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Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network

RESEARCH ARTICLE BIOSCIENCE RESEARCH, 2023 20(2):281-285. **OPEN ACCESS**

Determinants of excessive blood loss in total knee replacement surgery

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Total knee arthroplasty (TKA) is a safe and cost-effective operation that improves the quality of life in patients with advanced knee arthritis. Total knee replacement is most commonly performed for rheumatoid arthritis and osteoarthritis because of discomfort mixed with deformity and instability. The TKA operation causes significant blood loss, which may necessitate a transfusion. In order to limit blood loss and improve their surgical vision, orthopedic surgeons have commonly used a tourniquet in TKR surgery. Our findings will assist surgeons in deciding whether or not to employ tourniquets in their TKR patients if they do not reduce total blood loss. This is a retrospective, Case –control study. The assessment of blood loss quantity was measured with the help of mercuriali's formula. Patients were randomly allotted into two different groups after confirmation of TKR surgery. Cases group patients had tourniquet used during surgery while control group didn't used tourniquet. SPSS 21 was used to add and analyses the data. Total 60 patients were enrolled in the study. Mean (SD) age, height and weight of the patients were 51.8 ± 10.8 years, 162.7 ± 0.07 cm and 75 ± 18.1 kg respectively. On average the blood loss was 709.8 ml. On average significantly less blood loss were gauged in the intervention group A (tourniquet) than control group B (non-tourniquet) with p-value of 0.04. In females on average there was significantly less blood loss in comparison to males with p-value of 0.04.Because TKR is associated with significant blood loss, a standard procedure for TKR must be developed. Based on our findings, it is advisable to do TKR with a tourniquet.

Keywords: Total knee replacement surgery, Tourniquet

INTRODUCTION

Total knee arthroplasty (TKA) is a safe and cost-effective operation that improves the quality of life in patients with advanced knee arthritis (Skou 2015). Total knee replacement is most commonly performed for rheumatoid arthritis and osteoarthritis because of discomfort mixed with deformity and instability. The TKA operation causes significant blood loss, which may necessitate a transfusion. The volume of blood collected in the drains is used to assess blood loss (Weinstein AM, 2013). In order to limit blood loss and improve their surgical vision, orthopedic surgeons have commonly used a tourniquet in TKR surgery. However, the effectiveness of a tourniquet in reducing blood loss has been called into question (Lundblad H, 2008; Jiang FZ, 2015; Smith TO, 2010; Juelsgaard P, 2001).

A meta-analysis revealed that employing a tourniquet did not reduce real blood loss in TKA, despite the fact that intra-operative bleeding was considerably declined in the tourniquet group (Jarolem KL, 1995; Christodoulou AG, 2004). This is a significant finding because it suggests that over-all blood loss calculated using blood loss recorded in drains reflects only a portion of genuine blood loss, causing surgeons to underestimate surgical blood loss. The study found that, despite a decrease in mean intraoperative bleeding in the tourniquet group compared to the non-tourniquet group (Mean ± SD: 469 ± 44 vs 317 ± 72, p=0.000). If both knees are problematic, bilateral complete knee replacement should be considered. This saves time and allows everything to be done at once under a single anesthetic. Rehabilitation can also be done on both knees at the same time, shortening the overall regimen (Hetaimish BM 2012). The disadvantages of this approach include a longer anesthesia time and the likelihood of higher blood loss. If an infection develops, it is more likely to attack both knees. Furthermore, as

operational time grows, the risk of blood clots increases (Ferket BS, 2017). The operation on each knee can be done sequentially by the same surgeon, or it can be done simultaneously by two different surgeons, eliminating the disadvantage of a longer procedure (Suarez-Almazor ME, 2010). After TKR, the majority of patients report 90 to 95 percent improvement in pain and function. Blood loss is a common complication that is unavoidable during surgery (Dy CJ, 2012). This surgery has been conducted in Europe since the mid-nineteenth century. As may be expected, the ways of restoring function with TKR have varied greatly (Sehat KR, 2000; Zhao HY, 2020; burkart BC, 1994). A specific surgeon's path was heavily impacted by current technology as well as creativity. Since then, advancements in X-ray technology, biocompatible material development, antibiotic discovery, and the evolution of experts primarily focused with the musculoskeletal system have all played a part.

