International Journal of Research in Orthopaedics
Lochab VK et al. Int J Res Orthop. 2019 Nov;5(6):1156-1159
http://www.ijoro.org

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20194822

A prospective study to assess the efficacy of tranexamic acid in reducing blood loss during total hip arthroplasty

Vikas Kumar Lochab[1], Saumya Agarwal[1]*, Shivank Prakash[2], Somnath T. Sanikop[3]

Department of Orthopaedics, [1]Central Institute of Orthopaedics, [2]Sports Injury Centre, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India
[3]Department of Orthopaedics, KLES Dr. Prabhakar Kore Hospital, Belagavi, Karnataka, India

Received: 21 July 2019
Accepted: 09 September 2019

***Correspondence:**
Dr. Saumya Agarwal,
E-mail: saumyathecalyx.agarwal@gmail.com

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ABSTRACT

Background: Tranexamic acid has been reported to reduce bleeding, risk of thromboembolic events and the need for allogenic blood transfusion in total hip replacement patients. The present study was conducted to assess the efficacy of tranexamic acid in reducing blood loss during total hip replacement surgery.
Methods: Total hip arthroplasty patients (n=60) were divided into control and test groups with 30 patients each. Test group was administered with tranexamic acid (15 mg/kg) for 15 min before and after the surgery. Patients were administered cefuroxime (1.5 g), 30 min prior to the surgery and deep vein thrombosis prophylaxis; enoxaparin (40 mg), 48 hours after surgery. Demographic details along with levels of hemoglobin and blood loss before, during and after the surgery were recorded.
Results: Tranexamic acid reduced the early post-surgical blood loss (292±132.38 vs. 155.8±86.56 ml; $p<0.0001$), total blood loss (989.6±340.98 vs. 580.4±131.88 ml; $p<0.0001$), and the blood loss during surgery (723.5±277.73 vs. 434.3±131.83 ml; $p<0.05$). Test group required fewer transfusions (6.7%) than control group (26%) and had no increased incidence of deep-vein thrombosis. Postsurgical hemoglobin in the control group had significantly reduced as compared to test group.
Conclusions: Administration of intravenous tranexamic acid before and after the surgery was effective in reducing the blood loss and transfusion requirements and its related complications.

Keywords: Tranexamic acid, Blood transfusion, Arthroplasty, Hip replacement

INTRODUCTION

Total hip replacement (THR) procedure is one of the most common orthopedic procedures performed worldwide due to the predominance of hip arthritis population. According to Frost and Sullivan survey, approximately 70,000 joint replacement procedures were performed in India in 2011 and the requirement of arthroplasty was expected to elevate at a compound growth rate of 26.7% (calculated annually) till 2017.[1] Blood transfusion is one of the major requirements in THR procedure due to the extensive amount of blood loss during the procedure.[2] However, the transfusion of blood carries a risk of acquiring infection along with the chances of antibody-antigen reactions making it an expensive and unsafe solution for maintaining the hemostasis.[3] Therefore, research to control the blood loss is being extensively conducted to decrease the requirement of blood transfusion.

Pharmacological means of controlling blood loss has become popular with the introduction of antifibrinolytic agents such as tranexamic acid. These agents reduce the blood loss and requirement of blood transfusion, apart from promoting the maintenance of homeostasis.[4] Several

studies have reported the efficacy of tranexamic acid in controlling blood loss during THR procedure. However, reports on complications due to the administration of tranexamic acid have not been reported till date. Studies taking into account the weight and BMI of the patients (to monitor the anemic condition) and the parameters such as blood loss before, during and after the surgery in the Indian population are lacking. Therefore, the originality of the present study lies in the variables and parameters selected for evaluating the efficacy of tranexamic acid in reducing blood loss during total hip replacement surgery.

METHODS

A prospective study was conducted at KLES Dr. Prabhakar Kore Hospital and Research centre for duration of 2 years from May 2016 to April 2018. Patients (n=60) undergoing unilateral, primary total hip arthroplasty, operated by a single senior orthopaedic surgeon and diagnosed with avascular necrosis of the femoral head, primary osteoarthritis, or neck or femur fracture were included in the study. The selected patients were divided into two groups, control (n=30) and test (n=30), with 9 females and 21 males in each group. Written informed consent was obtained from the selected patients prior to the participation in the study. The study was approved by the institutional ethical committee. Patients were excluded from the study if they had a history of stents, allergy to tranexamic acid, or known hepato/renal dysfunction, deep vein thrombosis (DVT), cerebrovascular accident or stroke, myocardial infarction, pulmonary embolus, late onset color blindness, hypercoagulable state, bleeding disorders or abnormal Pro-time International normalized ratio.

