Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/18943
DOI URL: http://dx.doi.org/10.21474/IJAR01/18943

RESEARCH ARTICLE

REDUCTION BLOOD LOSS IN TKA: TRANEXAMIC ACID ARTHROPLASTY UNIT: ARMED FORCES HOSPITAL SOUTHERN REGION, KHAMIS MUSHAIT, KSA

S. Altheeb[1], A. Maqbool[2], T. Alshehri[1], A. Qaysi[3] and M. Maqbool[4]

1. Orthopedic Residents, Armed Forces Hospital Southern Region (AFHSR).
2. Medical Student Agha Khan University Karachi: Pakistan.
3. Arthroplasty Fellow at King Saud University Medical City.
4. Arthroplasty Consultant, Armed Forces Hospital Southern Region (AFHSR).

Manuscript Info

Manuscript History
Received: 20 April 2024
Final Accepted: 24 May 2024
Published: June 2024

Key words:-
TXA, TKA, Impact, Blood Loss

Abstract

Background: Total knee arthroplasty is the ideal surgical option for the management of severe pain in the arthritic knee.However, this surgery carries a high risk for blood loss due to the involvement of soft tissue and bone cuts in the knee region.Blood loss during Total Knee Replacement can lead toincreased morbidity, including longer stays in the hospital and delayed rehabilitation. Therefore, it is ideal to reduce the amount of bloodloss pre and post-operative. Tranexamic acidan anti-fibrinolytic agent has beenusedto achieve this goal with success.

Aim: Our study is Cohort comparative study to compareefficacy of 1 Gram TXA with placebo group.

Methods: This study was conducted at armed forces hospital southern region(AFHSR) on patients who performed primary total knee arthroplastyduring the period fromApril 2022 to December 2022 . The patients were simplerandomized into two groups; those who received tranexamic acid and those who didn't. SPSS program version 23 was used to analyze the collected data; a comparison was performed between the two groups.

Results: The study included 50 patients who underwent total knee replacement; Group one received tranexamic acid, and the Group Two didn't. The mean±SD of the total patients was 69.8 ±11.8 years, and regarding the two groups, there was no considerable difference between the two groups (P=0.2). There were significant differences between the two groups regarding gender (P=0.005) and dressing (P=0.002). There was no patient in the study who required a blood transfusion.

Conclusion:TXA can be used for TKA patients to reduce blood loss postoperatively; however, its impact on blood loss seems to be insignificant.

Introduction:-

Total knee arthroplasty (TKA), also known as total knee replacement (TKR), is the ideal surgical option for the management of severe pain in the arthritic knee (Kurtz et al., 2007)**.** It is also the most frequently performed surgical procedure globally **(**Rothbauer et al.,2017).

Corresponding Author:- S. Altheeb
Address**:-** Orthopedic Residents, Armed Forces Hospital Southern Region (AFHSR).

TKA carries a high risk for potential blood loss due to bone cuts and extensive soft tissue involvement in the knee region (Kukreja et al., 2009).Perioperative bleeding still being one of the major concerns in elective total knee arthroplasty (TKA); the blood loss ranges between 80 ml to 1800 ml(Cushner & Friedman, 1991; Sehat et al., 2000; Soni et al., 2014). The blood loss due to TKA can result in a longer duration required for recovery after the surgery and increased length of stay in hospital (Spahn, 2010), increased morbidity (Carson et al., 1996), and requirement of transfusion up to 60% of cases (Levine et al., 2014).

It is crucial to maximize hemostasis during surgical operations such as TKA to promote the stability of patients, reduce overall morbidity and mortality and permit adequate visualization of the surgical field (Yang et al., 2021).Postoperative blood loss can be controlled or reduced by different methods, including perioperative red cell salvage, blood donation, the use of recombinant human erythropoietin, and deliberate hypotension. However, blood transfusion carries risks to the patients, such as infection, disease transmission, and allergic reactions, besides its cost (Bierbaum et al., 1999; Forbes et al., 1991). Also, tourniquets have been used in up to 95% of cases in the absence of vascular disease (Berry et al., 2010). However, the use of a tourniquet carries several risks, such as muscle necrosis (Pedowitz et al., 1992)], thigh pain(Tai et al., 2012; Pfitzner et al., 2016), and early infections (Brennan et al., 2009)]. Additionally, venous thromboembolism is highlighted as the most notable adverse effect associated with the use of a tourniquet (Kato et al., 2002).

