and random states

The dataset was split into a TXA (n=257) and control (n=341) group

Methods

PART 2

Propensity scores (PS) were calculated using:

- age, gender, race, BMI, Charlson Comorbidity Index (CCI), ASA score, number of PSF levels fused, 3-column osteotomy (3CO) use, and posterior column osteotomy (PCO)

Using PS, stabilized inverse probability treatment weights (SIPTW) were calculated

A standardized mean difference (SMD) of less than 0.10 indicated a good balance between the two groups

Methods

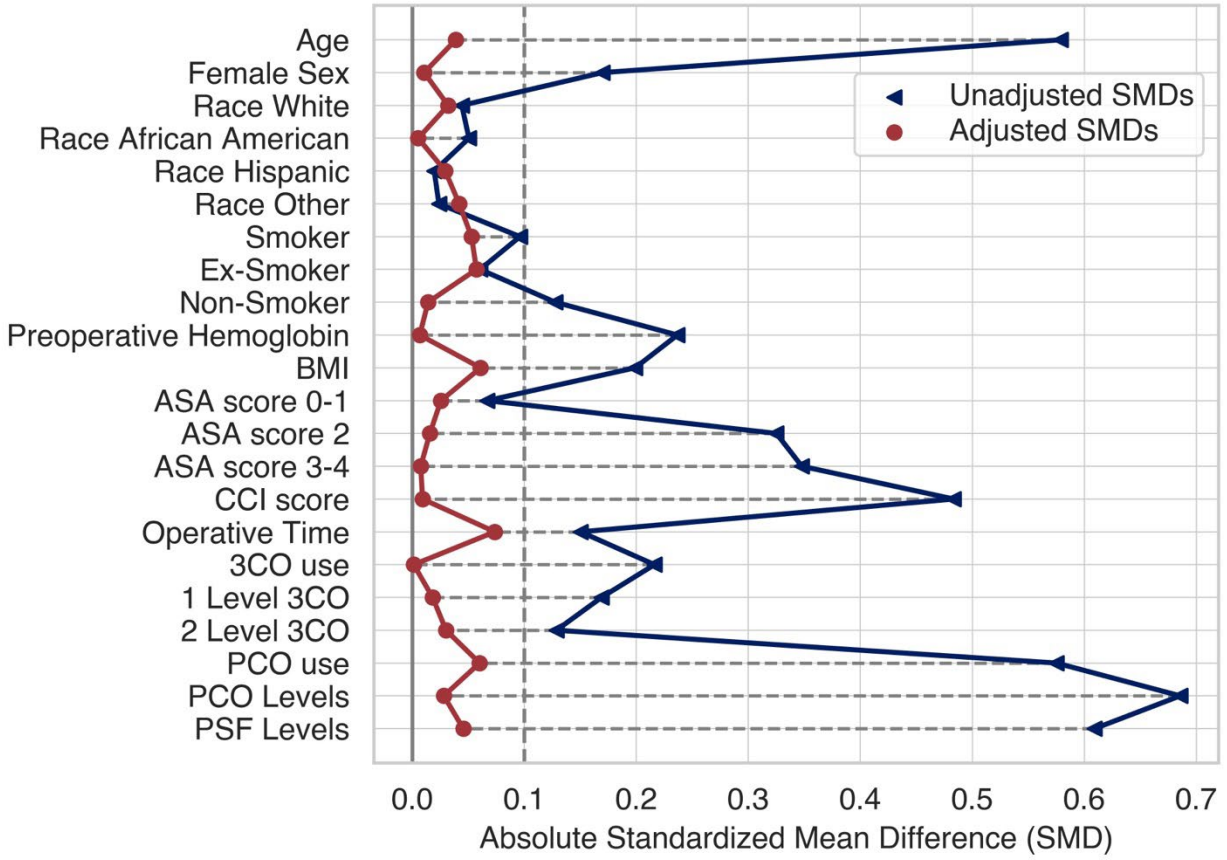
PART 3

Weighted analysis:

- *P* values: weighted regression analysis
- Treatment effect: median difference (non-normal), mean difference (normal), proportion difference (binary)
- 95% confidence intervals (CI) of treatment effect: percentile-based bootstrapping with 10,000 samples and replacement
- Primary outcomes were adjusted for multiplicity with Benjamini-Hochberg to control the false discovery rate (FDR) at a level of 0.05

Results

BASELINE CHARACTERISTICS



Results

TXA REGIMEN (N=249 IS EFFECTIVE SAMPLE SIZE IN WEIGHTED ANALYSIS)

Variable	Total (n=249)	Bolus only (n=104)	Infusion without loading dose (n=24)	Infusion with loading dose (n=121)
TXA mg	1603.7 (1000-2151.4)	1000 (1000-1075.7)	1264.3 (853.5-2081.3)	1897.4 (1610.6-4414.8)
Infusion mg	379.7 (0-1016.2)	-	1161.2 (843.4-1974.3)	780.9 (513.3-1808.8)
Infusion min	168.3 (0-387.8)	-	390.4 (299.1-427.9)	353.8 (230.6-426.3)
Infusion mg/h	92.8 (0-190.1)	-	210.4 (105.8-350.2)	100 (100-327.44)
Infusion mg/kg/h	1 (0-2.39)	-	2.4 (1.5-5)	1.6 (1.3-5)
Bolus/Loading dose mg	1000 (1000-1603.5)	1000 (1000-1075.7)	-	1000 (1000-2003.88)

Data is from the weighted analysis.
Data are median (interquartile range).
TXA: tranexamic acid.