The prevalence of OA knee increases with age (beyond the age of 50), particularly in women (Prasad N, 2007; Alcelik I, 2012). According to a number of published publications, men over the age of 45 are afflicted in 6% to 13% of cases, but women over the age of 45 are impacted in 7% to 19% of cases. Men have a 45% lower risk of developing this condition (Cushner FD, 1991; Schnettler T, 2017; Zhang FJ, 2010). Joint hypermobility or instability, specialized vocations or sports stress, peripheral neuropathy, joint injury, history of immobilization, repetitive knee bending or heavy weight lifting, and a significant family history are all risk factors (Gao FQ, 2015; Tai TW, 2012;).

The etiology is yet unknown. Important considerations, however, include:

• Genetic susceptibility

• Immunological reactions

• Inflammation in the joints and tendon sheaths

• Rheumatoid factors (RF) develop in the blood and synovium.

• Perpetuation of the inflammatory process • Articular cartilage degradation (Gibon E, 2013).

Currently, our institute's predominant approach is that a tourniquet is required to save blood loss because it provides surgeons with a bloodless field and reduces surgical time. Our findings will assist surgeons in deciding whether or not to employ tourniquets in their TKR patients if they do not reduce total blood loss.

MATERIALS AND METHODS

This is a retrospective, case-control study conducted in a tertiary care health care institute of Karachi, Pakistan. Patients were allotted into cases and control groups randomly, by using computerized randomization software. Consecutive non-probability sampling was performed, patients advised for knee replacement were added upon successfully understanding informed consent. The assessment of blood loss was performed in both groups, control group patients did not had tourniquet placement during surgery while tourniquet was placed in patients of cases group. Total 60 patients were included, 30 in each group.

All patients of age 40 to 70 years of either gender with diagnosis of chronic osteoarthritis were included. Patients with reported blood/bleeding disorder, coagulopathies and malignancy were excluded from the study.

Before surgery, patients who had given informed consent to participate in the study were randomly assigned to one of two study arms. After the leg was lifted and exsanguinated, the tourniquet was inflated to 350 mmHg and deflated after wound closure and bandage was applied in group A. Group B patients didn't had tourniquet used, while bleeding was immediately sealed by electric coagulation. In all groups, the knee was wrapped in a compressive dressing after a wool and crepe bandage was applied to the limb.

The wound dressing was changed in accordance with usual protocol. The injured limb was lifted above the level of the heart, and cold packs were wrapped around the affected knees. At the 24th postoperative hour, hemoglobin was tested, and blood was transfused only if the level of Hb was less than 9 g/dl. It was mentioned in the performance.

Pre-operative and post-operative CBCs on the first and fifth post-op days were recorded to calculate the estimated blood loss. Pre-op height and weight of the patients were also obtained for blood volume estimation. Any blood transfusions administered following surgery due to a reduction in hemoglobin below 9 g/dl were documented in the performa. Estimated blood Loss: Blood loss was calculated using the Mercuriali's formula (Mercuriali F, 1996) as follows:

Estimated blood loss = patient blood volume x ($Hct_{preop} - Hct_{postop\ day\ 5}$) + ml of red blood cells transfused

where patient's blood volume (BV) will be calculated through the Nadler formula (Doig GS, 2005)

Male blood volume: 604 + 0.0003668 x [height in cm]^3 +32.2 x weight in kg

Female blood volume: 183 + 0.000356 x [height in cm]^3 + 33 x weight in kg (Kalairajah Y, 2005)

The amount of fluid (0.9% normal saline/lactate) ringer's provided pre- and post-operatively was also recorded. SPSS version 21.0 was used to enter and analyses data. In both groups, the mean and standard deviation for age, weight, and predicted total blood loss will be computed. Gender frequency and percentage were computed. The T-test was used to compare total blood loss in both groups. There was stratification based on age, weight, and gender. The post-stratification t-test was used. A P value of less than or equal to 0.05 was considered significant.