Demographic data of the patients was recorded before the surgery. Biochemical parameters including the levels of blood sugar, blood urea, serum creatinine was evaluated. Hemogram, liver function test, blood group, and Rh typing were performed. Bleeding and clotting time were noted for all the patients. Physical examination of the patients involved chest X-ray (postero-anterior view), doppler ultrasound, electrocardiography, and 2D echo in the patients during the anesthetic evaluation. Operative procedure of total hip arthroplasty was performed in lateral position by modified hardinge approach.[5] For pain relief, spinal anesthesia with epidural anesthesia was provided after the surgery for 48 hours (with 12 hour interval).

Patients included in the test group received slow transfusion of tranexamic acid (15 mg/kg in normal saline; cyklokapron, pharmacia, Sweden) for 15 min at two stages. The first dose was given at the time of induction (15 mg/kg) and the second dose (15 mg/kg) was given at the time of closure. In addition, all the patients were routinely administered with cefuroxime injection (1.5 g) before 30 min of the surgery. For the management of trauma due to blood loss, patients of test and control groups were administered with DVT prophylaxis (enoxaparin 40 mg) subcutaneously from day 2 after the surgery. Blood loss during the surgery was collected with the help of suction in the suction apparatus. The amount of blood loss was calculated by measuring the volume of blood in the suction apparatus. Volume of blood absorbed in the swab and mop was calculated by excluding their dry weight from the total volume. Suction drain (RomoVac no. 14) was used to collect blood after the surgery, which was removed after 24 hours. No reactive bleeding was observed in any of the cases. Volume of saline used for lavage was excluded from the calculation. Blood transfusion was carried out for patients with clinical symptoms such as anemia or with hemoglobin levels lesser than 10 g/dl, after the surgery. Assessment of hemoglobin was performed before and after the surgery. Post op physiotherapy in the form of ankle, static, and dynamic quadriceps exercises was initiated from day 1.

Statistical analysis

Independent t-test and chi-square test were performed using of SPSS 21 to analyze the data. P≤0.05 was considered statistically significant.

RESULTS

Demographic data representing the mean age, weight, height, and body mass index (BMI) of the patients are shown in Table 1. Statistically significant (p=0.025) difference was found between the BMI of the control and test group.

Table 1: Comparison of the variables (n=30).

Variable	Group	Mean±SD	P value
Age (years)	Control	45.7±6.3	0.091
	Test	48.5±6.3	
Weight (kg)	Control	71±8.46	0.919
	Test	70.8±6.71	
Height (cm)	Control	165.3±8.45	0.963
	Test	165.2±8.19	
BMI (kg/m^2)	Control	26.9±1.74	0.025*
	Test	25.8 ± 1.96	

*p<0.05.

Mean pre-surgical hemoglobin levels between the test (12.5±1.61 g/dl) and control (12.3±1.43 g/dl) groups were comparable (p=0.613). However, evaluation of hemoglobin level after the surgery revealed significantly (p=0.017) higher levels in the test group (11.1±1.35 g/dl) when compared to the control group (10.2±1.47 g /dl). Mean blood loss during the surgery in the control group (723.5±277.73 ml) was significantly higher (p<0.05) than the test group (434.3±131.83 ml).Mean postsurgical blood loss was also observed to be significantly higher in the control group than in the test group (292±132.38 vs. 155.8±86.56 ml; p<0.0001). As a result, the total blood loss was significantly higher in the control group as

compared to the test group (989.6±340.98 vs. 580.4±131.88 ml; p<0.0001). In addition, the mean drain output measured after 24 hours of surgery was also recorded to be significantly higher in the control group when compared to the test group (269.2±128.4 vs. 149.2±81.27; p<0.001). Out of 60 patients, 10 patients (control group=8, test group=2) required blood transfusion. The requirement of transfusion was comparatively higher in the control group than in the test group. The association between the groups for the requirement of blood transfusion was not significant (Table 2).

