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# Determination of Mean Blood Loss with Tranexamic Acid in Patients Undergoing Total Knee Arthroplasty

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## ABSTRACT

Orthopedic surgeons routinely perform total knee arthroplasty (TKA). The use of antifibrinolytic therapy is one of the strategies to manage perioperative bleeding. TXA works by occupying the lysine-binding sites on plasminogen, thereby hindering its attachment to fibrin and ultimately halting the fibrinolysis process. Blood loss during gynaecological, cardiac, and orthopedic surgeries can be effectively managed with tranexamic acid. **Objectives:** To determine the average reduction in blood loss achieved with tranexamic acid in patients undergoing total knee arthroplasty. **Methods:** This interventional study was conducted over six months, from 25-08-2020 to 25-02-2021. A total of 60 patients from the OPD of the Orthopedic Department at Mayo Hospital, Lahore, were included in the study based on selected criteria. All participants signed informed consent forms. Demographic data were recorded, and TXA was administered after the surgery. All procedures were performed under general anesthesia. **Results:** The analysis showed that the average blood loss during surgery was 255.14 ml with the use of tranexamic acid. Excessive blood loss can have detrimental effects on a patient's health. **Conclusions:** It was concluded that tranexamic acid is effective in reducing bleeding during total knee replacement. Its use may also be more cost-effective compared to managing the consequences of significant blood loss.

## INTRODUCTION

In joint reforming surgery, the damaged part of the joint is surgically removed or reshaped using osteotomy or the same process is done with various surgical techniques [1]. Usually, arthroplasty is carried out by choice to relieve pain and bring back movement in a joint that was damaged by arthritis or injury [2]. For most of the past 45 years, surgeons have most commonly and successfully repaired damaged joints by replacing the joint's surface with a prosthesis [3]. An illustration is when someone has osteoarthritis of the hip, in which the surgeon may replace both the socket of the hip (acetabulum) and the upper part of the femur (the head and neck) with prosthetics [4]. During the operation, the objectives are to remove the pain, get the patient moving again, help walking and strengthen their muscles [5].' The loss of blood in this surgery is usually between 1,000 and 1,800 mL, so a transfusion is often necessary [6, 7]. Some studies have shown that after uncomplicated total knee arthroplasty, about 10% to 38%

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of patients need allogeneic transfusions [8, 9]. Blood transfusion may cause problems with breathing and heart function, disease transmission, an immune reaction and postoperative infection [10]. Administration of tranexamic acid can be given locally or intravenously at the start of surgery, and it has been found to lower the amount of blood loss and the requirement for blood transfusion in this setting [11]. The total blood loss was reduced, and blood transfusion was not required. This painless and safe use of tranexamic acid means it controls the discharge of surplus blood efficiently after knee arthroplasty [12, 13]. Using tranexamic acid can help reduce bleeding after big surgical procedures. It is usually given to patients through a vein during total joint replacement. Even though there have been studies on how safe tranexamic acid is for its antifibrinolytic effect, it still should not be used systemically [14]. During a total knee arthroplasty, it is possible to inject tranexamic acid into the joint [15]. But, not many studies have been done on how much chemo to give, its effects, and what side effects it might cause [16]. Research by Bidolegui et al., 363.4 ± 141 milliliters of drain loss was found at 24 hours when using tranexamic acid [17]. Results found by Yen et al., suggested that the menstrual blood loss was 921 milliliters after tranexamic acid use, and this statistic was significant ($p<0.05$) [18]. Literature reports that tranexamic acid may help lessen blood loss that results from a knee replacement. Sometimes, losing lots of blood can be harmful to both health and cost to the patient. Giving tranexamic acid is generally more economical than facing the expensive results of major blood loss. Furthermore, nothing local shows proof of this happening. That's why we needed to do this study, so in the future we can add tranexamic acid to the surgical procedure to help reduce blood loss. By doing this, our care will be better, and we will make sure to update local instructions for managing total knee replacement by including tranexamic acid.

This study aims to determine the average blood loss in patients receiving tranexamic acid during a total knee arthroplasty.

