Does Tranexamic Acid Reduce Perioperative Bleeding in Short Segment Pedicle Screw Fixation in Thoracolumbar Spine Fractures?

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ABSTRACT

Introduction: Blood loss with spinal surgery is common potential cause of morbidity and often requires blood transfusion. Tranexamic acid (TXA), is effective in reducing bleeding in patients undergoing knee arthroplasty. TXA used in spine surgery studies have included different cases leading to inconsistence of surgical procedures. Purpose of this prospective observational study was to examine effect of TXA decreasing bleeding in short segment pedicle screw fixation for thoracolumbar fractures.

Methods: 38 patients' undergoing short segment pedicle screw for thoracolumbar fractures were enrolled in study from July to August 2013. There were 28 male and 10 female patients, with an average age of 36.5 years. Patients received 10 mg/kg of TXA or a control 30 minutes intravenously before skin incision and 3 hours post-operative and oral medication for three days. Intraoperative bleeding was estimated by weighing surgical sponges, blood collected by suction container and by subtracting all irrigation fluid. Postoperative bleeding was measured from volume in vacuum drainage bag.

Results: Twenty (20) patients were in control group and eighteen(18) to TXA group. There were no statistical differences between groups in terms of age, gender, co-morbidities, and operating time, preoperative Hemoglobin, PT and INR. Intra-operative bleeding in TXA group was significant than in control group. Post-operative drainage and Hemoglobin in first 48 h was reduced compared with placebo in TXA group. Need for post-operative transfusion was nil in TXA group.

Conclusions: Administration of TXA before surgery significantly reduces perioperative bleeding in patients undergoing short segment pedicle screw fixation for thoracolumbar spine fractures.

Keywords: *bleeding; spinal surgery; tranexamic acid.*

INTRODUCTION

Spine surgeries that requires blood transfusion carries a substantial risk of immunologic reaction and transmission of disease.[1-4] Methods to reduce postoperative blood loss and avoid homologous blood transfusions include autologous blood, postoperative blood salvage, and administration of tranexamic acid.[5,6] Antifibrinolytic agents, such as tranexamic acid (TXA), forms a reversible complex that displaces plasminogen

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from fibrin, resulting in inhibition of fibrinolysis and also inhibits the proteolytic activity of plasmin.[7] Perioperative blood loss is influenced by the diagnosis, age, type of surgery and is desirable to use a uniform cohort to evaluate the effect of tranexamic acid.[8-11] Some studies have shown that TXA does not reduce blood loss perioperatively when used in low dose while performing pedicle subtraction osteotomy in spinal surgery[12] or in spine cancer surgery[13] and may be associated with seizures in higher doses[14]. However, some studies show that TXA is effective in reducing perioperative blood loss and the need for blood transfusion in patients undergoing spinal fixation and laminectomies.[15,16] Studies have stated that low dose of TXA has no effect on blood loss and need of blood transfusion.[17]

The purpose of this study was to evaluate the efficacy of low dose tranexamic acid in reducing blood loss in identical surgical procedures with single level pedicle screw fixation for thoracolumbar spinal fractures.

METHODS

This was a prospective observational study conducted at Kathmandu Medical Teaching Hospital from July 2011 to August 2013 in the Department of Orthopaedic surgery. The patient population included those with thoracolumbar burst fractures who underwent a single level pedicle screw fixation with inter-connector and fusion with the local graft from the spinous process. There were 38 patients with the male to female ration of 28:10 and average of 36.5 years (range 18-63). All patients received a loading dose of 10mg/kg of TXA or a placebo thirty minutes prior to skin incision and three hours post operatively and oral medication for three days. Patients with thoracolumbar burst fractures who underwent two level fixations, who had a pedicle screw inserted at the fracture level or who did not have an inter-connector placed and patients who underwent fusion using the iliac crest bone graft were excluded from the study.

Per operative blood loss was measured by an anesthetist and a nurse who measured the blood sponges and in the suction drain. The amount of saline irrigation was deducted from the total fluid drained. Post operatively blood loss was directly measured in the suction drain that was removed after 48/72 hours. Post operative hemoglobin was measured on the first day after surgery. The duration of surgery and any thromoembolic phenomena were also noted. None of the patients received any medication against venous thromboprophylaxis.

Statistical analysis was done with SPSS version 16 and independent t-test and a value of $p < 0.05$ was considered significant.

