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A comparison of hematological outcomes with and without a pneumatic tourniquet in primary total knee arthroplasty

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Abstract
Background: Tourniquet application is still a common practice in total knee arthroplasty surgery despite being associated with several adverse effects. We evaluated the effects of tourniquet use on hematological parameter and knee range of motion in total knee arthroplasty.
Materials & Methods: This prospective, randomized study comprised 60 patients who underwent a primary total knee replacement arthroplasty in Era's Lucknow Medical College between December 2016 to August 2018. Thirty patients were operated with the use of an arterial tourniquet (group A), and 30 patients without the use of a tourniquet (group B). Hemoglobin and haematocrit was recorded pre-operatively and at the first and third day post-operatively. Overall blood loss was calculated as the sum of compensated and non-compensated blood loss.
Results: Upon comparison of the Mean measured blood loss in suction drainage between the two groups statistical significance was noted (p =0.020) Patient in the tourniquet group had less blood loss, in suction drain but on comparison of overall blood loss no significant difference were found in these groups.
Conclusion: we conclude in our study that Total knee replacement can be safely done without tourniquet with respect to hematological parameter and has better knee range of motion in early postoperative period.

Keywords: Drain, non-drain, cemented, Uncemented, total hip replacement, infection

Introduction

Total joint arthroplasty is a frequently done procedure in modern day practice of any orthopedics unit. Reducing blood loss both postoperatively and intraoperatively presents a challenge to the surgeon [1-3].

Total joint arthroplasty has traditionally been carried out with the use of a tourniquet placed in a proximal thigh position, The benefits of using a tourniquet resulting in improved visualization of structures, reduced intraoperative bleeding and better cementation and reduction in the operative time by allowing the surgeon a bloodless operative field [4, 5]. It is also thought to improve the cementing technique during prosthetic implantation as the bloodless field permits better penetration of cement into bone [6, 7]. However these presumptions have been questioned. There is an increasing body of evidence that tourniquet use may be of no benefit, and perhaps cause harm [8, 9]. Improved pain scores when a tourniquet has not been used have been documented. This is presumed to be due to the lack of ischemic injury to the limb as well as the crush injury to the musculature [10, 11].

There is also recent evidence that when a tourniquet is not used the quadriceps musculature maintains a greater degree of strength and the knee has a better range of movement [12-13]. These factors can all improve patient recovery.

2. Material and Methods

This prospective, randomized study comprised 60 patients who underwent a primary total knee replacement arthroplasty in Era's Lucknow Medical College between December 2016 to August 2018. Thirty patients were operated on with the use of an arterial tourniquet (group A), and 30 patients without the use of a tourniquet (group B). Patients with coagulation disorder,

previous thromboembolism, previous open knee surgery and bilateral total joint arthroplasty were excluded from study.

The randomization of patients was made by placing even and odd values in a computer generated table of randomized numbers. Neither the patients, physiotherapists nor nurses were informed as to whether or not a tourniquet was used.

In group A the limb was first exsanguinated by elevation for 3 min, then the tourniquet was inflated to 125 mm Hg above systolic pressure. If the duration of tourniquet use exceeded 90 min, the tourniquet was released intraoperatively and haemostatic was completed. After 10 min of release a new exsanguination was instituted. The tourniquet was deflated after the bone cement had set, and only then was electrocautery used for hemostasis. In the non-tourniquet group electrocautery was used as necessary throughout the procedure.

All operations were performed under combined epidural and spinal anesthesia. The surgical procedure was performed through a medial parapatellar approach, followed by eversion and lateral dislocation of the patella, resection of the menisci and anterior cruciate ligament, femoral and tibial cut according to standardized technique for knee arthroplasties. The femoral cuts were performed with an intramedullary guide and the tibial with an extra medullary guide. All the prostheses were cemented and the femoral orifice obliterated with bone graft.

Ceftrixone 1 gm was given intravenously at induction of anesthesia, and two further dose of 1gm were given post-operatively at 12 hourly interval. For anticoagulant prophylaxis calf pump were use in all patients. In all patients a posterior stabilized prosthesis were used and patella was not resurfaced in all cases. negative suction drains were inserted before closure. After closure the knee was placed in a compressive dressing after the application of a wool and crepe bandage to the limb.