Results

PRIMARY OUTCOMES

Variable	TXA (N=249)	Control (N=341)	Difference Unadjusted (95% CI)	P Value[a]
Estimated blood loss total (mL)	1050 (600-1588.71)	1200 (750-1900)	-150 (-600 to -100)	0.007*
Percent estimated blood volume lost	23.3% (13.6%-35.5%)	25.5% (17%-44.6%)	-2.2% (-14% to -2.5%)	0.033*
Intraoperative Total RBC transfusion[b]	224 (90)	298 (87.4)	2.57% (-4% to 5%)	0.380
Intraoperative Total RBC transfusion volume (mL)	725 (125-1500)	850 (300-1579.33)	-125 (-725 to -125)	0.021*
Postoperative thromboembolic events (DVT/PE)	11 (4-4)	21 (6.2)	-1.7% (-5.4% to 1.9%)	0.380
Postoperative pRBC transfusion	92 (37)	149 (43.7)	-6.8% (-15.2% to 0.2%)	0.033*
Postoperative pRBC transfusion volume (mL)	0 (0-300)	0 (0-600)	0 (-300 to 0)	0.146

Data is from the weighted analysis.
Data are median (interquartile range) or number of patients (%).
The differences are median difference and difference in proportions and their 95% confidence interval.
TXA: tranexamic acid, CI: confidence intervals, RBC: red blood cells, pRBC: packed red blood cells.
[a]Adjusted P values: Benjamini-Hochberg correction with a false discovery rate (FDR) of 0.05 was applied to adjust for multiplicity.
[b]Total red blood cells = packed red blood cells + cell saver.
*Adjusted significant *P* values.

Results

SECONDARY OUTCOMES – PART 1 (INTRAOPERATIVE TRANSFUSION REQUIREMENTS)

Variable	TXA (N=249)	Control (N=341)	Difference (95% CI)	P Value[a]
Intraoperative pRBC transfusion	154 (61.9)	238 (69.8)	-8% (-18% to -2.1%)	0.030*
Intraoperative pRBC transfusion volume (mL)	600 (0-1172.95)	600 (0-1200)	0 (-600 to 0)	0.017*
Intraoperative cell saver transfusion	195 (78.3)	230 (67.5)	10.9% (2.3% to 15%)	0.003*
Intraoperative cell saver transfusion volume (mL)	250 (125-375)	250 (0-375)	0 (-250 to 0)	0.721
Intraoperative platelet transfusion	32 (12.9)	56 (16.4)	-3.6% (-9.6% to 2.1%)	0.189
Intraoperative platelet transfusion volume (mL)	0 (0-0)	0 (0-0)	0 (0 to 0)	0.246
Intraoperative plasma transfusion	56 (22.5)	84 (24.6)	-2.1% (-9.4% to 4.9%)	0.506
Intraoperative plasma transfusion volume (mL)	0 (0-0)	0 (0-0)	0 (0 to 0)	0.355

Data is from the weighted analysis.
Data are number of patients (%) or median (interquartile range).
The differences are difference in proportions and median difference and their 95% confidence interval.
TXA: tranexamic acid, CI: confidence intervals, pRBC: packed red blood cells.
[a]*P* values were not adjusted for multiplicity.
*Unadjusted significant *P* values.

Results

SECONDARY OUTCOMES – PART 2 (PERIOPERATIVE COMPLICATIONS)

Variable	TXA (N=249)	Control (N=341)	Difference (95% CI)	P Value[a]
Any intraoperative complications	31 (12.5)	30 (8.8)	3.7% (-1.5% to 8.5%)	0.132
Dural	26 (10.4)	24 (7)	3.4% (-1.5% to 8%)	0.133
Vascular	2 (0.8)	4 (1.2)	-0.4% (-1.8% to 1.5%)	0.509
Other	3 (1.2)	-	1.2% (0.4% to 3.6%)	0.999
Any postoperative complications	146 (58.6)	201 (58.9)	-0.3% (-8.6% to 5.6%)	0.964
Cardiovascular	83 (33.3)	129 (37.8)	-4.5% (-12.4% to 2.1%)	0.241
Renal	26 (10.4)	42 (12.3)	-1.9% (-8.1% to 2.9%)	0.493
Pulmonary	26 (10.4)	38 (11.1)	-0.7% (-6.3% to 4%)	0.792
Neurologic	26 (10.4)	47 (13.8)	-3.3% (-8.8% to 1.5%)	0.227
Surgical site	3 (1.2)	4 (1.2)	0% (-1.8% to 1.8%)	0.956

Data is from the weighted analysis.
Data are number of patients (%).
The differences are difference in proportions and their 95% confidence interval.
TXA: tranexamic acid, CI: confidence intervals.
[a]*P* values were not adjusted for multiplicity.
*Unadjusted significant *P* values.