SURGICAL TECHNIQUE

All patients underwent an open surgical procedure with single level pedicle screw (one level up and below the fracture level) with an inter-connector in the middle performed by the two authors. The incision was given after proper identification of the fracture level by using fluoroscopy and was kept as minimum as possible. After proper dissection and exposure of the pedicle entry point, proper sized screws were placed under the guidance of C-arm. The rods were placed and the spinous process detached and inserted locally as bone graft after proper decortications of the graft bed and an interconnector placed. Meticulous maintenance of hemostasis was done and wound closed in layers over a suction drain. All patients underwent similar post-operative care and rehabilitation. They were all allowed to sit up on the second day with brace and mobilize as tolerated on 3/4th day. Isometric spinal exercises started after 3 weeks and brace continued till six weeks. Patients were allowed normal activity after 4 months when fusion was noted in the x-ray and if patient had no pain during through physical examination.

RESULTS

There were 38 patients enrolled in the study with 20 in the control group and 18 in the TXA group. Sixteen(16) patients had burst fracture at D12 level, 17 at L1 and 5 at L2 level. There were no statistical differences between the groups in terms of age, gender, co-morbidities, and the operating time and pre-op Hemoglobin (Hb), PT and INR as shown in Table 1.

Table 1. Preoperative comparisons of variable between two groups.

Variables	Control group	TXA group	Significance
Age	32.19 ± 10.71	39.47 ± 13.52	0.07
Operation time	139.29 ± 18.53	130.88 ± 15.83	0.15
Pre op Hb	13.50 ± 1.09	13.34 ± 1.29	0.67
PT	14.19 ± 1.40	14.88 ± 1.69	0.18
INR	1.16 ± 0.12	1.14 ± 0.12	0.66

The intraoperative bleeding in the TXA group (205.88 ± 79.53 ml) was statistically significant than in the control group (322.62 ± 71.55 ml). Post operative drainage during the first 48 h was reduced statistically compared with the placebo (214.29 ± 47.15 vs. 128.24 ± 61.64

ml; p <0.001) in the TXA group. The post operative Hb in the control group was significantly less than in the TXA group (10.18 ± 1.76 vs. 11.67 ± 1.44). The need for post operative transfusion was nil in TXA group while one patient in control group required one unit of blood transfusion. None of the patients experienced seizures, cardiac or neurological episodes, deep venous thrombosis (DVT), or pulmonary embolus during their postoperative period. One patient developed superficial wound infection that was controlled with local dressing and oral antibiotics.

Table 2. Per and postoperative comparisons of variables between two groups.

Variables	Control group	TXA group	Signif-icance
Peroperative blood loss	322.62 ± 71.55	205.88 ± 79.53	<.001
Postoperative Hemoglobin	10.18 ± 1.76	11.67 ± 1.44	<.01
Postoperative drain	214.29 ± 47.15	128.24 ± 61.64	<.001

DISCUSSION

This was a prospective study that was conducted to investigate the efficacy of TXA in reducing blood loss in uniform cohort of patients. TXA has been used in spine surgery and has been shown to reduce blood loss and in some studies has reduced the need for blood transfusion as well. Most of these studies have included diversity of spine disorders and procedures.[19-22] Elwatidy et al in their study have reported that TXA reduced the blood loss in surgery by 48% and reduction in postoperative drain by 55% and the need for blood transfusion was less by 80%. This study included patients with different pathology and also had different treatment plan and the surgical procedures were not the same.[15]

To determine the efficacy of TXA in reducing blood loss the procedures have to be uniform with similar patient cohort and the same surgical procedure.[11,23] Spinal surgery is frequently associated with blood loss and repeated transfusion, hence, a comprehensive blood conservation strategy gains paramount importance to ensure decreased complications in the perioperative period and the overall success of the operative treatment.[23]

Blood transfusion also involves additional cost but the major reason for minimizing the number of transfusions is to reduce the risks of transfusion-associated risks, such as immunologic reactions, transmission of disease, coagulopathy, possible over-transfusion, and volume overload.[5] We do not have a cell saver system in our institute so other means of blood loss has to be implemented. Several methods reportedly reduce postoperative blood loss and avoid homologous blood transfusions. In a meta analysis, Gill et al. found that aprotinin, tranexamic acid, and aminocaproic acid all were associated with reduced blood loss in spinal surgery.[22] Similarly in a recent analysis, Li et al. reported that administration of TXA reduces total blood loss and need for blood transfusion and its relative safely even in high doses in spine surgery.[23] Tranexamic acid is a synthetic antifibrinolytic drug, that competitively inhibits the activation of plasminogen to plasmin used to prevent bleeding and hence the lysine binding sites of plasminogen to fibrin. Fibrinolysis is stimulated by surgical trauma and this increased fibrinolytic activity may increase blood loss after spinal fixation, at least during the early postoperative hours.