The major postoperative bleeding after TKA surgery is considered to be hyperfibrinolysis; therefore, antifibrinolytic drugs have been proposed, such as aminocaproic acid, aprotin, and tranexamic acid (TXA) (Marra et al., 2016).It was suggested to use TXA as an antifibrinolytic drug after TKA surgery (Gameel et al., n.d), as it has become commonly used for reducing blood loss in trauma, orthopedic and cardiac procedures (Patel et al., 2020).TKA is an anti-fibrinolysis agent that prevents clot lysis by blocking the proteolytic action of plasminogen activators (Eubanks, 2010).However, TXA mustn't be used for patients with an allergy history, thrombosis, arterial thrombosis, venous thrombosis or thromboembolism inherent risk, epilepsy, acute renal failure, and subarachnoid hemorrhage (Eubanks, 2010).The impact of using TXA on blood loss among patients who underwent TKA.

Subjects and Materials:-

This study was conducted on patients who underwent primary total knee replacement at AFHSR during the period fromApril 2022 to December 2022 .All surgeries done by single Arthroplasty trained surgeon using standard medial para patellar approach using cemented post stbilised knee(zimmer Parsona) with no drains used in either group. The patients were categorized into two groups; those who received tranexamic acid and those who didn't. The study included patients who performed primary total knee replacement only, with the exclusion of those who underwent a semi-constrained total knee replacement. Demographics of patients, including age and gender, were investigated. Clinical data of patients, including hemoglobin levels before surgery and after the surgery as well as blood loss and dressing, were also recorded. The primary outcome is regarded as blood transfusion with secondary outcome as change of dressing during hospital stay.

Statistical analysis:

SPSS program version 23 was used to analyze the collected data; categorical data were represented using numbers and proportions, whereas numerical data were represented using mean and standard deviation. Comparison between the two groups was performed using either a t-test or chi-square based on the type of data. P-value ≤ 0.05 was considered significant.

Results:-

A total of 50 patients were included; the age range was 49-98 years, and the mean±SD of age was 69.8±11.8 years. Females were more dominant compared to males, 40 (80%) Vs. 10 (20%), respectively (Table 1).

Table 1:- Demographics of participants.

Variables	**Description (n=50)**
Age	
Range	49 - 98
Mean ± SD	69.8 ± 11.8
Sex	
Male	10 (20)

Female	40 (80)

The clinical data of patients are shown in Table 2; no patient required a blood transfusion with a strict criteria of transfusion if Hb below 8. The range of hemoglobin before the operation was 9.3-15 with a mean ±SD of 12.5±1.3, whereas that of hemoglobin postoperatively was 8.3-14.1 with a mean±SD of 11.6±1.4.

Table 2:- Clinical data of participants.

Variables	**Description (n=50)**
Blood transfusion	
Yes	0 (0)
No	50 (100)
Hemoglobin pre operation	
Range	9.3 - 15
Mean ± SD	12.5 ± 1.3
Hemoglobin post operation	
Range	8.3 - 14.1
Mean ± SD	11.6 ± 1.4

Group One received tranexamic acid 1 Gram 30 min before the skin inbcision, and the other half didn't, with a ratio of 1:1. Regarding the dressing of patients from both Groups, the majority, 38 (76%), reported dry dressing, whereas 9(18%) and 3(6%) displayed soaked and oozing dressing, respectively, (Table3).

Table 3:- Usage of tranexamic acid and dressing.