Table 2: Postsurgical blood transfusions in the control and study groups (n=30).

Blood transfusion	Group		Total	P value
	Control, N (%)	Test, N (%)		
No transfusion	22 (93.3)	28 (73.3)	50	
1 unit	5 (16.7)	2 (6.7)	7	0.863
2 unit	3 (10)	0 (0)	3	

DISCUSSION

Tranexamic acid has been reported to be effective in reducing the blood loss in orthopedic procedures, thereby reducing the need for the transfusion of blood.[6] The therapeutic concentration of tranexamic acid should reach a level of 5-10 mg/l in the plasma for being therapeutically active in reducing the blood loss.[7] Intravenous administration of 15 mg/kg of tranexamic acid, as administered in the present study, has been reported to result in the requisite plasma concentration leading to substantial reduction in bleeding during the operation, as proven by several studies.[7,8]

The present prospective study was designed to confirm the beneficial effects of tranexamic acid administered during and after the hip replacement surgery. The assessment was done by comparing two groups of unilateral THR patients. The tranexamic acid treatment protocol used in the present study is based on the knowledge of pharmacokinetics and postarthroplasty fibrinolysis properties of tranexamic acid. The peak plasma tranexamic acid levels are attained immediately upon intravenous administration. Tranexamic acid has the elimination half-life of 3 hours and its effect is reported to be dose-dependent in nature with lower doses (15 mg/kg) being more effective in hip arthroplasty and higher doses (≥30 mg/kg) in knee arthroplasty.[9]

A record of demographic data of the patients is essential before the initiation of THR procedure, as patients with more weight and BMI tend to develop postoperative complications. Obese individuals also tend to undergo longer duration of surgery and have higher requirements of intraoperative blood transfusion. In the current study, all the patients were below 30 kg/m^2 and hence were hypothesized to incur lesser complications after the surgery.[10]

The morbidity and mortality associated with anemia must be weighed against the risks associated with blood transfusions for surgical procedures with a high risk of bleeding. Majority (90%) of the patients in the previous studies have been diagnosed with postoperative anemia after arthroplasty leading to insufficient oxygen supply and an increase in the risk of myocardial infarction, the leading cause of death following major orthopedic procedures.[11,12] Hemoglobin levels was significantly (p=0.017) reduced in the control group as compared to the test group in the present study. The reduction of hemoglobin levels due to excessive bleeding can also lead to myocardial infarction.[7]

Use of liberal blood transfusion strategies decrease mortality rate;[13] however, can be associated with potentially life-threatening risks such as incompatibility and pulmonary edema[14] On the other hand, tranexamic acid therapy has been reported to be one among the intensely studied blood-sparing strategies with reports of being relatively inexpensive and highly effective in reducing bleeding, during and after surgery.[8]

The blood loss during and after the surgery and the total blood loss were observed to be significantly reduced by 39% (p<0.05), 47% (p<0.0001), and 41% (p<0.0001), respectively in the test group of the present study. The findings were consistent with the reports of similar studies and supports the hypothesis that tranexamic acid induces the inhibition of early fibrinolysis before the body's usual response.[15-17] The evaluation of postoperative hematoma was not significant when assessed between patients treated with tranexamic acid and placebo in a similar study and, hence was not performed in the present study.[18,19]

Reducing the need for allogeneic blood transfusions minimizes the risks of infection and fluid overload, which occurs due to an immunomodulating effect.[20] The present study also indicated 75% reduction in the requirement of blood transfusion with the administration of tranexamic acid. The use of tranexamic acid during the surgery often gives rise to concerns, as it increases the risk of DVT, after the surgery. However, no evidence of DVT was found in the control and test groups in the present study and in similar studies.[15]

CONCLUSION

Administration of tranexamic acid is a cost-effective way of reducing blood loss during and after the surgery in