A wide range of TXA dosing has been advocated, depending on the indication. Dose regimens of TXA vary widely in the literature, loading doses range from 2.5 mg/kg to 100 mg/kg and maintenance doses from 0.25 mg/kg to 4 mg/kg/h delivered over time periods of 1 to 12 hours.[24] Since a single level spinal fixation is relatively a smaller operation compared to long fusions in spine surgery we decided to use a low dose of TXA (10mg/kg). In a study on cervical laminoplasty, where the surgical duration was less, they have used only a bolus dose of TXA and have shown less postoperative blood loss.[25] It has been reported that even large doses of TXA does not have any side effects like thrombophobic complications, drug interactions, numbness or weakness and allergic reactions but some have reported seizures if used in high doses.

The study by Farrokhi. et al used similar dose as in our study and found no significant difference in blood loss perioperatively and the need for blood transfusion.[17] Although the duration of the surgery was not statistically different the number of levels of spinal instrumented were different and they have mentioned that some of the surgeries were labeled complicated. TXA administered in scoliosis surgery in children revealed that blood loss was reduced by 48% and blood transfusion requirements by 42% during spinal instrumentation.[26]

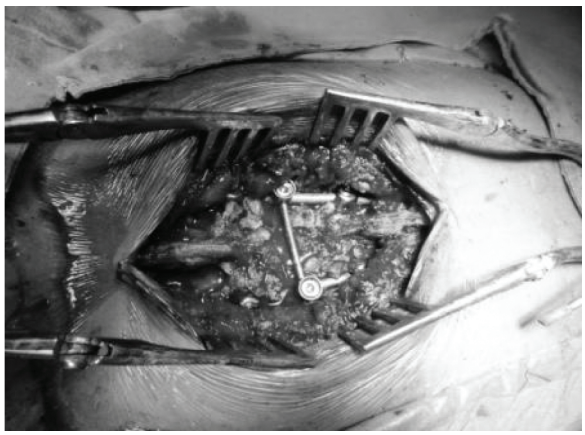

Figure 1. Intra operative single level spinal fixation with interconnector rod and bone graft.

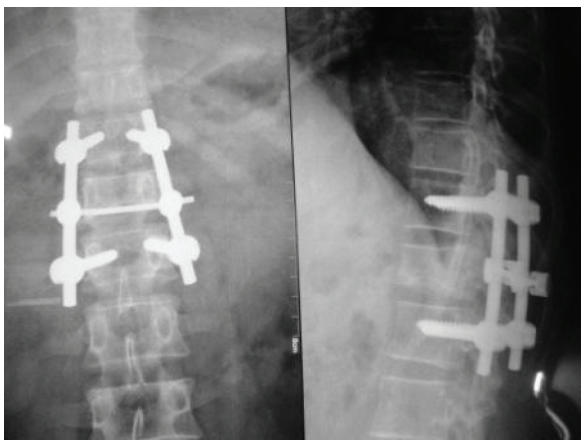

Figure 2. Radiograph showing a single level pedicle screw fixation with interconnector rod.

Another recent study on uniform patients of adolescence idiopathic scoliosis have reported that TXA not only decrease intra and post operative blood loss and the number of units of blood transfusion but also the cell saver blood transfusion in these patients with the loading dose of 1G and maintenance dose of 100 mg/h till wound closure.[27] The positive feature of our study is the uniformity of treatment groups and a consecutive patients undergoing spinal fusion for thoracolumbar burst fractures. The procedures were performed by the same surgeons in the same institution as it has been mentioned that the intra operative blood loss may be influenced by the technique and number of surgeons.

The limitation of our study is relatively small number of patients and the patients were not randomized as the surgeons knew the group of the patients. Another weakness could be that the measurement of the blood loss during surgery. An anesthetist and a trained nurse measured the blood loss in the suction bottle and soaked gauge pieces and tried to follow the same method throughout the study period but there may have been some fault in measurement.

CONCLUSIONS

Our results show that even low doses of TXA help in reducing blood loss not only in total knee replacement but also in spinal surgery that needs instrumentation. Tranexamic acid is relatively cheap and widely available drug that can be used prophylactically to reduce the blood loss and also post operative blood transfusion in instrumented spine surgery.

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