	Description (n=50)
Tranexamic Acid	
Yes	25 (50)
No	25 (50)
Dressing	
Dry	38 (76)
Soaked	9 (18)
Oozing	3 (6)

The comparison between the two groups of patients who received and those who didn't receive tranexamic acid is shown in Table 4. There was no significant difference between the age range or age mean of the two groups (P=0.2). Regarding gender, males significantly tended not to receive tranexamic acid (P=0.005).

Table 4:- Comparison between the two groups regarding demographics.

Variables	**Tranexamic**		**P value**
	Yes (n=25)	**No (n=25)**	
Age			
Range	53 - 98	49 - 86	
Mean ± SD	71.7 ± 12.1	67.8 ± 11.4	0.244
Sex			
Male	1 (4)	9 (36)	**0.005**
Female	24 (96)	16 (64)	

Blood transfusion wasn't varied between the two groups as no one received blood (P=1). Patients who didn't receive tranexamic acid displayed lower hemoglobin levels before the operation but with no significant difference (P=0.3). Also, there were no significant differences between the two groups regarding the mean postoperative hemoglobin level (P=0.4) (Table 5).

Table 5:- Comparison between the two groups regarding clinical data.

Variables	**Tranexamic**		**P value**
	Yes (n=25)	**No (n=25)**	

Blood transfusion			
Yes	0 (0)	0 (0)	1.000
No	25 (100)	25 (100)	
Hemoglobin pre operation			
Range	10 - 14	9.3 - 15	
Mean ± SD	12.3 ± 1.1	12.7 ± 1.4	0.369
Hemoglobin post operation			
Range	8.9 - 14	8.3 - 14.1	
Mean ± SD	11.5 ± 1.2	11.7 ± 1.5	0.485

The comparison between the two groups regarding dressing revealed a significant difference between the two groups (P=0.002), where all patients who displayed soaked dressing belonged to the group that didn't receive tranexamic acid. Also, more patients of those who received tranexamic acid tended to display dry dressing.

Table 6:- Comparison between the two groups regarding dressing.

Variables	**Tranexamic**		**P value**
	Yes (n=25)	**No (n=25)**	
Dressing			
Dry	22 (88)	16 (64)	**0.002**
Soaked	0 (0)	9 (36)	
Oozing	3 (12)	0 (0)	

Discussion:-

A high risk for blood loss is associated with TKA surgery**(**Kukreja et al., 2009). TKA was suggested to be used as an antifibrinolytic drug after TKA surgery (Gameel et al., n.d)**]**. As far as we know, there was no previous Saudi study conducted on this subject; therefore, we conducted this study. In the current study, we found female dominancy as they represented the majority of the sample as well as in the control and TXA group. The same was reported in a previous study where female dominancy was found among TKA patients and female dominancy in the control and TXA group **(**Sadigursky et al., 2016).

In a study that investigated the efficacy of using TXA in primary TKA, it was found that TXA was a safe and efficient way to reduce overall blood loss in TKA patients **(** Gameel et al., n.d). However, in the current study, we didn't find any significant difference between the two groups, the control, and TXA group, regarding hemoglobin levels before and postoperatively. The difference between the mean hemoglobin level before and after surgery was low in the two groups and wasn't significant.

A study was conducted on 64 patients who underwent total knee replacement (TKR)and divided them into two groups those who received TXA and those who didn't. The mean preoperative hemoglobin in TXA and non-TXA groups was 13.06 and 12.44, respectively, whereas the mean hemoglobin level after surgery was 10.29 and 9.16, respectively. Additionally, those who received TXA didn't require a transfusion of blood, whereas 12.5% of the other group required a blood transfusion **(**Utomo et al., 2019). The contrary was found in our study, where the level of hemoglobin among those who received TXA was lower in our study before surgery (12.3) but higher postoperatively (11.5) compared to the previous study. Also, the mean of hemoglobin before (12.7) and after the operation (11.7) was higher compared to the previous study **(**Utomo et al., 2019). Additionally, our study revealed that none of the patients in either group required a blood transfusion. It should be noted that the mean hemoglobin level before surgery among the TXA group was lower than that of the control but with no significant difference. Additionally, the reduction in the mean hemoglobin level postoperatively was lower in TXA compared to the controls, but also with no significant difference.