RESULTS

Total 60 patients were enrolled in the study. Half of them (n=30) were enrolled in tourniquet group and half of them (n=30) in non-tourniquet group. 35% patients were

male and 65% were female. Mean (SD) age, height and weight of the patients were 51.8 ± 10.8 years, 162.7 ± 0.07 cm and 75 ± 18.1 kg respectively. On average the blood loss was 709.8 ml. No significant difference in mean age, height and weight of the patients between both the groups was reported, however significant difference was observed in mean blood loss between both the groups as 0.01. On average significantly less blood loss were gauged in the intervention group A (tourniquet) than control group B (non-tourniquet) with p-value of 0.04. In females on average there was significantly less blood loss in comparison to males with p-value of 0.04.

Table 1: Descriptive analysis of study participants

Gender	**Male**	21 (35%)
	Female	39 (65%)
Weight (Kgs)		75 ± 18.1
Height (cms)		162.7 ± 0.07
Blood loss (ml)		701 ± 508

Upon comparing both groups significant difference was noted in blood loss amount in group with tourniquet with mean value of 408 ± 109ml while the control group represented slightly higher blood loss with mean value of 528 ± 121, the p-value was 0.01. While there was no difference reported in age, weight and height of both group participants.

Table 2: Comparison of study group participants

Variables	Group A Cases	Group B Controls	P-Value
Age	49.2 ± 5.8	50.1 ± 3.8	0.07
Weight	54.8 ± 8.7	58.1 ± 9.8	0.05
Height	169.2 ± 21.8	170.1 ± 19.5	0.06
Blood loss	408 ± 109	528 ± 121	0.01

DISCUSSION

In terms of estimated blood loss, using a tourniquet is preferable. Patients were randomly assigned to groups A and B in this study, and we discovered a substantial difference in mean blood loss between the two groups. The tourniquet group (A) has significantly less blood loss (p 0.001). Our findings are consistent with another study. That also a substantial difference in blood loss between the two groups. They discovered a significant drop in even in HB (p-value 0.001) and Hct (p-value =0.001), as well as decreased computed blood loss in the tourniquet group (p-value =0.003) (Aleclik I, 2012; Abdel-Salam AN, 1995) .Significantly larger blood loss in terms of TMBL in the non-tourniquet group, however we discovered significantly greater loss in the tourniquet group when he employed the Gross technique for estimated blood loss (P=0.02) (Jiang FZ, 2015). Another study included unilateral knee for TKR, but bilateral knees are excluded (Tetro AM, 2001). We studied bilateral knees and quantified estimated blood loss. It is preferable to conduct the study on a large number of patients, and extra variables such as operating time and post-op issues should be included. We do not frequently do TKR without a tourniquet in our context. We do not frequently do TKR without a tourniquet in our context (Wakankar HM, 1999; Yi S, 2014; Fan Y, 2014; Olivecrona C, 2006). It is a learning curve; with practice, we will be able to do TKR without a tourniquet with less blood loss than our previous outcomes. We do not frequently do TKR without a tourniquet. It is a learning curve; with practice, we will be able to do TKR without a tourniquet with less blood loss.

CONCLUSION

In developing nations, particularly in Pakistan, awareness and acceptability of TKR for the treatment of osteoarthritis is expanding. Total knee replacement is becoming more common and will become more common in the future. Because TKR is associated with significant blood loss, a standard procedure for TKR must be developed. Based on our findings, it is advisable to do TKR with a tourniquet. We discovered that the use of a tourniquet results in decreased blood loss. We also saw shorter operating times and less blood transfusions.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

ACKNOWLEDGEMENT

We acknowledgment the assistant of Operative team at DUHS and orthopedic department.

AUTHOR CONTRIBUTIONS

TAQ: Objective, final approval, Surgery supervision
AAS: Supervision of Data, surgery, Randomization of participants, Write-upSA: Data collection, Surgery AAS: Data collection Surgery TA: Data entry, analysis, Follow up SS: Data entry, Results interpretation, Follow up IMR: Data collection, ethical considerations, Follow up

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