## METHODS

From August 25, 2020, to February 25, 2021, which is six months, this interventional study took place in Unit I of the Department of Orthopedic Surgery at Mayo Hospital in Lahore. The study focused on understanding the results of total knee replacement surgery for patients. A total of sixty cases were chosen to keep the error within 1%, achieve a 95% confidence level, and show that tranexamic acid reduced bleeding by an average of 921 ± 252 milliliters. The sampling method used was non-probability consecutive sampling. The inclusion criteria were patients who were 50 to 70 years old, of either gender, having a unilateral total knee replacement as outlined by the surgery description. Among the exclusion criteria were patients who had taken part in prior unsuccessful treatments or repeatedly fractured, patients with fractures that involved the entire bone (open fractures), those with severe double fractures of the knees (comminuted fractures), and those who required bilateral knee replacements. The ethical approval letter was taken from Green International University with registration No: IRC-GIU-155-04-2025. Informed consent was signed. Basic information about patients (name, age, gender, BMI, affected anatomical site, and duration of osteoarthritis) was collected before surgery, and 10 mg/kg of TXA was administered at the end of the procedure. All patients were placed under general anesthesia during surgery, which was carried out by a single surgical team with the researcher's assistance. An area of the wound was fitted with a suction drain to help remove excess blood. Post-surgery, patients remained in the post-surgical area to be carefully monitored for the next 24 hours. The suction drain was removed within a day, and the amount of blood drained was measured as defined by the operation. All the information about the study was recorded in a preform that had been prepared beforehand. The collected data were analyzed using SPSS version 23.0 to perform statistical analysis. The average values and standard deviation (SD) for age, BMI, and duration of osteoarthritis were reported as mean ± SD. The results for the qualitative variables (such as gender and the side of the body) were presented as frequencies and percentages. The groups were categorized based on age, gender, BMI, side of the affected joint, and the duration of osteoarthritis. The results from the post-stratification independent sample t-test were considered significant if the p-value was less than or equal to 0.05.

## RESULTS

Studying the age of the patients, we found that 32 individuals (53.3% of the total sample), were 50-60 years old and 28 individuals (46.7%) were aged 61–70 years and had a calculated mean age of 60.18 ± 5.52 years. Also, examining the gender of the patients showed 38 (63.3%) were male and 22 (36.7%) were female (Table 1).

**Table 1:** Distribution of Age, Gender, and Anatomical Side (n=60)

| Gender | Frequency (%) |
|---|---|
| **Age** | |
| 50-60 Years | 32 (53.3%) |
| 61-70 Years | 28 (46.7%) |
| Total | 60 (100%) |
| **Gender** | |
| Male | 38 (63.3%) |
| Female | 22 (36.7%) |
| Total | 60 (100.0%) |

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| Anatomical Side | |
|---|---|
| Right | 20 (33.3%) |
| Left | 40 (66.7%) |
| Total | 60 (100.0%) |

During total knee arthroplasty, patients receiving tranexamic acid had a mean blood loss of 255.14 ± 81.68 ml (Table 2).

**Table 2:** Distribution of BMI, Duration of Osteoarthritis, and Blood Loss (n=60)

| Variables | Mean ± SD |
|---|---|
| BMI (kg/m$^2$) | 25.66 ± 2.16 |
| Duration of Osteoarthritis (months) | 9.00 ± 4.23 |
| Blood loss (ml) | 255.14 ± 81.68 |

The data were arranged by age, gender, body mass index, affected side and disease duration (Table 3).

**Table 3:** Stratification for Blood Loss Concerning Age, Gender, Anatomical Side, BMI and Duration of Osteoarthritis Using Independent Sample t-test (n=60)

| Blood Loss | n | Mean ± SD | SD Error Mean | p-Value |
|---|---|---|---|---|
| **Age** | | | | |
| 50-60 Years | 32 | 243.22 ± 74.286 | 13.132 | 0.230 |
| 61-70 Years | 28 | 268.76 ± 88.793 | 16.780 | |
| **Gender** | | | | |
| Male | 38 | 254.01 ± 87.722 | 14.230 | 0.336 |
| Female | 22 | 257.09 ± 71.989 | 15.348 | |
| **Anatomical side** | | | | |
| Right | 20 | 250.10 ± 66.404 | 14.848 | 0.632 |
| Left | 40 | 257.66 ± 89.032 | 14.077 | |
| **BMI** | | | | |
| 17-25 kg/m$^2$ | 25 | 240.25 ± 65.768 | 13.154 | 0.236 |
| >25 kg/m$^2$ | 35 | 265.77 ± 90.809 | 15.350 | |
| **Duration of Osteoarthritis** | | | | |
| <=12 Months | 49 | 263.84 ± 85.754 | 12.251 | 0.081 |
| >12 Months | 11 | 216.36 ± 45.227 | 13.636 | |