Another study compared two groups of patients who underwent TKA; the control subjects who didn't receive TXA and TXA group that received TXA. It was found that there were differences in favor of the drug 48 hours after the surgery for hemoglobin (P=0.01) **(**Guerreiro et al., 2017). We didn’t find any differences between the two groups regarding the level of hemoglobin postoperatively. However, this may return to the fact that we didn’t assess the level of hemoglobin at different time intervals.

Seol et al. conducted a study on 100 patients who performed TKA, and the patients were categorized into two groups, each involving 50 patients. One control group involved those who received a placebo injection and the TXA group. The study reported that hemoglobin drop was significantly higher among the control group compared to the TXA group (P=0.0001). Also, there was a significant difference between the two groups regarding transfusion (P=0.01), where a higher proportion of the control group received blood transfusion **(**Seol et al., 2016). These findings were in contrast to ours, where there was no significant difference between the control and TXA groups regarding blood transfusion or hemoglobin drop. Additionally, none of our patients required a blood transfusion.

In a meta-analysis, it was found that the administration of TXA in TKA resulted in a reduction of blood loss by an average of 500 ml when compared to placebo **(**Yang et al., 2012). However, in this study, we did not estimate the value of blood loss.

A retrospective study included 291 patients who underwent TKA compared patients who received a single preoperative dose of TKA and those who received a single dose preoperatively followed by a second postoperative dose. However, the study revealed that none of the patients experienced adverse events. There 13.5% and 5.7% of those who received single and double doses, respectively, required blood transfusion **(**Legnani et al., 2019). These findings reveal the safety of TXA even in double doses; however, we did not assess the use of double doses.

A previous study compared three groups that received TXA for TKA, the studied groups included patients who received TXA either intravenously, intra-articularly, and intravenously plus intra-articular. It was found that there was no significant difference in the measure of outcomes, with the exception of a significantly lower maximum hemoglobin loss in the combined group compared to the intravenous group (P=0.02). However, there were no differences between the groups in the amount of blood in the drain or the rate of blood transfusion**(**Marra et al., 2016). In the current study, we did not assess the impact of different methods of TXA administration. Furthermore, we did not find a significant difference regarding hemoglobin loss.

There are several risk factors for increased intraoperative bleeding in primary TKA; such factors include male gender, certain medication usage, age, and hypothermia **(**Eubanks, 2010). However, in our study, males significantly tended to receive no TXA, whereas females tended to receive TXA, although male gender is a risk factor for TKA.

One study reported no significant difference regarding gender between TXA and non-TXA groups (P=0.7), whereas there was a significant difference between the two groups regarding the mean age (P<0.0001), where those who received TXA were significantly older **(**Drain et al., 2020). The contrary was found in our study, where the significant difference between the two groups was regarding gender (P=0.005), and age showed no significant difference between the two groups (P=0.2).

There was no previous study compared between patients who received TXA and those who did not receive TXA regarding dressing, but we did in this study. The comparison between the two groups regarding dressing showed a significant difference between the two groups (P=0.002); patients who received TXA significantly tended to display dry dressing, whereas those who did not receive TXA tended to display soaked dressing.

Conclusion:-

TXA can be used for TKA patients to reduce blood loss postoperatively, and this was obvious in our study regarding the dressing of the patients in each group. However, we found no significant differences between those who received TKA and those who did not regarding the mean level of hemoglobin postoperatively.

References:-

1. (Berry & Bozic, 2010) Berry, D. J., & Bozic, K. J. 2010. Current practice patterns in primary hip and knee arthroplasty among members of the American Association of Hip and Knee Surgeons. The Journal of Arthroplasty, 25(6 Suppl), 2–4. https://doi.org/10.1016/j.arth.2010.04.033
2. (Bierbaum et al., 1999) Bierbaum, B. E., Callaghan, J. J., Galante, J. O., Rubash, H. E., Tooms, R. E., & Welch, R. B. 1999. An analysis of blood management in patients having a total hip or knee arthroplasty. The Journal of Bone and Joint Surgery. American Volume, 81(1), 2–10. https://doi.org/10.2106/00004623-199901000-00002

