ORIGINAL ARTICLE

How does tranexamic acid affect blood transfusion and bleeding amount in pelvis-acetabulum fractures treated with open reduction and internal fixation?

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ABSTRACT

BACKGROUND: This study aimed to investigate intravenous tranexamic acid's (TA) effect on blood loss and transfusion ratios in pelvis-acetabulum fractures treated with open reduction and internal fixation.

METHODS: Patients who underwent open reduction and internal fixation due to pelvis-acetabulum fractures between January 2017 and January 2019 constituted this study's target population. After applying inclusion and exclusion criteria, patients were divided into two groups: Those who were perioperatively given 15 mg/kg TA (i.e., Group 1) and those who were not (i.e., Group 2). Data including age, gender, mechanism of injury, fracture type, presence or absence of additional injuries, the time interval between admission and surgery, incision site, pre-operative and post-operative hemoglobin levels, intraoperative estimated blood loss (EBL), number of blood units transfused, and complications were recorded. Two groups were compared regarding these parameters.

RESULTS: The study cohort included 58 patients. There were 30 patients in Group 1 and 28 patients in Group 2. Our analysis revealed that the number of blood units transfused was significantly higher in Group 2 than Group 1 (p=0.016). However, there was no significant difference between the two groups regarding intraoperative EBL, pre-operative and post-operative hemoglobin levels, and the time interval between admission and surgery.

CONCLUSION: Administration of intravenous TA reduces blood transfusion requirement in patients with pelvis-acetabulum fractures treated with open reduction and internal fixation. This approach can prevent potential blood transfusion-related complications.

Keywords: Acetabulum; blood transfusion; pelvis; tranexamic acid; trauma.

INTRODUCTION

Pelvis and acetabular fractures and related surgical interventions bear a high risk of bleeding and hemodynamic deterioration.[1] Several studies suggested different approaches to reduce bleeding and blood transfusion needs during various orthopedic procedures.[1,2] In many orthopedic studies, how to reduce bleeding during surgical procedures has been investigated. Some of these studies worked on antifibrinolytic agents such as tranexamic acid (TA).[2]

Since it is readily affordable and it can easily penetrate large joints, TA is the most widely used antifibrinolytic medication in these studies.[2] These efforts are justified because allogeneic blood transfusion has several potential complications, including blood-borne disease transmission.[3,4]

Although many studies are investigated the effects of TA on bleeding amount and blood transfusion volume in the setting

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of various orthopedic trauma surgeries, most of these studies worked either on combined pelvis-acetabulum and femur fractures or isolated acetabular fractures.[5–10] Besides, these studies found controversial results.[8–10] Furthermore, most of these studies did not investigate this agent's effects on blood transfusion rates in the setting of open reduction and internal fixation procedures performed due to pelvis-acetabulum fractures.

This study aimed to investigate TA's effects on bleeding volumes and blood transfusion rates in patients with pelvis and acetabulum fractures who undergo open reduction and internal fixation.

MATERIALS AND METHODS

This study was designed as a retrospective study, and it was conducted in accordance with the Declaration of Helsinki. The study was approved by the Ethical Review Committee of Gaziantep University Hospital (Approval number: 2020/346).

Adult (i.e., age ≥18) who underwent open reduction and internal fixation due to pelvis-acetabulum fractures at our center between January 2017 and January 2019 constituted this study's target population. Patients with a bleeding disorder, patients who were pregnant, those with a history of venous thromboembolism, patients on anticoagulants, or who had severe anemia due to previously diagnosed comorbidities such as hematologic, cardiovascular, or cerebrovascular diseases or chronic illnesses, and those who had hypersensitivity to TA were excluded from the study. Patients who had to undergo explorative laparotomy for simultaneous intra-abdominal injuries or those who had spinal column or intracerebral injuries were also omitted.

Data of the study patients were retrospectively reviewed. This review revealed that all patients underwent surgery under spinal anesthesia. Study patients were divided into two groups based on the presence or absence of perioperative TA administration. While patients who were given TA were included in Group 1, those who were not given TA constituted Group 2. In Group 1, 15 mg/kg TA was administered intravenously in 100 ml normal saline 30 min immediately before incision. Cell saver was not used. Low-molecular-weight heparin (40 mg/0.4 mL, q.d.) was given subcutaneously for thromboembolism prophylaxis in all patients for 30 days.

The same surgeon operated on all patients. Decisions regarding intraoperative and post-operative blood transfusions were given by the anesthesiologist and the orthopedic surgeon, respectively. Patients were transfused if their blood hemoglobin level was below 10 g/dL or arterial blood pressure was lower than 90/60 mmHg, and heart rate was above 100 beats per minute. No drain was used in any patient.

