

**Research Paper****Comparative Study of Reducing Blood Loss in Total Knee Replacement with and without the Use of Tranexamic Acid, Tourniquet, and Drainage****Authors**

**Mustafa M Elfadli, Hassan A Bushaala, Ayman B Alhowty, Tareg Elferjani,
Hatem Eltawahny, Seraj Elzentani**

Orthopedic Department, Benghazi Medical Center

Abstract

Background: Patients who undergo total knee arthroplasty (TKA) may develop large blood loss. The intraoperative and postoperative blood loss after TKA ranges from 1500 to 1900 cc. TKA is often carried out using a tourniquet and drains to collect the shedded blood loss. However, tranexamic acid is found to decrease blood loss. Tranexamic acid is a fibrinolysis inhibitor that blocks the plasminogen, and it has been reported before that it reduces blood loss in patients undergoing TKA. However, few reports describe the effects of tranexamic acid on blood loss in patients who underwent TKA.

Objectives: To study the reduction of blood loss after intravenous tranexamic acid infusion in patients undergoing TKA without the use of tourniquets or drains.

Patients and Methods: We performed a total of 95 TKA in osteoarthritis patients between 2017-2018. A total of 30 patients were operated during 2017 and at that time tourniquets with drains were used with no intravenous tranexamic acid. On the other hand, a total of 45 patients were operated in the year 2018 and for those intravenous tranexamic acid was used to decrease the blood loss without the use of tourniquets or drains. For those who received tranexamic acid it was given as follows, at time of anesthesia induction a total of 1 gram tranexamic acid is infused over 10 min. At closure, another 1 gram tranexamic acid is infused over 10 min. Furthermore, Patient's demographics, preoperative and postoperative hemoglobin (Hb) levels were studied as well as the need for blood transfusion between the two groups.

Results: The two groups had similar characteristics. The mean of pre and postoperative hemoglobin difference was 2.9 (SD 1.0) and 3.5 (SD 1.23) in the tourniquets and tranexamic acid groups respectively (*p* value = 0.041). However, postoperatively 5 (16.6%) of the tourniquets group received blood transfusion. Whereas, no one (0%) of the tranexamic acid patients needed to receive blood (*p* value = 0.005).

Conclusion: The use of tranexamic acid may decrease the total blood loss in patients undergoing TKA. Furthermore, there is less need for blood transfusion in those who received tranexamic acid.

Introduction

Total knee arthroplasty (TKA) is a common and effective surgical procedure for the treatment of end-stage knee osteoarthritis. However, significant blood loss is a common complication associated with TKA, with reported intraoperative and postoperative blood loss ranging from 1500 to 1900 cc^[1,2]. This substantial blood loss can lead to the need for allogeneic blood transfusion, which carries its own risks and complications.

To mitigate blood loss in TKA, various strategies have been employed, including the use of tourniquets and surgical drains. Tourniquets are commonly used to provide a bloodless surgical field, while drains are used to collect and remove the shed blood during and after the procedure^[3,4]. However, these techniques have their own limitations and drawbacks, such as increased risk of complications and patient discomfort.

In recent years, the use of antifibrinolytic agents, such as tranexamic acid, has emerged as a promising strategy to reduce blood loss in TKA. Tranexamic acid is a synthetic lysine analog that inhibits the activation of plasminogen to plasmin, thereby reducing fibrinolysis and promoting clot stability^[5]. Several studies have reported the efficacy of tranexamic acid in reducing blood loss and transfusion requirements in patients undergoing TKA^[6,7].

The aim of this study was to compare the reduction of blood loss in patients undergoing TKA with and without the use of intravenous tranexamic acid, while also avoiding the use of tourniquets and drains.

Materials and Methods

Study Design and Participants

This was a retrospective comparative study conducted at our institution between 2017 and 2018. A total of 95 patients who underwent primary TKA for knee osteoarthritis were included in the analysis. The study was approved by the Institutional Review Board, and all patients provided informed consent.

Surgical Technique and Interventions

During the study period, two different management strategies were employed. In 2017, a total of 30 patients underwent TKA using a tourniquet and with surgical drains, without the administration of intravenous tranexamic acid (tourniquet group). In 2018, a total of 45 patients underwent TKA without the use of tourniquets or drains, and instead received intravenous tranexamic acid (tranexamic acid group).