3. (Brennan et al., 2009) Brennan, S. A., Walls, R. J., Smyth, E., Al Mulla, T., & O'Byrne, J. M. 2009. Tourniquets and exsanguinators: a potential source of infection in the orthopedic operating theater? Acta Orthopaedica, 80(2), 251–255. https://doi.org/10.3109/17453670902930016
4. (-Carson et al., 1996) -Carson, J. L., Duff, A., & Poses, R. M. 1996. Effect of anaemia and cardiovascular disease on surgical mortality and morbidity. Lancet, 348.
5. (-Cushner & Friedman, 1991) -Cushner, F. D., & Friedman, R. J. 1991. Blood loss in total knee arthroplasty. Clin Orthop Relat Res, 269, 98–101.
6. (-Drain et al., 2020) -Drain, N. P., Gobao, V. C., Bertolini, D. M., Smith, C., Shah, N. B., Rothenberger, S. D., Dombrowski, M. E., Malley, O., Klatt, M. J., Hamlin, B. A., & Urish, B. R. 2020. Administration of tranexamic acid improves long-term outcomes in total knee arthroplasty. The Journal of Arthroplasty, 35(6), S201-206.
7. (-Eubanks, 2010)-Eubanks, J. D. 2010. Antifibrinolytics in major orthopaedic surgery. J Am Acad Orthop Surg, 18, 132–138.
8. (Forbes et al., 1991)Forbes, J. M., Anderson, M. D., Anderson, G. F., Bleecker, G. C., Rossi, E. C., & Moss, G. S. 1991. Blood transfusion costs: a multicenter study. Transfusion, 31(4), 318–323. https://doi.org/10.1046/j.1537-2995.1991.31491213295.x
9. (-Gameel et al., n.d.)-Gameel, S., Abdelwahab, M. M., Helmy, K. S., & Ibrahim, A. (n.d.). Tranexamic Acid Efficacy in Total Knee Arthroplasty (A prospective comparative study). The Egyptian Orthopedic Journal, 2021(1), 30–35.
10. (-Guerreiro et al., 2017)-Guerreiro, J. P., Badaro, B. S., Balbino, J. R., Danieli, M. V., Queiroz, A. O., & Cataneo, D. C. 2017. Application of tranexamic acid in total knee arthroplasty-prospective randomized trial. The open orthopaedics journal. 11.
11. (-Kato et al., 2002)-Kato, N., Nakanishi, K., Yoshino, S., & Ogawa, R. 2002. Abnormal echogenic findings detected by transesophageal echocardiography and cardiorespiratory impairment during total knee arthroplasty with tourniquet. Anesthesiology, 97.
12. (-Kukreja et al., 2009)-Kukreja, P., Johnson, B. M., Traylor, C., O'keefe, K. J., Naranje, S., Mckeown, J., Paul, C. A., Bell, B., Johnson, B., Traylor, C. V., & Keefe, O. 2009. Comparison of the Utilization of Tranexamic Acid and Tourniquet Use in Total Knee Arthroplasty: A Retrospective Case Series. Cureus, 14(5).
13. (-Kurtz et al., 2007)-Kurtz, S., Ong, K., Lau, E., Mowat, F., & Halpern, M. 2007. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am, 89(4), 780–785.
14. (-Legnani et al., 2019)-Legnani, C., Oriani, G., Parente, F., & Ventura, A. 2019. Reducing transfusion requirements following total knee arthroplasty: effectiveness of a double infusion of tranexamic acid. Eur Rev Med Pharmacol Sci, 23(5), 2253–2256.
15. (-Levine et al., 2014)-Levine, B. R., Haughom, B., Strong, B., Hellman, M., & Frank, R. M. 2014. Blood management strategies for total knee arthroplasty. J Am Acad Orthop Surg, 22.
16. (Marra et al., 2016) Marra, F., Rosso, F., Bruzzone, M., Bonasia, D. E., Dettoni, F., & Rossi, R. 2016. Use of tranexamic acid in total knee arthroplasty. Joints, 4(4), 202–213. https://doi.org/10.11138/jts/2016.4.4.202
17. (-Patel et al., 2020)-Patel, N. K., Johns, W., Vedi, V., Langstaff, R. J., & Golladay, G. J. 2020. Tourniquet and tranexamic acid use in total knee arthroplasty. Arthroplasty Today, 6, 246–250.
18. (-Pedowitz et al., 1992)-Pedowitz, R. A., FridEn, J., & Thornell, L. E. 1992. Skeletal muscle injury induced by a pneumatic tourniquet: an enzyme- and immunohistochemical study in rabbits. J Surg Res, 52.
19. (Pfitzner et al., 2016)Pfitzner, T., von Roth, P., Voerkelius, N., Mayr, H., Perka, C., & Hube, R. 2016. Influence of the tourniquet on tibial cement mantle thickness in primary total knee arthroplasty. Knee Surgery, Sports Traumatology, Arthroscopy: Official Journal of the ESSKA, 24(1), 96–101. https://doi.org/10.1007/s00167-014-3341-6
20. (-Sadigursky et al., 2016)-Sadigursky, D., Andion, D., Boureau, P., Ferreira, M. C., Carneiro, R. J., & Colavolpe, P. O. 2016. Effect of tranexamic acid on bleeding control in total knee arthroplasty. Acta Ortopédica Brasileira, 24, 131–136.
21. (-Sehat et al., 2000)-Sehat, K. R., Evans, R., & Newman, J. H. 2000. How much blood is really lost in total knee arthroplasty? Correct blood loss management should take hidden loss into account. Knee, 7, 151–155.
22. (-Seol et al., 2016)-Seol, Y. J., Seon, J. K., Lee, S. H., Jin, C., Prakash, J., Park, Y. J., & Song, E. K. 2016. Effect of tranexamic acid on blood loss and blood transfusion reduction after total knee arthroplasty. Knee Surgery & Related Research, 28(3).
23. (-Soni et al., 2014)-Soni, A., Saini, R., & Gulati, A. 2014. Comparison between intravenous and intra-articular regimens of tranexamic acid in reducing blood loss during total knee arthroplasty. J Arthroplasty, 29, 1525–1527.

