Postoperative Administration of Tranexamic Acid Reduces Chest Tube Drainage in the First 48 Hours Following Vertebral Body Tethering Surgery for Scoliosis Correction

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INTRODUCTION:

Vertebral body tethering (VBT) is a non-fusion surgical option for treating adolescent idiopathic scoliosis (AIS). While previous studies have focused on radiographic outcomes and implant-related complications, the anterior thoracic approach of VBT necessitates the use of chest tubes (CTs), raising concerns about chest tube management and pulmonary complications.

Tranexamic acid (TXA) is a synthetic anti-fibrinolytic agent known for its effectiveness in reducing blood loss and the need for allogeneic blood transfusions in various orthopedic surgeries. Intraoperative TXA has been particularly successful in reducing blood loss during spinal fusion for scoliosis correction. However, the use of post-operative TXA, including its appropriate dosage and duration, has not been studied in patients following VBT. This study aims to assess the efficacy of post-operative intravenous TXA in reducing CT drainage and retention after VBT procedures.

METHODS: A consecutive series of 40 patients who received 48 hours of post-op IV TXA (48H TXA) were compared to 35 VBT patients who received 24 hours of post-op IV TXA (24H TXA) and 49 patients who did not receive TXA (No TXA). All patients were 18 years old or younger. TXA was delivered at 2 mg/kg/h. Group comparisons were performed using one-way ANOVA for continuous variables and Chi-square for categorical variables. Tukey's Honest Significant Difference (HSD) test was used to assess between-group differences. Multivariate linear regression analysis was used to assess predictors of total chest tube drainage volume and overall chest tube placement duration.

RESULTS:

There were no significant differences in baseline characteristics, including age, sex, BMI, and preoperative major and minor cobb angles. With longer TXA use, there was decreased chest tube (CT) drainage volume on the day of surgery (48H TXA 112 ± 62 cc, 24H TXA 212 ± 92 cc, No TXA 270 ± 115 cc; p<0.001), on postoperative day (POD) 1 (48H TXA 180 ± 92 cc, 24H TXA 200 ± 108 cc, No TXA 266 ± 137 cc; p=0.002), and on POD 3 (48H TXA 45 ± 72 cc, 24H TXA 46 ± 71 cc, No TXA 98 ± 118 cc; p=0.010) Similar trends were observed in total CT drainage volume (p<0.001) and overall CT drainage time (p=0.007). **(Table 1)** The declining trend in DOS CT drainage volume was maintained when CTs were placed for thoracic (N=64), thoracolumbar (N=29), or both curves (N=31) when assessed separately. For patients with chest tubes at both levels, 48 hours of TXA was associated with approximately half the total chest tube drainage volume (48H TXA 590 ± 272 cc vs. No TXA 1189 ± 213 cc; p<0.001), and chest tube removal was two days earlier (overall drainage time for 48H TXA 65 ± 13 hrs vs. No TXA 108 ± 23 hrs; p<0.001) compared to no TXA patients. **(Table 2)** Multivariate linear regression analysis demonstrated that the TXA group was a significant predictor of total chest tube drainage (p<0.001) and the length of overall chest tube time (p=0.010). Postoperatively, hospital admission and ICU stay lengths did not differ between TXA groups.

DISCUSSION AND CONCLUSION:

Intravenous postoperative TXA (2 mg/kg/hr) for 48 hours significantly decreases chest tube (CT) drainage and retention time following vertebral body tethering (VBT) surgery for adolescent idiopathic scoliosis (AIS). 48H TXA reduced CT drainage on the day of surgery and postoperative days 1 and 3 compared to 24H TXA and no TXA. Additionally, 48H TXA led to CT removal two days earlier without increasing complications. These findings support the use of post-op TXA in managing CT drainage after VBT surgery.

Table 1. Overall Chest Tube Drainage Characteristics (ANOVA)

	No TXA, N = 49	**24 HR TXA**, N = 35	**48 HR TXA**, N = 40	**p-value**
Bilateral Chest Tubes (CT)				0.2
No	37 (76%)	21 (60%)	31 (78%)	
Yes	12 (24%)	14 (40%)	9 (23%)	
Total CT Day of Surgery Drainage Volume (cc)	270 (115)	212 (92)	112 (62)	**<0.001**
POD1 CT Drainage Volume (cc)	266 (137)	200 (108)	180 (92)	**0.002**
POD2 CT Drainage Volume (cc)	159 (109)	121 (113)	134 (88)	0.2
POD3 CT Drainage Volume (cc)	98 (118)	46 (71)	45 (72)	**0.010**
POD4 CT Drainage Volume (cc)	25 (62)	14 (40)	15 (41)	0.5
POD5 CT Drainage Volume (cc)	8.7 (25)	5.7 (32)	2 (9)	0.4
POD6 CT Drainage Volume (cc)	0.2 (1.4)	7.4 (44)	0 (0)	0.3
POD7 CT Drainage Volume (cc)	0 (0)	3.7 (22)	0 (0)	0.3
Total CT Drainage Volume (cc)	818 (411)	611 (353)	487 (252)	**<0.001**
Length of CT Drainage (hrs)	70 (34)	66 (28)	67 (30)	**0.007**

Table 2. Comparison of chest tube drainage volumes (cc) and total chest tube drainage time (hrs) between non-TXA, 24-hour TXA, and 48-hour TXA groups for CTs placed for instrumented thoracic, thoracolumbar, or both thoracic + thoracolumbar curvatures (ANOVA)

	Thoracic (N=64)				**Thoracolumbar (N=29)**				**Both (Thoracic and Thoracolumbar; N=31)**			
	No TXA (N=29)	**24 HR TXA (N=16)**	**48 HR TXA (N=19)**	**p-value**	**No TXA (N=8)**	**24 HR TXA (N=5)**	**48 HR TXA (N=16)**	**p-value**	**No TXA (N=12)**	**24 HR TXA (N=14)**	**48 HR TXA (N=5)**	**p-value**
DOS	258 (118)	200 (64)	123 (59)	**<0.001**	226 (125)	162 (65)	91 (35)	**<0.001**	329 (83)	245 (118)	135 (118)	**0.006**
POD1	243 (113)	193 (70)	182 (55)	**0.046**	155 (66)	94 (82)	146 (77)	0.3	396 (132)	247 (126)	280 (171)	**0.029**
POD2	134 (101)	147 (126)	147 (86)	0.9	105 (123)	32 (66)	113 (91)	0.3	255 (46)	123 (98)	152 (84)	**<0.001**
POD3	80 (97)	73 (91)	63 (89)	0.8	75 (198)	14 (31)	31 (50)	0.6	157 (83)	26 (38)	22 (44)	**<0.001**
POD4	21 (69)	27 (54)	31 (55)	0.9	11 (32)	-	-	0.3	42 (62)	5 (20)	-	0.054
POD5	10 (28)	12 (48)	3 (14)	0.7	1 (4)	-	-	0.3	11 (27)	0.7 (3)	-	0.3
POD6	0.3 (2)	16 (65)	-	0.2	-	-	-	-	-	-	-	-
POD7	-	8 (33)	-	0.2	-	-	-	-	-	-	-	-
Total Drainage Volume	747 (358)	676 (411)	549 (267)	0.2	520 (463)	302 (240)	382 (200)	0.4	1189 (213)	647 (264)	590 (272)	**<0.001**
Overall Drainage Time	87 (34)	78 (40)	75 (32)	0.5	60 (26)	41 (21)	59 (29)	0.4	108 (23)	70 (25)	65 (13)	**<0.001**