Determining the Effect of Intraoperative TXA on Postoperative Blood Loss in ACDF

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INTRODUCTION:

Fibrinolysis is a highly regulated enzymatic process that can transiently increase during surgery and cause increased blood loss. To counteract this effect, tranexamic axic (TXA) is often administered during spine procedures to reduce postoperative blood loss and surgical duration without increasing risk of complications or thrombotic events. Currently, there are no studies evaluating TXA use for patients undergoing cervical discectomy and fusion (ACDF). The primary aim of our study was to examine the effects of intraoperative TXA use on postoperative bleeding in ACDF, as measured by drain output over 24 hours. Based on evidence from previous studies, we hypothesized that intraoperative TXA could be an effective agent in improving hemostasis following ACDF.

METHODS:

A tertiary medical center's prospectively collected registry was queried between 1/1/18-12/1/21 for all patients who underwent elective ACDF surgery and received a drain postoperatively. Patients with history of coagulopathy, use of perioperative anticoagulant medications, liver/renal failure, severe cardiac disease, cancer, or traumatic indication for ACDF were excluded. Patients were separated into two groups; those who had received intraoperative TXA and those who did not. TXA was first administered to the patient with a 30 mg/kg bolus followed by continuous 3 mg/kg per hour infusions beginning 1 hour prior to surgery and for the duration of the procedure. Registry variables included age, gender, BMI, number of levels, and spine pathology. The primary outcome was postoperative blood loss, measured by 24 hour drain output. Secondary outcomes included total drain output, intraoperative estimated blood loss, operative duration, drain duration, changes in pre/post operative Hemoglobin (Hb) and Hematocrit (Hct) levels, as well as rate of transfusions, complications, revisions, and reoperations. Complications included hematoma formation, pulmonary embolism, stroke, and deep venous thrombosis. Drain duration was the total time a drain remained in place post operatively. A variety of statistical tests were performed.

RESULTS:

190 patients underwent ACDF and did not receive intraoperative TXA while 96 patients underwent ACDF and did receive TXA, resulting in a total sample size of 286 patients. There were no differences between the groups for any baseline variables or number of levels fused (Table 1).

On bivariate analysis, the non-TXA group experienced a greater decrease in Hb between preoperative and postoperative labs (1.50 ± 1.41 vs 1.00 ± 1.26, p=0.006) and Hct between preoperative and postoperative labs (4.93 ± 4.56 vs 3.15 ± 3.81, p=0.003) compared to the TXA group (Table 2). There were no differences in 24 hour drain output, total drain output, drain duration, or complication rates between groups.

A univariate analysis was performed to identify which outcomes were affected by use of intraoperative TXA (Table 3). Results showed that intraoperative TXA was associated with a decrease in 24 hour drain output (β=-9.65, 95% CI: -17.5 to -1.79, p=0.016) and total drain output (β=-11.6, 95% CI: -21.2 to -1.97, p=0.018). There were reduced changes in Hb levels (β=-0.5, 95% CI: -0.87 to -0.13 p=0.008) and Hct levels (β=-1.78, 95% CI: -2.96 to -0.61, p=0.003) between preoperative and postoperative labs. There was no association between the use of intraoperative TXA and drain duration, estimated blood loss, LOS, transfusion rates, thrombotic events, hematomas or reoperations within 3 months.

A multivariate analysis was performed controlling for age, gender, BMI, spine pathology and number of levels to evaluate TXA's influence on various outcomes (Table 3). Results showed intraoperative TXA was associated with shorter drain duration (β=-5.74, 95% CI: -10.9 to -0.53, p=0.031), reduction in 24 hour drain output (β=-12.2, 95% CI: -19.4 to -4.89, p=0.001) and total drain output (β=-14.0, 95% CI: -22.9 to -5.05, p=0.002). In addition, intraoperative TXA was associated with reduced change between preoperative and postoperative Hb levels (β=-0.49, 95% CI: -0.86 to -0.12, p=0.011) and Hct levels (β=-1.76, 95% CI: -2.95 to -0.58, p=0.004). TXA use had no impact on intraoperative estimated blood loss, LOS, transfusion rates, thrombotic events, hematomas, or reoperations within 3 months.

DISCUSSION AND CONCLUSION:

To our knowledge, this is a novel study investigating the relationship between intraoperative TXA administration and perioperative blood loss in ACDF. The results show that intraoperative TXA use for ACDF procedures leads to a decrease in perioperative blood loss and faster drain removal. In addition, TXA administration did not increase the risk of thromboembolic complications. Thus, we conclude that intraoperative TXA is an effective agent for reducing perioperative blood loss in ACDF procedures.