24. (-Spahn, 2010)-Spahn, D. R. 2010. Anemia and patient blood management in hip and knee surgery: a systematic review of the literature. Anesthesiology, 113.
25. (Tai et al., 2012)Tai, T.-W., Chang, C.-W., Lai, K.-A., Lin, C.-J., & Yang, C.-Y. 2012. Effects of tourniquet use on blood loss and soft-tissue damage in total knee arthroplasty: a randomized controlled trial: A randomized controlled trial. The Journal of Bone and Joint Surgery. American Volume, 94(24), 2209–2215. https://doi.org/10.2106/JBJS.K.00813
26. (-Utomo et al., 2019)-Utomo, D. N., Wardhana, T. H., Amrullah, A. H., & Hamzah, H. 2019. The effect of tranexamic acid injection on hemoglobin level, albumin level, and pain on patient receiving total knee replacement. Journal Orthopaedi and Traumatology Surabaya, 8(1), 1–1.
27. (Yang et al., 2021)Yang, Y., Wang, Z., Wang, F., Zhao, X., Yang, K., He, J., Jin, Y., Yang, H., Ding, D., & Jin, Q. 2021. Prospective, randomised, controlled study on the efficacy and safety of different strategies of tranexamic acid with total blood loss, blood transfusion rate and thrombogenic biomarkers in total knee arthroplasty: study protocol. BMJ Open, 11(2), e038399. https://doi.org/10.1136/bmjopen-2020-038399
28. (-Yang et al., 2012)-Yang, Z. G., Chen, W. P., & Wu, L. D. 2012. Effectiveness and safety of tranexamic acid in reducing blood loss in total knee arthroplasty: a meta-analysis. J Bone Joint Surg Am, 94.