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Efficacy of tranexamic acid in reducing perioperative blood loss in lower limb orthopaedic surgeries: A prospective randomised single blinded study

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Abstract

Introduction: Tranexamic acid (TXA) is a lysine analog that exhibits an anti-fibrinolytic effect by directly preventing the activation of plasminogen as well as inhibiting activated plasmin from degrading fibrin clots.

Objectives: The objective of the study is to know the effect of Tranexamic acid in reducing intraoperative and postoperative blood loss in patients undergoing lower limb orthopaedic surgeries and to study the effect of drug on perioperative hemodynamic.

Materials and Methods: A prospective randomised control study was done in Basaveshwara Medical College and Hospital, Chitradurga to know the effect of Tranexamic acid in reducing intraoperative and postoperative blood loss in patients undergoing lower limb orthopaedic surgeries.

Results: Who received tranexamic acid had roughly 170ml lesser intra-operative blood loss than the control subjects and this difference was statistically significant ($p<0.05$).

Conclusion: Perioperative blood loss and the need for transfusion in major orthopedic surgeries can be effectively reduced by using Tranexamic acid.

Keywords: Anti-fibrinolytic agents, blood loss, perioperative, tranexamic acid

Introduction

One of the goals in the perioperative period is minimizing perioperative blood loss. Marked blood loss is always a complication of major orthopaedic surgeries. There are so many causes of bleeding. One of them is increased fibrinolytic activity. Tranexamic acid (TXA) is a lysine analog that exhibits an anti-fibrinolytic effect by directly preventing the activation of plasminogen as well as inhibiting activated plasmin from degrading fibrin clots [1]. These properties of TXA promote hemostasis and thereby can reduce the duration and quantity of blood loss [1, 2]. As such, TXA has been listed on the World Health Organization's (WHO) List of Essential Medicines and has been utilized in various fields of medicine including Obstetrics, General Surgery and Orthopaedic Surgery [3-7]. Given the nature of surgical procedures, with the need to maximize haemostasis for patient stability as well as for adequate visualization of the surgical field, the use of adjunctive TXA perioperatively has become more widely implemented in recent years. The CRASH-2 trial was the first large scale randomized controlled trial (RCT) that evaluated the use of TXA in over 20,000 trauma patients [8]. A similar study explored the use of intravenous TXA in military personnel with

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combat injuries (MATTERs study) and noted that those receiving TXA had lower mortality particularly in patients that necessitated large quantities of blood transfusions [9]. The promising results from these studies have prompted greater utilization of the drug and stimulated further investigations to better elucidate the role of TXA in surgical practice.

Methodology

A prospective randomised control study was done in Basaveshwara Medical College and Hospital, Chitradurga to know the effect of Tranexamic acid in reducing intraoperative and postoperative blood loss in patients undergoing lower limb orthopaedic surgeries. The objective of the study is to know the effect of Tranexamic acid in reducing intraoperative and postoperative blood loss in patients undergoing lower limb orthopaedic surgeries and to study the effect of drug on perioperative hemodynamic.

A total of sixty patients belonging to ASA physical status 1 and 2 were randomly divided into two groups. Patients in Group A received Tranexamic acid 10mg/kg loading dose followed by continuous infusion of 1mg/kg/hr. Patients in Group B received normal saline as placebo. Intraoperative and postoperative blood loss, hemodynamics are monitored and documented. Postoperative monitoring was done upto 24hrs.

Inclusion criteria

i) Age: 18 years to 70 yrs
ii) ASA: I,II
iii) Surgery: Elective

Exclusion criteria

i) Known allergy to tranexamic acid.
ii) History/evidence of coagulopathy and bleeding disorder.
iii) Renal dysfunction.

All the data was initially entered to Microsoft Excel 2010 and later these spreadsheets were used for analysis. Statistical analysis was done using SPSS version 20.0. Descriptive statistics were calculated as frequency, percentage, mean and standard deviation. Descriptive data were represented using various tables, graphs, diagrams etc. For all the statistical tests of significance, p value of <0.05 was considered to reject the null hypothesis.

Results

Table 1: Age Distribution of the Study Population (N=60)

Age group	Tranexamic acid group N (%)	Control group N (%)	Total N (%)
21 - 30 years	9 (30)	8 (26.7)	17 (28.3)
31 - 40 years	9 (30)	9 (30)	18 (30)
41 - 50 years	4 (13.3)	6 (20)	10 (16.7)
51 - 60 years	4 (13.3)	1 (3.3)	5 (8.3)
61 to 70 years	4 (13.3)	6 (20)	10 (16.7)
Total	30 (100)	30 (100)	60 (100)
Mean age (Mean ± S.D)	41.87 ± 14.38	41.93 ± 15.61	

Table 2: Gender distribution of the study population (N=60)

Gender	Tranexamic acid group N (%)	Control group N (%)	Total N (%)
Male	25 (83.3)	27 (90)	52 (86.7)
Female	5 (16.7)	3 (10)	8 (13.3)
Total	30 (100)	30 (100)	60 (100)

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Table 3: Distribution of the Study Subjects According to American Society of Anesthesiologist (ASA) Grading (N=60)

ASA grading	Tranexamic acid group N (%)	Control Group N (%)	Total N (%)
Grade I	19 (63.3)	15 (50)	34 (56.7)
Grade II	11 (36.7)	15 (50)	26 (43.3)
Total	30 (100)	30 (100)	60 (100)

Table 4: Comparison of Pre-Operative Hemoglobin Levels Among Subjects in Tranexamic Acid Group and the Control Group (N=60)

Group	Mean Hb	Std. Deviation	p value	95% confidence interval
Tranexamic acid	11.92	0.97	0.743	-0.543 to 0.390
Control group	12.00	0.82		

The mean pre-operative haemoglobin level in tranexamic acid group is 11.92 and in control group is 12.00.

