

Efficacy of Topical Tranexamic Acid on Reducing Blood Loss in Primary Total Knee Arthroplasty

Efficacy of Intra-Articular TA Injection in Arthroplasty

Naveed Ali Shair¹, Muhammad Abubakar², Khurram Shehzad¹, Muhammad Shakeel¹, Ejaz Ahmad¹ and Abdullah Tariq³

ABSTRACT

Objective: The aim of this study was to evaluate the efficacy of intra-articular TA injection in patients of primary TKA.

Study Design: Experimental study

Place and Duration of Study: This study was conducted at the Department of Orthopedics Surgery, Lahore General Hospital, Lahore, from October 2018 to March 2020.

Materials and Methods: A total of 92 patients undergoing primary cemented TKA were enrolled. Since June 2019 and onwards, we adopted topical TA (n=52) while controls were all those cases (n=40) undergoing TKA between October 2018 to May 2019. Standard medial parapatellar approach with tourniquet were done among all the patients. Patients of topical TA group were given intraarticular 1.5 gram TA diluted to 50 ml normal saline. Transfusion rate, highest hemoglobin drop (preoperative to postoperative lowest levels), highest hematocrit drop (preoperative to postoperative lowest levels), duration of hospitalization along with drainage output and thromboembolic complications were recorded.

Results: Out of a total of 92 patients, 35 (38.0%) were male and 57 (62.0%) female. No statistically significant difference was noted in terms of characteristic of study participants among both study groups ($P>0.05$). When compared to topical TA group, significantly higher drop between preoperative and postoperative hemoglobin levels and hematocrit levels were recorded among controls ($p<0.05$). Transfusion rate was also high among controls (25.0% vs. 5.8%, $p=0.0087$). Duration of hospitalization was significantly short among topical TA group ($p=0.0181$). No significant difference in terms of post-operative complications was seen among both study groups ($p>0.05$).

Conclusion: Topical TA in reducing postoperative blood loss for primary TKA was found to be effective. We consider this technique to be safe and efficient to our patients undergoing TKA.

Key Words: Efficacy, topical Tranexamic acid, blood loss, total knee arthroplasty.

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INTRODUCTION

Total knee arthroplasty (TKA) is linked with noteworthy perioperative blood loss and high rates of transfusion ranging between 11 to 21%.¹

Allogenic blood transfusion is considered to have risks of associated adverse effects like transfusion reactions,

volume over-load as well as disease transfer. Blood transfusion is also found to raise risk of postoperative infections especially because of effects on immunosuppression. Preoperative autologous transfusion, hypotensive anesthesia, drain clamping, application of fibrin tissue adhesive, compressive bandage or cryotherapy are some of the tactics used to lower blood transfusion rates around the world.^{2,3}

Tranexamic Acid (TA) is known to be an anti-fibrinolytic drug used for the control of bleeding during a variety of surgical situations. Many researchers around the world have noted excellent efficacy as well as safety regarding lessening the blood loss in total joint replacement procedures.^{4,5} Although various routes and dosage regimens exist for TA but usage of topical TA have not yet been fully explored.

Topical TA provides luxury of administration, nominal systemic adverse effects along with little systemic absorption and highest local concentration.^{6,7} Effectiveness of topical TA has been compared with intravenous TA in recent studies and the researchers have found no increase in the risk of thromboembolic

¹. Department of Orthopedics Surgery, Lahore General Hospital, Lahore.

². Department of Orthopedics Surgery, Sir Ganga Ram Hospital, Lahore.

³. Department of Orthopedics Surgery, DHQ Hospital, Nanakana Sahab, Lahore.

Correspondence: Dr. Naveed Ali Shair, Senior Registrar of Orthopedic Surgery, Lahore General hospital, Lahore.

Contact No: dr_malik912@yahoo.com

Email: 0333-6909380

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events. Wind T et al from USA noted that topical TA was excellent in reducing rates of post-surgery blood transfusion and it was noted that none (0/130) of the patients undergoing TKA required blood transfusion.⁸

As efficacy of TA is well established in various medical conditions, still there are no studies conducted evaluating the efficacy of topical TA among patients of primary TKA in Pakistan. The aim of this study was to evaluate the efficacy of intra-articular TA injection in patients of primary TKA.