Table 1. Patient's demographics

	Tranexamic acide				p
	Used		Non-used		
	n	%	n	%	
Gender					0.649
Female	7	23.3	8	28.6	
Male	23	76.7	20	71.4	
Injury mechanism					0.479
Traffic accident (driver/passenger)	17	56.7	15	53.6	
Traffic accident (pedestrian)	4	13.3	7	25.0	
Falling from high	9	30.0	6	21.4	
Incision					0.314
Anterior	22	73.3	20	71.4	
Posterior	6	20.0	3	10.7	
Anterior + posterior	2	6.7	5	17.9	
Additional injuries					0.637
Yes	10	33.3	11	39.3	
No	20	66.7	17	60.7	
Age	30	37 [23–52]**	28	33.5 [23.5–46]**	0.591
Operative time	30	170 min. (101–220)	28	165 min (113–211)	0.677

*Significant at 0.05 level; Chi-square test. **Mean age and median counts.

Table 2. Parameters differences between two groups

	Tranexamic acid	None
	Mean±SD	Mean±SD
Pre-op hemoglobin (g/dl)	12.9±1.8	12.2±2
Post-op hemoglobin (g/dl)	10.8±1.7	10.6±1.7
Interval between injury and operation (day)	2.2±1.1	3±2
Total blood transfusion (unit)	2.1±2.5	4.6±4.2
Estimated blood loss (ml)	486.6±284.3	626.79±349.4

SD: Standard deviation.

Table 3. Hemoglobin, total blood transfusion, estimated blood loss, interval between incision and operation parameters

	Used (n=30)	Non-used (n=28)	p
	Median [25%–75%]	Median [25%–75%]	
Preoperative hemoglobin	13.25 [11.2–14.3]	12.6 [11.15–13.5]	0.231
Postoperative hemoglobin	10.5 [9.5–12]	10.25 [9.05–11.75]	0.575
Interval between insicion and operation (day)	2 [2–3]	2.5 [2–3]	0.127
Total blood transfusion	1 [0–3]	3.5 [1.5–6.5]	0.016*
Estimated blood loss	450 [250–650]	550 [375–825]	0.120

*Significant at 0.05 level; Mann-Whitney U test.

Parameters including age, gender, mechanism of injury, fracture type, presence or absence of additional injuries, the time interval between admission and surgery, surgical time, incision site, pre-operative and post-operative hemoglobin levels, intraoperative estimated blood loss (EBL), number of blood units transfused, and complications were retrieved from patient folders and recorded to a database. Two groups were compared concerning these variables.

Statistical Analysis

The normality of the distribution of continuous variables was tested by the Shapiro–Wilk test. For non-normally distributed data, Mann–Whitney U-test was used to compare two independent groups, while the Chi-square test was performed to analyze the relationship between two categorical variables. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS for Windows, v24.0) software, and the p value was considered significant when it was lower than 0.05.

RESULTS

A total of 58 patients participated in the study. While TA was administered to 30 patients (Group 1), it was not administered in 28 patients (Group 2). There was no significant difference between the two groups regarding age, gender distribution, mechanism of injury, and surgical time (Table 1).

Pre-operative and post-operative hemoglobin levels, the time between injury and surgery, EBL, and the number of blood units transfused in both groups are displayed in Table 2.

Our comparative analysis revealed no significant difference between the two groups concerning pre-operative and post-operative hemoglobin levels, the time between injury and surgery, and EBL during surgery (Table 3 and Fig. 1). However, number of blood units transfused was significantly higher in Group 2 than Group 1. There was a statistically significant dif-

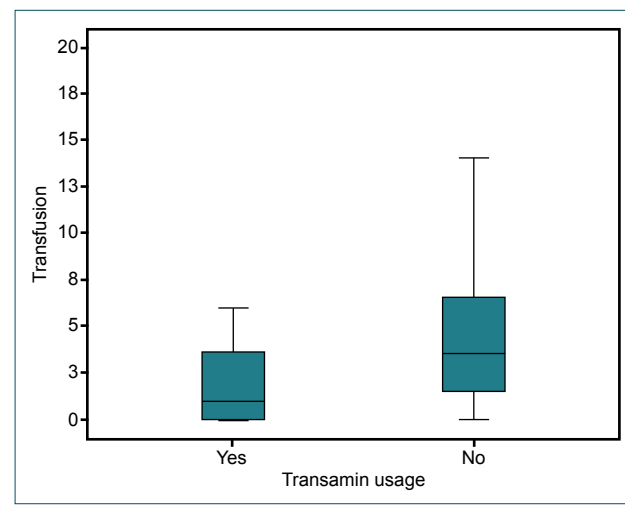

Figure 1. Tranexamic acid usage and transfusion rates.

ference between the groups regarding the number of blood units transfused.

DISCUSSION

Our study investigated TA's effect on intraoperative EBL and transfusion rates in patients who underwent open reduction and internal fixation due to combined pelvis and acetabulum fractures. The TA's effect on blood loss associated with pelvis and acetabulum fracture surgeries was previously investigated.[8,9] However, it is important to note that while one of these studies included patients with pelvis, acetabulum, or proximal femur fractures, the other one included patients with acetabular fractures only. Moreover, in some other studies investigating TA administration's potential benefits on blood loss in patients with pelvis-acetabular fractures, the cell salvage method was used as an adjunct to TA.[11] Scannell et al. reported that there was no difference between the patient groups who were treated with and without TA regarding blood transfusion rates.[11] In our study, we used TA only and investigated its blood-saving effect in the setting of combined pelvis-acetabulum fracture surgeries. It was previously reported that acetabular fractures accompany pelvic fractures at a rate of 15.7%.[12] Our study found that blood transfusion rates were significantly lower in the group where TA was used.