Table 5: Distribution of the Study Subjects According to Indication for Surgery (N=60)

Diagnosis	Tranexamic acid group N (%)	Control group N (%)	Total N (%)
Supracondylar fracture femur	17 (56.7)	16 (53.3)	33 (55)
Inter-trochanteric fracture femur	5 (16.7)	1 (3.3)	6 (10)
Sub-trochanteric fracture femur	6 (20)	12 (40)	18 (30)
Neck of femur fracture	2 (6.7)	1 (3.3)	3 (5)
Total	30 (100)	30 (100)	60 (100)

Table 6: Distribution of the Study Subjects According to Surgical Procedure Done (N=60)

Surgical procedure	Tranexamic acid group N (%)	Control group N (%)	Total N (%)
Dynamic compression screw	20 (66.7)	17 (56.7)	37 (61.7)
Dynamic Hip screw	9 (30)	12 (40)	21 (35)
Total Hip replacement	1 (3.3)	1 (3.3)	2 (3.3)
Total	30 (100)	30 (100)	60 (100)

Table 7: Comparison of Intra-Operative Blood Loss among Subjects in Tranexamic Acid Group and the Control Group (N=60)

Group	Mean blood loss (ml)	Std. Deviation	Mean difference	p value	95% confidence interval
Tranexamic acid	513	83.7	172.0 ml	<0.001	-225.8ml to 118.1ml
Control group	685	121.1			

Intra-operative blood loss was calculated based on number of pads (1 pad = 50 ml blood loss) and gauze soaked (1 gauze = 5 ml blood loss) and the volume of the suction drain. Subjects who received tranexamic acid had roughly 170ml lesser intra-operative blood loss than the control subjects and this difference was statistically significant ($p<0.05$).

Discussion

One of the most common complications during major orthopaedic surgery is perioperative blood loss. Significant blood loss causes changes in hemodynamics of the patient perioperatively. In these situations to maintain hemodynamics of the patient stable, blood transfusions become inevitable. But blood transfusion itself cause certain disadvantages like risk of transmission of infections, increased chance of allergic reactions and circulatory overload due to transfusion.

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Because of these disadvantages we have to avoid unnecessary blood transfusion. For that we have to reduce blood loss during surgical procedures. Increased fibrinolytic activity is one of the reason for blood loss perioperatively. So the use of an antifibrinolytic drug may cause reduction in perioperative blood loss. One of the most widely used antifibrinolytic is Tranexamic acid. Other antifibrinolytic agents are Epsilon Aminocaproic Acid and Aprotinin. So many studies are conducted to know the efficacy of tranexamic acid in reducing the blood loss.

Elwatidy *et al*. [10] studied about the efficacy and safety of prophylactic large doses of tranexamic acid in spine surgery. This study showed that prophylactic use of large doses of tranexamic acid provides an effective safe and cheap method for reducing blood loss during and after spine operation. It helps in reducing transfusion related complications.

A similar study was conducted by Sadehi *et al*. [11, 12] to see the effect of tranexamic acid on hip fracture surgery. They concluded that tranexamic acid group has significantly lower perioperative blood loss. Benoni G *et al*. [13] studied whether fibrinolytic inhibition with tranexamic acid reduces blood loss and blood transfusion after knee arthroplasty. They did a double blinded study. Their study showed that the blood loss in tranexamic acid group is less compared with the placebo group. Yamasaki *et al*. [14] did a study about whether tranexamic acid reduces postoperative blood loss in cementless total hip arthroplasty. Their study showed that the greatest reduction in blood loss was observed during the first four hours of surgery in the tranexamic acid group. So they concluded that in patients undergoing total hip arthroplasty without cement, preoperative administration of tranexamic acid is associated with decreased postoperative blood loss during the first 24 hours, especially during the first four hours after surgery. Lozano *et al*. [15] studied the effectiveness and safety of tranexamic acid administration during total knee arthroplasty. They concluded that routine administration of tranexamic acid during TKA is associated with 67% reduction in RBC transfusions and in those transfused, with a reduction in the number of units administered. Tranexamic acid treatment was not associated with an increase in thromboembolic complications.

Intraoperative blood loss

In Tranexamic acid group, mean blood loss was 513ml, and that for contol group was 685ml. Mean difference was 172ml. p value was <0.001. Subjects who received tranexamic acid had roughly 170ml lesser intraoperative blood loss than the control subjects and this difference was statistically significant ($p<0.05$).

Postoperative blood loss

In Tranexamic acid group, mean blood loss according to suction drain was 65.5ml, 60.83ml, 60.33ml in the postoperative 0^{th} hr, 12^{th} hr, 24^{th} hr respectively and that for control group it is 98.0ml, 108.83ml, 102.83ml respectively. Subjects who received tranexamic acid had roughly 120ml lesser postoperative blood loss according to volume of suction drain than the control subjects and this difference was statistically significant.

In tranexamic acid group, the need for blood transfusion was 6.7% and 10% in the intraoperative period and postoperative period respectively and in the control group it is 17% and 50% respectively. It was statistically significant. Hence it can be stated that tranexamic acid can reduce the need for blood transfusion in upto 50% of subjects.

Conclusion

From the above study it is concluded that the perioperative blood loss and the need for transfusion in major orthopedic surgeries can be effectively reduced by using Tranexamic acid.

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