For the tranexamic acid group, patients received 1 gram of tranexamic acid infused over 10 minutes at the time of anesthesia induction, and another 1 gram infused over 10 minutes at the time of wound closure. All surgeries were performed by the same experienced arthroplasty surgeon using a standardized surgical technique.

Outcome Measures

The primary outcome measure was the difference in pre- and postoperative hemoglobin levels between the two groups. Secondary outcomes included the rate of blood transfusion in each group.

Statistical Analysis

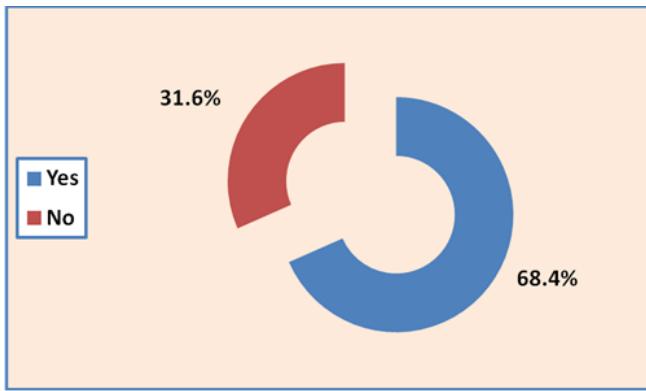
Continuous variables were reported as mean ± standard deviation (SD) and compared using the Student's t-test. Categorical variables were reported as frequencies and percentages and compared using the Chi-square test. A p-value <0.05 was considered statistically significant.

Results

The two groups were comparable in terms of patient demographics, including age, gender, and body mass index (Table 1).

Table 1 Distribution of patients according use of Tranex

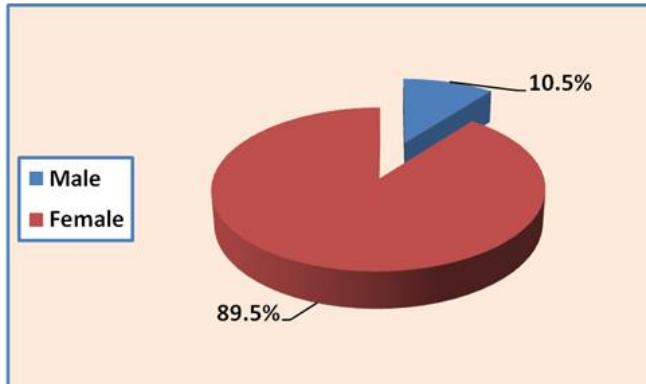
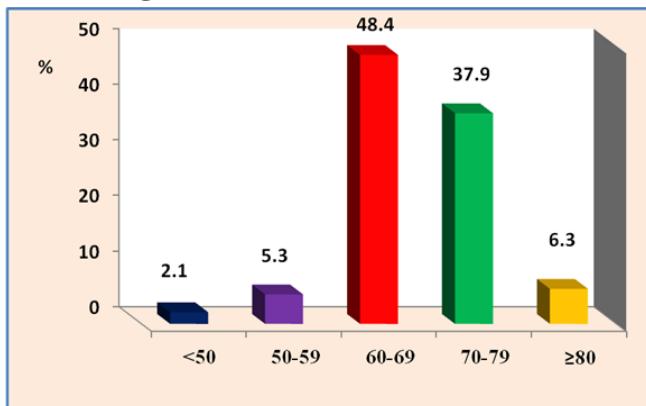
Tranexamic acid	No.	%
Yes	65	68.4
No	30	31.6
Total	95	100



The mean difference in pre- and postoperative hemoglobin levels was 2.9 ± 1.0 g/dL in the tourniquet group and 3.5 ± 1.23 g/dL in the tranexamic acid group, a statistically significant difference ($p=0.041$).

Regarding blood transfusion, 5 patients (16.6%) in the tourniquet group required postoperative blood transfusion, whereas none of the patients (0%) in the tranexamic acid group required blood transfusion, a statistically significant difference ($p=0.005$).

Patients age



Blood transfusion

Blood transfusion	Drug		Without drug	
	No.	%	No.	%
Yes	0	0	5	16.7
No	65	100	25	83.3
Total	65	100	30	100

Discussion

This study demonstrates that the use of intravenous tranexamic acid can effectively reduce blood loss in patients undergoing TKA, without the need for tourniquets or surgical drains. The results show a significantly smaller decrease in hemoglobin levels and a lower rate of blood transfusion in the tranexamic acid group compared to the tourniquet group.