Allogenic blood transfusion (ABT) is mostly life-saving in trauma patients.[13–15] However, it is known that ABT is not an innocent procedure. It is associated with increased blood-borne infection and transfusion complication-related mortality rates. Since we found that administration of TA reduced ABT requirement in the setting of pelvis-acetabulum fracture surgeries, it can be postulated that this approach can also lower ABT-related mortality.

Lack et al. stated that the incidence of transfusion correlated with the severity of pre-operative anemia in patients who underwent surgery due to acetabulum fractures.[9] In our study, we excluded the patients with comorbidities and severe pre-operative anemia to eliminate the potential effects of pre-operative anemia on ABT rates. Our analysis elucidated that mean pre-operative hemoglobin level was similar in Groups 1 and 2 (12.9 and 12.2 g/dl, respectively).

In various orthopedic procedures with high risk of bleeding such as total hip or knee arthroplasties and spinal surgeries, TA was used for blood-saving purposes.[16–20] These studies showed that TA reduced intraoperative EBL and ABT requirement, especially in arthroplasty surgeries.[20] In our study, despite the fact that post-operative hemoglobin drop and EBL were similar between two groups, the ABT rate was significantly higher in patients who were not given TA (i.e., Group 2).

Our study has some limitations which need to be considered while evaluating its findings. Although there was no difference between the groups regarding the variability of fracture types, fracture types differed between the groups. This heterogeneity can be a source of bias. Furthermore, the criteria for intraoperative ABT were not previously determined. This approach can be a source of selection bias. Third, although the study data were prospectively collected, they were analyzed retrospectively. Forth, while EBL is not an objective parameter, it was one of the primary outcomes of our study. Furthermore, data regarding thromboembolic events were not collected.

Conclusion

Despite these weaknesses of our study, we suggest that TA administration can reduce blood transfusion need in the setting of open reduction and internal fixation surgeries performed due to combined pelvis-acetabulum fractures. This approach can also save the patients from potential ABT-related complications.

Ethics Committee Approval: This study was approved by the Gaziantep University Clinical Research Ethics Committee (Date: 21.10.2020, Decision No: 2020/346).

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Conflict of Interest: None declared.

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ORİJİNAL ÇALIŞMA - *ÖZ*

Açık redüksiyon ve internal fiksasyonla tedavi edilen pelvis-asetabulum kırıklarında traneksamik asit kan transfüzyonu ve kanama miktarlarını nasıl etkiler?

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AMAÇ: Bu çalışmada intravenöz traneksamik asidin açık redüksiyon ve internal fiksasyon ile tedavi edilen pelvis-asetabulum kırıklarında kan kaybı ve transfüzyon oranları üzerine etkisini araştırmak amaçlandı.
GEREÇ VE YÖNTEM: Ocak 2017–Ocak 2019 tarihleri arasında pelvis-asetabulum kırığı nedeniyle açık redüksiyon ve internal fiksasyon yapılan hastalar bu çalışmanın hedef popülasyonunu oluşturdu. Dahil etme ve dışlama kriterleri uygulandıktan sonra hastalar iki gruba ayrıldı: perioperatif olarak 15 mg/kg traneksamik asit verilenler (Grup 1) ve verilmeyenler (Grup 2). Yaş, cinsiyet, yaralanma mekanizması, kırık tipi, ek yaralanmaların varlığı veya yokluğu, yatış ve ameliyat arasındaki zaman aralığı, insizyoni, ameliyat öncesi ve sonrası hemoglobin seviyeleri, ameliyat sırasında tahmini kan kaybı (EBL), transfüze edilen kan ünitesi sayısı verileri ve komplikasyonlar kaydedildi. Bu parametreler açısından iki grup karşılaştırıldı.
BULGULAR: Çalışma grubu 58 hastayı içeriyordu. Grup 1'de 30 hasta, Grup 2'de 28 hasta vardı. Analizimiz, Grup 2'de transfüzyon yapılan kan ünitesi sayısının Grup 1'e göre anlamlı olarak daha yüksek olduğunu ortaya koydu (p=0.016). Bununla birlikte, intraoperatif EBL, ameliyat öncesi ve sonrası hemoglobin düzeyleri ve başvuru ile cerrahi arasındaki zaman aralığı açısından iki grup arasında anlamlı bir fark yoktu.
TARTIŞMA: İntravenöz traneksamik asit uygulaması, açık redüksiyon ve internal fiksasyon ile tedavi edilen pelvis-asetabulum kırıklı hastalarda kan transfüzyonu ihtiyacını azaltmaktadır. Bu yaklaşım, kan nakline bağlı olası komplikasyonları önleyebilir.
Anahtar sözcükler: Asetabulum; kan transfüzyonu; pelvis; traneksamik asit; travma.

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