

Comparing the effect of intravenous tranexamic acid by continuous infusion method with a separate intravenous method on bleeding after the simultaneous bilateral knee Arthroplasty

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ARTICLE INFO	ABSTRACT
<p>Article type: Original Article</p> <hr/> <p>Article History: Received: 07 Nov 2024 Accepted: 31 Dec 2024</p> <hr/> <p>Keywords: Total knee arthroplasty, Tranexamic acid, Postoperative bleeding</p>	<p>Introduction: Significant postoperative bleeding is linked to total knee arthroplasty (TKA), and tranexamic acid (TXA), a strong medication with strong anti-fibrinolytic properties, can lessen surgical bleeding. This study compared the effects of continuous intravenous tranexamic acid infusion with a separate intravenous approach concerning postoperative bleeding in synchronic bilateral knee arthroplasty.</p> <p>Materials and Methods: Hemoglobin changes (24 and 48 hours after surgery), the gases used during the procedure, and the amount of bleeding were assessed in 120 patients who had simultaneous bilateral knee replacement surgery and received intravenous tranexamic acid by continuous infusion (n = 40), single intravenous injection (n = 40), or without injection (n = 40).</p> <p>Results: In 120 patients who underwent simultaneous bilateral knee replacement surgery and received intravenous tranexamic acid by continuous infusion (n = 40), single intravenous injection (n = 40), or no injection (n=40), hemoglobin changes (24, 48 hours postoperatively), the gases used during the procedure, and the extent of bleeding were evaluated.</p> <p>Conclusion: The current study's findings demonstrated that the rate of postoperative hemorrhage and the quantity of gases used in continuous infusion and stat intravenous were reduced compared to the control group. Furthermore, the continuous infusion strategy decreased postoperative hemorrhage and gas consumption compared to the stat intravenous approach.</p>
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Introduction

Numerous research has examined the impact of tranexamic acid on one-sided knee arthroplasty, and its influence on bleeding following knee arthroplasty has been established up to this point. For instance, intravenous tranexamic acid therapy dramatically lowers the amount of perioperative bleeding and the requirement for blood transfusions in unilateral knee arthroplasty, according to a 2013 meta-analysis research that included 19 studies (1).

Additionally, in a 2013 meta-analysis of 22 studies, tranexamic acid medication decreased postoperative bleeding, the need for transfusions following knee arthroplasty, and the overall blood volume lost compared to the control group (2).

Even though tranexamic acid has been shown in numerous studies to be useful in minimizing bleeding after total knee replacement, its optimal usage, dosage, and timing remain unclear. However, there is no set protocol for the intravenous administration of tranexamic acid during surgery (3). However, tranexamic acid (TEA) can be administered intra-articularly, intravenously (as continuous infusions or individual injections), or in combination with these two methods (4). As a result, numerous studies have examined various tranexamic acid regimens in knee arthroplasty and produced a range of findings. Nonetheless, an ongoing debate exists on the best tranexamic acid regimen for knee replacements. In many studies, only one aspect of the use of tranexamic acid in total arthroplasty has been addressed. For example, they have only checked the use of intravenous tranexamic acid (5). Comprehensive studies are required to establish a protocol for the use of tranexamic acid, as most of the studies on the effect of tranexamic acid in knee arthroplasty have been conducted in cases of unilateral surgery. However, some have also examined patients who have undergone bilateral surgery. Other studies have compared the intravenous method with the intra-articular method (4), and some have only examined the appropriate dose of tranexamic acid for use in arthroplasty (6). Additionally, some studies have been retrospective, not providing reliable evidence (7). In these situations, tranexamic acid's ability to lessen

postoperative bleeding and lower hospitalization rates and expenses for patients has been explored generally; nevertheless, the best way to administer it has not been particularly addressed in this context either. New research has to be done (8–10). Due to the lack of research on the effects of various intravenous tranexamic acid administration techniques (continuous infusion versus multiple separate injections) in simultaneous bilateral knee arthroplasty, the current study was carried out to compare the effects of intravenous tranexamic acid administered by continuous infusion method with a separate intravenous method in bleeding following simultaneous bilateral knee arthroplasty in the medical centers of Ardabil City during the years 2019-2020.

Materials and Methods

In 2020–2021, 120 patients who were candidates for knee arthroplasty at Ardabil City's medical centers participated in the retrospective cohort research. Patients with a history of cardiovascular and cerebrovascular accidents, a history of coagulation disorders manifested as clot formation or bleeding, sensitivity to tranexamic acid, uremic patients, patients with cardiac stents, and patients who were candidates for arthroplasty were all included in the study. Three groups of forty patients each were randomly selected. Twenty minutes prior to surgery, the first group received a continuous intravenous infusion of 2 grams of tranexamic acid. One gram of tranexamic acid was administered intravenously to the second group by a different intravenous method 20 minutes before surgery, and then a single dose of one gram was taken during surgery and 20 minutes before opening the tourniquet. In the third group, the method without injection was applied to them. All of these patients' hemoglobin levels throughout the 24 and 48 hours following surgery, the number of gauzes used during the procedure, the quantity of bleeding based on underlying conditions, the length of the tourniquet, the length of the surgery, BMI, age, gender, and platelet count. Both before and after the procedure, we were assessed. The same physician used the same surgical technique, the subvastus approach, on each patient.