Table 1. Patient Demographics and Baseline Characteristics

	No TXA, N = 190	TXA, N = 96	p-value
Age	52.53 ± 11.00	54.25 ± 11.28	0.272[1]
Gender			0.242[2]
Female	89 (46.84%)	52 (54.17%)	
Male	101 (53.16%)	44 (45.83%)	
BMI	31.36 ± 7.63	30.25 ± 6.50	0.421[1]
Spine Pathology			
Disc Herniation	94 (49.47%)	50 (52.08%)	0.677[2]
Single Disk Collapse	5 (2.63%)	1 (1.04%)	0.667[2]
Central Stenosis	63 (33.16%)	28 (29.17%)	0.494[2]
Foraminal/Laminal Stenosis	141 (74.21%)	63 (65.62%)	0.129[2]
Spondylolisthesis Insiability	7 (3.68%)	10 (10.42%)	0.023[2]
Number of Levels Fused	1.56 ± 0.693	1.59 ± 0.674	0.677[1]

x ± s represents mean ± standard deviation
Test used: [1]Wilcoxon test; [2]Pearson test
Abbreviations: TXA: Tranexamic Acid, BMI: Body Mass Index

Table 2. Intraoperative Variables, Hematologic Labs, Complications

	No TXA, N = 190	TXA, N = 96	p-value
Operative Duration (mins)	131.73 ± 58.89	138.09 ± 53.21	0.207[1]
Estimated Intraoperative Blood Loss (mL)	50.16 ± 61.20	54.11 ± 49.10	0.101[1]
Baseline labs			
Hb (g/dL)	13.98 ± 1.49	14.12 ± 1.46	0.656[1]
Hct (%)	42.64 ± 3.67	42.52 ± 4.16	0.749[1]
Platelets (10^3 /μL)	262.03 ± 72.92	255.13 ± 73.19	0.137[1]
PT (s)	12.96 ± 1.472	13.18 ± 2.07	0.853[1]
PTT (s)	28.018 ± 3.88	27.380 ± 2.89	0.279[1]
Postoperative labs			
Hb (g/dL)	12.49 ± 1.96	13.02 ± 1.65	0.088[1]
Hct (%)	37.71 ± 5.52	39.18 ± 4.65	0.082[1]
Delta Hgb	1.50 ± 1.41	1.00 ± 1.26	**0.006**[1]
Delta Hct	4.93 ± 4.56	3.15 ± 3.81	**0.003**[1]
Postoperative outcomes			
24H drain output (mL)	31.33 ± 34.69	21.68 ± 23.72	0.050[1]
Total drain output (mL)	37.30 ± 43.09	25.74 ± 27.78	0.082[1]
Drain duration (hours)	29.56 ± 24.18	24.60 ± 10.51	0.119[1]
Complications			
Hematoma	2 (1.05%)	3 (3.12%)	0.339[2]
Thrombotic Events	2 (1.05%)	0 (0.00%)	0.553[2]
PE	1 (0.52%)	0 (0.00%)	>0.999[2]
Stroke	0 (0.00%)	0 (0.00%)	
DVT	2 (1.05%)	0 (0.00%)	0.553[2]
Reoperation with in 3 months	2 (1.05%)	2 (2.08%)	0.604[2]
Revision (Adjacent Segments)	11 (5.79%)	1 (1.04%)	0.066[2]
Revision Pseudarthrosis	2 (1.05%)	2 (2.08%)	0.604[2]
Transfusion	3 (1.57%)	0 (0.00%)	0.553[2]

x ± s represents mean ± standard deviation
Test used: [1]Wilcoxon test; [2]Pearson test
Abbreviations: TXA: Tranexamic Acid, Hb: Hemoglobin, Hct: Hematocrit, PT: Prothrombin Time, PTT: Partial Thromboplastin Time, PE: Pulmonary Embolism, DVT: Deep Venous Thrombosis

Table 3. Univariate and Multivariate Analysis of TXA Effect on Postoperative Outcomes

	Univariate		Multivariate	
Outcome	**OR/ β (95% CI)**	**p-value**	**OR/ β (95% CI)**	**p-value**
Drain duration	-4.96 (-10.2, 0.25)	0.062	-5.74 (-10.9, -0.53)	**0.031**
Drain output 24h	-9.65 (-17.5, -1.79)	**0.016**	-12.2 (-19.4, -4.89)	**0.001**
Drain output total	-11.6 (-21.2, -1.97)	**0.018**	-14.0 (-22.9, -5.05)	**0.002**
EBL	3.95 (-10.2, 18.1)	0.584	0.93 (-11.4, 13.3)	0.882
Delta Hb	0.5 (0.87, 0.13)	**0.008**	0.49 (0.86, 0.12)	**0.011**
Delta Hct	-1.78 (-2.96, -0.61)	**0.003**	-1.76 (-2.95, -0.58)	**0.004**
Transfusion	-	>0.999	0.98 (0.96, 1.00)	0.058
Thrombotic event	-	>0.999	0.99 (0.97, 1.01)	0.314
Hematoma	3.03 (0.49, 23.3)	0.229	1.02 (0.99, 1.06)	0.163
LOS	-0.16 (-0.66, 0.35)	0.916	-0.18 (-0.68, 0.33)	0.494
Reoperation within 3 months	2 (0.24, 16.9)	0.492	1.01 (0.98, 1.04)	0.475

Abbreviations: OR: Odds ratio, EBL: Intraoperative Estimated Blood Loss, Hb: Hemoglobin, Hct: Hematocrit