MATERIALS AND METHODS

This experimental study was done at The Department of Orthopedics Surgery, Lahore General Hospital, Lahore, from October 2018 to March 2020. Approval from Institutional Ethical Committee was seeked for this study. Informed consent was gained from all the study participants.

A total of 92 patients undergoing primary cemented TKA were enrolled. Since June 2019 and onwards, we adopted topical TA (n=52) while controls were all those cases (n=40) undergoing TKA between October 2018 to May 2019. Patients having allergy to TA or those who had severe ischemic cardiopathy or all those who had known coagulopathy were not enrolled. Patients having severe pulmonary or renal impairments, any hematological disorders or those having past history of arterial or venous thromboembolic disorders were also excluded.

Standard medial parapatellar approach with tourniquet were done among all the patients. Intramedullary guidance was employed regarding femoral cutting. Extramedullary or toffset 15mm intramedullary guidance was employed regarding tibial cutting. Sealing of femoral canal was done using autologous bone plug following the usage of intramedullary alignment. Following cementation of all the elements and placement of the implant, hemostasis was done using tourniquet release. Patients of TA group were given intraarticular 1.5 gram TA which was diluted to 50 ml using normal saline following closure of arthrotomy. The injection was administered through incisional would targeting the suprapatellar pouch. Drainage bottle having suction pressure of 200 mmHg was clamped for a period of 2 hours whereas release was done after 2 hours. Drain output were recorded and all the drainages were detached between 24-48 hours. Hemoglobin levels of all the study participants were checked right after the procedure as well as on the 1st and 5th post-operative days. Among patients who were found to hemoglobin levels below 7.0 g/dl, transfusion was done as per institutional guidelines. Same standards of post-operative thromboembolic prophylaxis were done among all study participants. Foot pumps as well as anti-embolic stocking were given to all the study participants until they started mobilization. Physiotherapy along with occupational therapy was

done in all patients. Patients got discharged when ambulated at their own.

A specially designed template was used for recording all the study information. Transfusion rate, highest hemoglobin drop (preoperative to postoperative lowest levels), highest hematocrit drop (preoperative to postoperative lowest levels), duration of hospitalization along with drainage output and thromboembolic complications were recorded. SPSS version 26.0 was used for data analysis. Quantitative variables were compared using independent sample t test while chi square test was applied to compare qualitative variables considering p value<0.05 as significant.

RESULTS

Out of a total of 92 patients, 35 (38.0%) were male and 57 (62.0%) female. Overall, mean age, BMI, preoperative haemoglobin, preoperative hematocrit and operation time were recorded to be 68.98±5.62 years, 28.64±4.68 kg/m², 13.3±1.4 g/dl, 0.406±0.035 and 97±25 minutes respectively. Table number 1 compares characteristics of patients while no statistically significant difference was noted among both study groups (P>0.05).

Table No.1: Characteristics of Study Participants among both Study Groups

Characteristics		Topical Tranexamic Acid Group (n=52)	Controls (n=40)	P-Value
Age in Years (Mean±SD)		69.60±5.37	68.48±5.82	0.3415
Gender	Male	20 (38.5%)	15 (37.5%)	0.9250
	Female	32 (61.5%)	25 (62.5%)	
BMI in kg/m ² (Mean±SD)		28.42±4.51	28.71±4.82	0.7676
Preoperative Hemoglobin in g/dl (Mean±SD)		13.4±1.4	13.2±1.4	0.4987
Preoperative Hematocrit (Mean±SD)		0.408±0.035	0.404±0.037	0.5974
Operation Time in minutes (Mean±SD)		95±26	99±24	0.4515

Table number 2 shows comparison of post-operative outcome variables between both study groups. When compared to topical TA group, significantly higher drop between preoperative and postoperative hemoglobin levels were recorded among controls (p=0.0001). Likewise, significantly higher drop in postoperative hematocrit levels among were recorded when compared to topical TA group (p=0.0002). Transfusion rate was high among controls in comparison to topical TA group (25.0% vs. 5.8%, p=0.0087). Duration of hospitalization was significantly prolonged among controls (p=0.0181). Drainage output was observed to be significantly low in topical TA group when compared to controls (185±101 vs. 262±98, p=0.0004).

No significant difference in terms of post-operative complications was seen among both study groups ($p>0.05$).