Descriptive statistics techniques, such as mean and standard deviation for quantitative data and frequency and frequency percentage for qualitative data, were used to analyze the information gathered using a checklist.

SPSS software version 25 was used to perform ANOVA and Chi-square tests. Also, the Tukey post-hoc test was used to compare the two groups after the ANOVA test. In all cases, the significance level was considered to be 0.05.

Ethical Approval

The study was conducted after approval by the ethics committee of Ardabil University of

Medical Sciences and registered by code IR.ARUMS.REC.1399.626.

Results

A total of 120 patients were analyzed. The patients under examination had an average age of 65.8 ± 6.9 years, with a standard deviation of 6.9 years. Sixty-one patients (50.8%) were female, and 59 patients (49.2%) were male. The mean body mass index was 27.2 ± 2.7 kg/m². The three groups did not differ statistically significantly in terms of gender (P=0.967), age (P=0.943), or body mass index (P=0.134).

Table 1. The baseline characteristics of the study population

Variables		Continuous venous group		Separate venous group		Without injection		p-value
Age (year)		65.6±7.2		65.7±6.9		66.1±6.9		0.94
BMI		27.3±3		26.5±2.3		27.7±2.5		0.14
Sex	Male (n, %)	19	47.5	20	50	20	50	0.97
	Female (n, %)	21	52.5	20	50	20	50	

There was no statistically significant difference between the three studied groups regarding the frequency of underlying diseases, including diabetes,

high blood pressure, heart disease, rheumatological disease, kidney disease, thyroid disease, and lung disease.

Table 2. Background co-morbidities in patients by the three investigated groups.

Variables		Continuous venous group		Separate venous group		Without injection		p-value
		n	%	n	%	n	%	
DM	+	2	5	2	5	2	5	1
	-	38	95	38	95	38	95	
BP	+	3	7.5	2	5	2	5	0.8
	-	37	92.5	38	95	38	95	
Heart Diseases	+	2	5	1	2.5	2	5	1
	-	38	95	39	97.5	38	95	
Rheumatologic disease	+	1	2.5	1	2.5	1	2.5	1
	-	39	97.5	39	97.5	39	97.5	
Kidney	+	1	2.5	0	0	1	2.5	1
	-	39	94.5	40	100	39	97.5	
Thyroid diseases	+	0	0	1	2.5	0	0	1
	-	40	100	39	97.5	40	100	
Lung diseases	+	0	0	0	0	1	2.5	1
	-	40	100	40	100	39	97.5	

Only the variables of postoperative bleeding ($P=0.001$) and the quantity of gauze consumed ($P=0.001$) were statistically significant in the comparison of the three groups; however, there was no significant difference in the variables of hemoglobin before the operation ($P=0.637$), hemoglobin h 24 after operation ($P=0.703$), hemoglobin h 48 after operation ($P=0.720$), platelet before operation ($P=0.571$), platelet after operation ($P=0.361$), duration of closure Tourniquet ($P=0.524$), and duration of surgery ($P=0.650$).

According to the LSD post-hoc test, the continuous intravenous acid infusion group experienced considerably less postoperative bleeding than both the isolated intravenous acid infusion group ($P=0.001$) and the non-injection group ($P=0.001$). Following the procedure, there was considerably less bleeding in the group receiving separate intravenous acid transferase than in the group not receiving such injection ($P=0.003$).

The continuous intravenous acid tranexamic group utilized considerably less gauze than the individual intravenous acid tranexamic group ($P=0.001$) and the group without injection ($P=0.001$). Compared to the non-injection group, the distinct intravenous acid tranexamic group utilized considerably less gauze ($P=0.001$). Following surgery, none of the three groups under investigation experienced any infection, pulmonary embolism, DVT, hearing arrhythmia, or brain ischemia.