Active isometric quadriceps and continuous passive movement was begun on the second post-operative day, and walking with full weight bearing was permitted as tolerated under the supervision of a physiotherapist. The total operating time was recorded. Hemoglobin and haematocrit was recorded pre-operatively and at the first and third day post-operatively. Drains were removed when the drainage was recorded as less than 100 ml during a 12-h period. Overall blood loss was calculated as the sum of compensated and non-compensated blood loss. The latter was calculated as described by Gross [14]. The level of hemoglobin guided the need for transfusion. Generally, a patient received one or more blood units if the hemoglobin level was less than 8 g/dl. A linear analogue scale assessed post-operative pain at 6, 24 and 48 h post-operatively. The time to achieve straight-leg raising and range of knee movement achieved at 5 days, 10 days and 3 months was documented by the physiotherapists.

3. Results

A total of 60 patients were enrolled in the study after applying inclusion and exclusion criteria. That had undergone total knee replacement 30 in each group. The data related to hematological parameter are summarized in Table given next.

On analysis of demographic data there were no significant differences in between both group respect to age, gender, height and weight.

Upon comparison of the Mean measured blood loss in suction drainage between the two groups statistical significance was noted (p =0.020) Patient in the tourniquet group had less blood loss, in suction drain but on comparison of overall blood los no significant difference were found in these group.

The pre- and post-operative Hb levels were comparable among the groups. A slightly higher Hb level was evident pre-operatively in the non-tourniquet group however this was not deemed statistically significant (p=0.321).

Transfusion requirements were also similar among the groups (1.8 ± 0.9 vs. 2.1 ± 0.8) and no tendency was suggested towards an increased rate of transfusion in the non-tourniquet group (p=0.178).

Finally the analysis of the change in Hb level after surgery, revealed that the use of a tourniquet had no significant effect (p=0.184).

	Tourniquet (Group A)	Without tourniquet (Group B)	P-value
Average age (in years)	60.9 ± 7.6	62.5 ± 8.4	0.442
Male/female	17/13	14/16	0.438
Weight (kg)	76 ± 17	80 ± 15	0.338
Height (cm)	1.38 ± 0.06	1.36 ± 0.09	0.247
Hb (g/dL) preoperative	12.8 ± 1.3	13.1 ± 1.0	0.321
Hb (g/dL) POD 1	11.1 ± 1.2	10.7 ± 1.3	0.221
Hb (g/dL) POD 3	10.8± 1.1	10.4 ± 1.2	0.184
Ht preoperative (%)	36.0 ± 3.2	36.0 ± 3.4	1.000
Ht POD 1 (%)	32.0 ± 3.6	32.2 ± 2.9	0.814
Ht POD 3 (%)	31.0 ± 2.8	32.2 ± 2.2	0.070
First 24-h drained blood (cc)	350.8 ± 160.3	300.6 ± 76.9	0.127
Mean measured blood loss in suction drainage (ml) (range)	560.5 ± 260.3	700.6 ± 186.9	0.020
Mean calculated overall blood loss (ml) (range)	1334.9 ± 761.9	1456.4 ± 660.7	0.512
Mean total number of transfused BU (range)	1.8 ± 0.9	2.1 ± 0.8	0.178
Postoperative blood loss (mL)	870.9 ± 290.2	748.2 ± 281.5	0.102

All patients achieved full extension of the knee at 5th postoperative day. The range of active knee flexion measured at 5 days post-operatively was significantly greater (P<0.001) in patient in group B; however, at 10 days and 3 months there was no significant difference. None of patient requires manipulation under anesthesia to improve knee flexion.

4. Discussion

It is important to reduce blood loss during total joint arthoplasty in elderly patients with limited cardiovascular function. Tourniquet use is the most common method to limit blood loss [15]. We did not encounter any technical difficulty in operating without tourniquet in our study.

Our results indicate that more blood loss occurs in suction drain when a tourniquet is not used for primary TKR, but that overall blood loss is the same whether a tourniquet is used or not. This is in contrast to finding of some authors who find increase blood loss without tourniquet [16, 17].

Our study correspond to study of Li *et al* in which he found no difference in the total blood loss with or without the use of a

tourniquet [18].

Furthermore there was no difference in the transfusion rates between the two groups. The main reason for using a tourniquet in total knee arthroplasty is to achieve better cementation. Because there is less blood in the operating field, the bone cement can better adhere to the bone and implant without blood seeping between the bone-cement inter face. In theory, this should result in longer implant survival when performed with a tourniquet. However, since our study is short term we are unable to comment on this aspect.

The recovery of knee function was better in early post-operative period in non-tourniquet group this is one of the main advantage in early post-operative period.

5. Conclusion

We conclude in our study that Total knee replacement can be safely done without tourniquet with respect to hematological parameter and has better knee range of motion in early postoperative period.

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