The mechanism by which tranexamic acid reduces blood loss in TKA is well-established. Tranexamic acid inhibits the activation of plasminogen to plasmin, thereby preventing the breakdown of fibrin clots and reducing overall blood loss^[5]. This effect has been widely reported in the literature, with several studies showing the efficacy of tranexamic acid in decreasing blood loss and transfusion requirements in TKA^[6,7].

Importantly, our study also demonstrates that the beneficial effects of tranexamic acid can be achieved without the use of tourniquets or drains. The avoidance of these additional interventions may have several advantages, such as reduced surgical time, decreased risk of complications, and improved patient comfort.

The limitations of this study include its retrospective nature and the relatively small sample size. Additionally, we did not assess other clinical outcomes, such as postoperative pain, length of hospital stay, or long-term functional outcomes. Further prospective, randomized studies with larger sample sizes are warranted to validate these findings and explore the full impact of tranexamic acid on TKA outcomes.

Conclusion

The use of intravenous tranexamic acid can effectively reduce blood loss in patients undergoing TKA, without the need for tourniquets or surgical drains. This strategy resulted in a smaller decrease in hemoglobin levels and a lower rate of blood transfusion compared to the use of tourniquets and drains. These findings suggest that tranexamic acid may be a valuable tool in the management of blood loss in TKA.

References

1. Alshryda S, Sarda P, Sukeik M, Nargol A, Blenkinsopp J, Mason JM. Tranexamic acid in total knee replacement: a systematic review and meta-analysis. *J Bone Joint Surg Br.* 2011;93(12):1577-1585. doi:10.1302/0301-620X.93B12.26987
2. Aglietti P, Baldini A, Vena LM, Abbate R, Fedi S, Falciani M. Effect of tourniquets on activation of coagulation in total knee replacement. *Clin Orthop Relat Res.* 2000;(371):169-177. doi:10.1097/00003086-200002000-00021
3. Benoni G, Fredin H. Fibrinolytic inhibition with tranexamic acid reduces blood loss and blood transfusion after knee arthroplasty: a prospective, randomised, double-blind study of 86 patients. *J Bone Joint Surg Br.* 1996;78(3):434-440.
4. Camarasa MA, Olle G, Serra-Prat M, et al. Efficacy of aminocaproic, tranexamic acids in the control of bleeding during total knee replacement: a randomized clinical trial. *Br J Anaesth.* 2006;96(5):576-582. doi:10.1093/bja/ael057
5. Ekbäck G, Axelsson K, Ryttberg L, et al. Tranexamic acid reduces blood loss in total hip replacement surgery. *Anesth Analg.* 2000;91(5):1124-1130. doi:10.1097/00000539-200011000-00015
6. Hynes M, Calder P, Scott G. The use of tranexamic acid to reduce blood loss during total knee arthroplasty. *Knee.* 2003;10(4):375-377. doi:10.1016/s0968-0160(03)00058-1
7. Jansen AJ, Andreica S, Claeys M, D'Haese J, Camu F, Jochmans K. Use of tranexamic acid for an effective blood conservation strategy after total knee arthroplasty. *Br J Anaesth.* 1999;83(4):596-601. doi:10.1093/bja/83.4.596
8. Maniar RN, Kumar G, Singhi T, Nayak RM, Maniar PR. Most effective regimen of tranexamic acid in knee arthroplasty: a prospective randomized controlled study in 240 patients. *Clin Orthop Relat Res.* 2012;470(9):2605-2612. doi:10.1007/s11999-012-2310-y
9. Ozkunt O, Sarıyilmaz K, Gemalmaz HC, Kaya I, Ugurlu M. The effect of tourniquet use and timing of tourniquet release on blood loss in total knee arthroplasty. *Acta Orthop Traumatol Turc.* 2018;52(4):252-256. doi:10.1016/j.aott.2018.04.002
10. Wei Z, Liu M. The effectiveness and safety of tranexamic acid in total hip or knee arthroplasty: a meta-analysis of 2720 cases. *Transfusion.* 2015;55(8):1871-1880. doi:10.1111/trf.13090