Results

SECONDARY OUTCOMES – PART 3 (POSTOPERATIVE LABS + TRANSFUSION REQUIREMENTS)

Variable	TXA (N=249)	Control (N=341)	Difference (95% CI)	P Value[a]
Postoperative hemoglobin day 1 (g/dL)	10.27 ± 1.55	10.18 ± 1.47	0.09 (-0.16 to 0.33)	0.466
Postoperative hemoglobin day 2 (g/dL)	9.31 ± 1.40	8.96 ± 1.27	0.34 (0.12 to 0.57)	0.002*
Postoperative hemoglobin day 3 (g/dL)	9.29 ± 1.16	9.01 ± 1.20	0.27 (0.08 to 0.46)	0.006*
Pre-post hemoglobin day 1 (g/dL)	-2.79 ± 1.95	-2.87 ± 1.90	0.07 (-0.24 to 0.39)	0.623
Pre-post hemoglobin day 2 (g/dL)	-3.75 ± 1.92	-4.09 ± 1.96	0.33 (0.02 to 0.65)	0.040*
Pre-post hemoglobin day 3 (g/dL)	-3.78 ± 1.90	-4.04 ± 2.10	0.26 (-0.06 to 0.58)	0.126
Postoperative plasma	8 (3.2)	8 (2.4)	0.9% (-1.9% to 3.8%)	0.529
Postoperative plasma transfusion volume (mL)	0 (0-0)	0 (0-0)	0 (0 to 0)	0.461
Postoperative platelets	5 (2)	10 (2.93)	-0.9% (-3.4% to 1.4%)	0.523
Postoperative platelet transfusion volume (mL)	0 (0-0)	0 (0-0)	0 (0 to 0)	0.388

Data is from the weighted analysis.
Data are mean ± standard deviation, number of patients (%) or median (interquartile range).
The differences are median difference and difference in proportions and their 95% confidence interval.
Pre-post hemoglobin is the difference between preoperative and postoperative hemoglobin.
TXA: tranexamic acid, CI: confidence intervals.
[a]*P* values were not adjusted for multiplicity.
*Unadjusted significant *P* values.

Results

SECONDARY OUTCOMES – PART 4 (POSTOPERATIVE OUTCOMES)

Variable	TXA (N=249)	Control (N=341)	Difference (95% CI)	P Value[a]
LOS	7 (5-9)	6 (5-8)	1 (1 to 2)	0.772
ICU LOS	2 (1-3)	2 (1-3)	0 (0 to 0)	0.985
30-day readmission	26 (10.44)	57 (16.72)	-6.3% (-12.4% to -1.6%)	0.030*
Any Reoperation	31 (12.45)	53 (15.54)	-3.1% (-9.3% to 2.4%)	0.301
Surgical site infection	7 (2.81)	18 (5.28)	-2.5% (-5.5% to 0.6%)	0.107
CSF leak	-	1 (0.29)	-0.3% (-1.5% to 0%)	0.999
Hematoma	-	2 (0.59)	-0.6% (-2.1% to -0.3%)	0.999
PJK/PJF	10 (4.02)	10 (2.93)	1.1% (-1.8% to 4.1%)	0.482
Pseudoarthrosis	3 (1.20)	5 (1.47)	-0.3% (-2.1% to 1.7%)	0.691
Hardware failure	7 (2.81)	9 (2.64)	0.2% (-2.6% to 2.7%)	0.796
Recurrent symptoms	4 (1.61)	7 (2.05)	-0.5% (-2.2% to 2%)	0.533
Other	4 (1.61)	9 (2.64)	-1% (-3.8% to 1.2%)	0.469

Data is from the weighted analysis.
Data are median (interquartile range) or number of patients (%).
The differences are median difference and difference in proportions and their 95% confidence interval.
TXA: tranexamic acid, CI: confidence intervals, CSF: cerebrospinal fluid, LOS: hospital length of stay, ICU LOS: intensive care unit length of stay, PJK: proximal junctional kyphosis, PJF: proximal junctional failure.
[a]*P* values were not adjusted for multiplicity.
*Unadjusted significant *P* values.

Conclusions

IV TXA use was associated with significant reduction in EBL, %EBV lost, intraoperative total RBC transfusion volume, postoperative pRBC transfusion rate, and no significant association with thromboembolic events (DVT/PE).

Exploratory secondary analysis showed an unadjusted significant reduction in intraoperative pRBC transfusion rate and volume, intraoperative cell saver transfusion rate, pre-post hemoglobin day 2 (decreased difference), and 30-day readmission.

There was no significant difference in perioperative complications.

IV TXA in multilevel thoracolumbosacral PSF for ASD is safe and efficacious.

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