Table No.2: Comparison of Post-Operative Outcome Variables between Both Study Groups

Outcome Variables	Topical Tranexamic Acid Group (n=52)	Controls (n=40)	P-Value
Hemoglobin drop in g/dl (Mean+SD)	2.68+0.81	3.57+1.28	0.0001
Hematocrit drop (Mean=SD)	0.0851+0.031	0.119+0.052	0.0002
Transfusion Required	Yes 3 (5.8%)	10 (25.0%)	0.0087
	No 49 (94.2%)	30 (75.0%)	
Duration of Hospitalization (days)	10.12+4.04	12.31+4.67	0.0181
Drainage Output (ml)	185+101	262+98	0.0004

DISCUSSION

Total knee arthroplasty is considered to be associated with a variety of post-surgery complications. Disproportionate blood loss is an important complication of TKA and is linked to prolonged duration of hospitalization along with higher hospitalization cost.¹⁰ TA is known to be a synthetic anti-fibrinolytic that has trans-isomers of 4-aminocarboxylic methyl cyclohexane. TA inhibits the activation of plasminogen to plasmin and possess good affinity to sites where lysine is connecting to plasminogen and plasmin.¹¹ TA slows down fibrinolytic mechanism following formation of the clot and also extends the dissolution duration of fibrin, so protects clot and prevents activation of the coagulation cascades.¹² All these characteristics make TA a very good choice to be used in procedures which have high risk of bleeding.

In the present study, topical TA significantly reduced drop between preoperative and postoperative hemoglobin levels when compared to controls. Likewise, significantly lower drop in postoperative hematocrit levels recorded among topical TA group ($p=0.0002$). Ishida K et al noted intraarticular TA to significantly reduce postoperative hemoglobin drop among patients undergoing TKA.¹³ They also found significantly lower amount of drain following TKA surgery after using intraarticular TA. Intraarticular TA resulted in significant reduction in blood loss following TKA. Our results are quite similar to what Pui KP et al from South China where they found intraarticular TA injection to significantly reduce drain output when compared to controls postoperatively.¹⁴ Drain output levels among topical TA group were actually more less to what we actually noted because TA was diluted in 50

ml normal saline which had also escaped through drainage.

In this study, transfusion rate was high among controls in comparison to topical TA group (25.0% vs. 5.8%, $p=0.0087$). Duration of hospitalization was significantly prolonged among controls ($p=0.0181$). Findings of a Chinese study also depicted similar results where transfusion rate among patients using intraarticular TA injection was significantly decreased when compared to controls (3.2% vs. 23.9%, $P<0.05$).¹⁴ Various other researches have also reported similar findings.^{15,16} In the present work, TA was used in a dose of 1.5g. Cid J et al found no significantly difference in the rates of blood transfusion among patients using high dose (135 to 150mg/kg) of low dose (15 to 35 mg/kg) of TA.¹⁷ We noted no significant difference in terms of post-operative complications was seen among both study groups ($p>0.05$). Our findings in terms of post-operative complications following intraarticular TA injection are also supported by other researchers as well.¹⁸ Pui KP et al observed 2 patients of pulmonary embolism following intraarticular injection of TA among patients undergoing TKA.¹⁴ Our results portrayed topical TA to be associated with lower rates of systemic absorption so it can be considered a very safe alternative choice when compared to intravenous TA.

Our study had few limitations as well. We could not compare comorbidity data among patients of both study groups so real impact of confounding variables could not be noted although characteristics compared between cases and controls were statistically similar. We did not exclude anemic patients in the current study so we are unable to find the true effect of preoperative anemia and its association with blood loss. We only recorded short term outcomes among our patients so we are not sure about long term effects and side effects of topical TA.

CONCLUSION

Topical TA in reducing postoperative blood loss for primary TKA was found to be effective. We consider this technique to be safe and efficient to our patients undergoing TKA.

Author's Contribution:

Concept & Design of Study: Naveed Ali Shair
 Drafting: Muhammad Abubakar, Khurram Shehzad
 Data Analysis: Muhammad Shakeel, Ejaz Ahmad, Abdullah Tariq
 Revisiting Critically: Naveed Ali Shair, Muhammad Abubakar
 Final Approval of version: Naveed Ali Shair

Conflict of Interest: The study has no conflict of interest to declare by any author.

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