THR, as evidenced in the present study. The treatment appeared to be safe as there was no increase in thrombotic complications such as DVT or pulmonary embolism. Further studies can include large-scale randomized trials for ascertaining the most effective dose of tranexamic acid required to be administered in THR.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Pachore JA, Vaidya SV, Thakkar CJ, Bhalodia HKP, Wakankar HM. ISHKS joint registry: A preliminary report. Indian J Orthop. 2013;47(5):505-9.
2. Carling MS, Jeppsson A, Eriksson BI, Brisby H. Transfusions and blood loss in total hip and knee arthroplasty: a prospective observational study. J Orthop Surg Res. 2015;10(1):48.
3. Dakir A, Ramalingam B, Ebenezer V, Dhanavelu P. Efficacy of tranexamic acid in reducing blood loss during maxillofacial trauma surgery–a pilot study. J Clin Diagn Res. 2014;8(5):ZC06-8.
4. Kazemi SM, Mosaffa F, Eajazi A, Kaffashi M, Daftari Besheli L, Bigdeli MR, et al.The effect of tranexamic acid on reducing blood loss in cementless total hip arthroplasty under epidural anesthesia. Orthopedics. 2010;33(1):17.
5. Schneider M, Kawahara I, Breusch SJ. Modified Hardinge approach with limited incision. Orthopaedics. 2006;35(7):751-60.
6. Poeran J, Rasul R, Suzuki S, Danninger T, Mazumdar M, Opperer M, et al. Tranexamic acid use and postoperative outcomes in patients undergoing total hip or knee arthroplasty in the United States: retrospective analysis of effectiveness and safety. BMJ. 2014;349:g4829.
7. Danninger T, Memtsoudis SG. Tranexamic acid and orthopedic surgery—the search for the holy grail of blood conservation. Ann Transl Med. 2015;3(6):77.
8. Irisson E, Hemon Y, Pauly V, Parratte S, Argenson JN, Kerbaul F. Tranexamic acid reduces blood loss and financial cost in primary total hip and knee replacement surgery. Orthop Traumatol Surg Res. 2012;98(5):477-83.
9. Zufferey P, Merquiol F, Laporte S, Decousus H, Mismetti P, Auboyer C, et al. Do antifibrinolytics reduce allogeneic blood transfusion in orthopedic surgery? Anesthesiology. 2006;105(5):1034-46.
10. Dehn T. Joint replacement in the overweight patient. Ann R Coll Surg Engl. 2007;89(3):203.
11. Al-Attar N. Postoperative mocardial infarction. E-Journal of Cardiology Practice. 2011;10(4).
12. Liumbruno GM, Bennardello F, Lattanzio A, Piccoli P, Rossetti G. Recommendations for the transfusion management of patients in the peri-operative period. III. The post-operative period. Blood Transfus. 2011;9(3):320-35.
13. Docherty AB, O'Donnell R, Brunskill S, Trivella M, Doree C, Holst L, et al. Effect of restrictive versus liberal transfusion strategies on outcomes in patients with cardiovascular disease in a non-cardiac surgery setting: systematic review and meta-analysis. BMJ. 2016;352:i1351.
14. Duquenne P, Hoest L, Henkes W, De Sart F. Tranexamic acid reduces postoperative blood losses associated with elective total hip replacement. J Bone Joint Surg Br. 1999;81(B, Suppl II)):233-4.
15. Taufiq RP, Aggarwal RA, Nayani ZS, Pawar KA. Effect of single dose tranexamic acid on blood loss in total hip arthroplasty in Indian population. Int J Sci Res. 2015;4(8):727-9.
16. Rajesparan K, Biant LC, Ahmad M, Field RE. The effect of an intravenous bolus of tranexamic acid on blood loss in total hip replacement. J Bone Joint Surg Br. 2009;91(6):776-83.
17. Claeys MA, Vermeersch N, Haentjens P. Reduction of blood loss with tranexamic acid in primary total hip replacement surgery. Acta Chir Belg. 2007;107(4):397-401.
18. Benoni G, Lethagen S, Nilsson P, Fredin H. Tranexamic acid, given at the end of the operation, does not reduce postoperative blood loss in hip arthroplasty. Acta Orthop Scand. 2000;71(3):250-4.
19. 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):434-40.
20. Niskanen RO, Korkala OL. Tranexamic acid reduces blood loss in cemented hip arthroplasty: a randomized, double-blind study of 39 patients with osteoarthritis. Acta Orthop. 2005;76(6):829-32.

Cite this article as: Lochab VK, Agarwal S, Prakash S, Sanikop ST. A prospective study to assess the efficacy of tranexamic acid in reducing blood loss during total hip arthroplasty. Int J Res Orthop 2019;5:1156-9.