## DISCUSSION

Knee replacement surgery, which is also called knee arthroplasty or total knee replacement, replaces the surface of the damaged knee joint. While the procedure is being done, plastic and metal are positioned along the bone surfaces that make up the knee joint, such as the kneecap. It's offered to someone who has serious arthritis or a major knee injury. Many forms of arthritis may cause problems in the knee. Usually, osteoarthritis occurs in adults over 40 due to losing the joint cushion, which worsens with time [19]. Synovial membrane inflammation caused by rheumatoid arthritis leads to excess fluid, pain and stiffness. A history of injury can lead to traumatic arthritis, which can damage the knee's cartilage. The objective of knee replacement surgery is to replace and cover up the parts of the knee that are damaged, and this helps relieve severe pain that other methods have not helped. Total knee replacement (TKR) is widely recognized as an effective and accepted way to treat knee osteoarthritis. It was found in the research that the age distribution of the patients put 53.3% of the patients (n=32) aged 50-60 years and 46.7% of them (n=28) aged 61-70 years. The average age was 60.18 ± 5.52 years. A greater number of males, 63.3%, were in the sample (38 participants), and fewer females, 36.7%, were in the sample (22 participants) [20]. Mean blood loss in those patients who received tranexamic acid was seen to be 255.14 ± 81.68. Bidolegui et al., showed that the drain loss within 24hours averaged 363.4 ± 141ml in patients given tranexamic acid [17], while Yen et al., found it to be 921 ± 252ml (p=0.014) [18]. In orthopedic surgeries, blood loss is commonly managed with TXA, because studies show it to help prevent and treat complications that occur while the patient is in the hospital. Numerous studies have been done to check if TXA is safe and effective for patients needing orthopedic surgery. When TXA was given peri-operatively to patients undergoing total hip arthroplasty (n=57), there was a 30% decrease in the need for transfusion when compared to a group receiving the placebo [21]. Many differences exist between developing countries and Western developed countries. In terms of age, physical appearance, how severe their condition is and their habits, patients in these two areas are different [22]. Also, when used in patients who do not do much physical activity, modern joint replacements with strong bearing surfaces may result in prolonged durability of the arthroplasty in developing countries [22]. Among a nationwide group of over 870,000 people who had elective total knee or hip arthroplasties in 510 U.S. hospitals, intravenous TXA used before or during surgery was not linked to a higher chance of any complication. Acute renal failure, dying in the hospital, heart attack, stroke and thromboembolic problems were the investigated issues. This is important because, besides demonstrating that TXA is safe in adults undergoing major orthopedic surgery, the authors also grouped patients by how much TXA was given (none, ≤1,000 mg, 2,000 mg and ≥3,000 mg). Studies found that TXA administration was closely linked to a significant decrease in blood transfusions, and odds ratios for this effect ranged from 0.31 to 0.38. The overall risk of transfusion-related reactions (OR) for allogeneic transfusions was 0.29 to 0.37. Important to note, these patients had no important rise in the risk of different complications like combined complications, renal failure, admission to intensive care or the risk of thromboembolic events [23]. In the research, giving people a 2,000 mg dose of TXA was found to offer the best combination of results and safety. Nevertheless, some experts worry about the constant use of TXA in elderly patients who have surgery [24].

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## CONCLUSIONS

It was concluded that for this study, researchers looked at how much blood the patients lost when tranexamic acid was used during total knee arthroplasty. Mean blood loss among the group using tranexamic was 255.14 ± 81.68 ml. Suffering from excessive bleeding can be very harmful to your health. Thus, we understood that tranexamic acid lessens bleeding after total knee replacement and may be more cost-effective than the problems of excessive bleeding.

## Authors Contribution

Conceptualization: MAA, SA
Methodology: MAA, HAS, SH
Formal analysis: MAA, SSS, SH
Writing review and editing: MAA, SA, SSS, MI, HMAA

All authors have read and agreed to the published version of the manuscript

## Conflicts of Interest

All the authors declare no conflict of interest.

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