Discussion

In the current study, the two groups receiving intravenous tranexamic acid (infusion and separate injections) experienced less postoperative bleeding and used fewer gauzes than those not receiving an injection. The effect of tranexamic acid (TEA) on blood loss related to knee arthroplasty was the subject of a prospective, double-blind investigation (11). This study found that short-term TA therapy decreased blood loss, thromboembolic consequences, and the requirement for blood transfusions, all consistent with our findings. a meta-analysis analyzed 1114 participants and 19 clinical trials. The research groups did not differ significantly regarding venous thromboembolism or

other adverse effects. After primary unilateral TEA, intravenous tranexamic acid can dramatically lower postoperative blood loss and the need for transfusions (1). The use of tranexamic acid in TEA considerably decreased blood loss, with a mean of 435 mL, and postoperative blood loss, with a mean of 406 ML, according to another meta-analysis. Additionally, tranexamic acid dramatically decreased both the transfusion volume and pace. There was no statistically significant difference in the odds of developing pulmonary embolism and deep vein thrombosis between the tranexamic acid and non-injection groups (2). Accordingly, tranexamic acid is a medication that effectively reduces bleeding after surgery, and our study's findings support this. In the current trial, the group receiving continuous intravenous infusion used fewer gauzes during the procedure and saw a lower postoperative bleeding rate than those receiving individual intravenous injections. In an investigation comparing the intravenous injection of multiple distinct doses with the continuous infusion of tranexamic acid, the intravenous injection approach outperformed the continuous infusion approach in terms of lowering the rate of hemoglobin drop and postoperative bleeding in patients (12), which is consistent with the results of our study; however, there was no significant difference in the hemoglobin levels of the two groups of patients in our study. However, because bilateral knee replacement was investigated concurrently in this investigation, a full comparison of the outcomes is impossible. A study has examined the efficacy of topical tranexamic acid treatment for blood loss following unilateral total knee replacement. The three groups in this study did not differ in their pulmonary embolism or deep vein thrombosis rates. This approach showed very little systemic absorption of tranexamic acid (13). In a study to examine the impact of tranexamic acid (TXA) administered both locally and intravenously (IV) during total knee arthroplasty (TKA), the combined group's postoperative hemoglobin decreases and drainage rates were noticeably lower than those of the other groups (4). In conclusion, blood loss and the transfusion rate can be successfully

decreased by combining local TXA treatment with preoperative intravenous injection. In research to examine the safety and impact of systemic tranexamic acid administration in TEA, neither DVT nor TE cases were observed in either of the two study groups (14). A study examined the impact of high-dose intravenous tranexamic acid during knee replacement. The patients were split into two groups, and each group was given a dose of 60 mg/kg and 20 mg/kg prior to the procedure. Five doses of one gram were subsequently given at 3, 6, 12, 18, and 24 hours following the procedure. In contrast to 20 mg/kg preoperatively, treatment with high-dose tranexamic acid intravenously (60 mg/kg) decreased perioperative bleeding without increasing complications (15). It was not done in our study of high doses of tranexamic acid, and it is advised that future research look into different tranexamic acid dosages and different administration methods. The impact of tranexamic acid on unilateral knee replacement has been the subject of numerous prior investigations. For example, in a meta-analysis in 2013 that reviewed 19 studies encompassing 1114 patients, it was concluded that treatment with intravenous tranexamic acid was considerably effective. In unilateral knee replacement surgery, it lessens the bleeding surrounding the surgical site and the requirement for blood transfusions (1). Additionally, tranexamic acid treatment decreased the overall blood volume lost, postoperative bleeding, and the requirement for transfusion in knee arthroplasty compared to the control group in a 2013 meta-analysis of 22 studies (2). Total blood loss and hemoglobin drop were higher in the control group than in the intravenous treatment group in a retrospective study that looked at the impact of treating bleeding from simultaneous bilateral knee arthroplasty with intravenous tranexamic acid, a single dose of one gram 5 to 10 minutes prior to surgery, as opposed to the control group (no injection method). However, this difference was not substantial (8). There was no discernible difference between the groups in our study for the variables of hemoglobin before the operation, hemoglobin 24 hours after the operation, hemoglobin 48 hours after the

operation, platelets before and after the operation, number of gauzes consumed, tourniquet closure duration, and surgical duration. Additionally, in a 2015 study that examined the impact of intravenous tranexamic acid on knee pain in 106 patients, one group received a single dose of 30 mg/kg during surgery, while another group received a bolus dose of 10 mg/kg followed by a dose of mg/kg (2 kg) two to twenty hours later (16). Contrary to our findings, this study indicated that a single intravenous dose of tranexamic acid is just as effective as a continuous intravenous infusion.

Conclusion

According to the current study's findings, continuous and separate intravenous acid tranexamic techniques resulted in less postoperative bleeding and less gauze than the group that did not receive an injection. Additionally, the continuous venous acid tranexamic approach used a substantially lower number of gauzes and had a significantly lower postoperative bleeding rate than the separate method. Double-blind clinical trial studies are advised to strengthen the evidence, examine the impact of the surgical technique utilized for knee arthroplasty, and look into the predictive markers of postoperative bleeding.

Conflict of Interest: None.

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