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The limited use of a tourniquet during total knee arthroplasty: A randomized controlled trial

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ABSTRACT

Background: Total knee arthroplasty (TKA) is commonly performed using a tourniquet. However, some studies have reported that several complications were associated with the use of a tourniquet in TKA. In this study we investigate whether the limited use of a tourniquet in TKA would reduce complications and facilitate postoperative recovery.
Methods: Sixty patients were randomly divided into two groups (30 cases/group): group A using the tourniquet throughout the surgical procedure, and group B using the tourniquet starting from the cementation to the completion of the procedure. Operation time, total measured blood loss, and incidence of complications were all recorded.
Results: There was no significant difference in operation time, total measured blood loss, and hemoglobin concentration between the two groups. Incidence of postoperative complications in group B was significantly decreased in comparison to that in group A. The limb circumference at 10 cm above the superior patellar pole or below the inferior patellar pole and the pain score in group B were significantly decreased compared with that in group A at any time point. Range of motion in group B was significantly increased at three and 5 days postoperatively in comparison to that in group A.
Conclusions: The limited use of a tourniquet in TKA provides the benefit of decreased limb swelling and knee joint pain while not compromising the operation time or blood loss and recovery.
Level of evidence: Level I (Therapeutic).
Trial registration number: NCT02102581.

1. Introduction

Tourniquets are widely used in total knee arthroplasty (TKA) [1,2]. TKA has been reported to be be associate with significant blood loss. Although the tourniquet is widely used by orthopedic surgeons, its role is controversial [3]. Several studies have shown that using a tourniquet in TKA could reduce the total blood loss [1,4], while results from others indicated the opposite [5–9]. Therefore the relationship between the use of a tourniquet and the total blood loss of patients undergoing TKA is still unclear.

In addition, some potential complications associated with tourniquet use have been reported in the literature, which include nerve palsy [10], vascular injuries [11], rhabdomyolysis [12], subcutaneous thigh fat necrosis [13], delayed recovery of muscle strength from microscopic changes in muscle myofibrils [14], wound complications [1,4,15], and venous thrombotic embolism [4,15,16].

Completely eliminating the use of a tourniquet during TKA may bring risk. The bone bed may have blood or fat on its surface and this might compromise cementation. This raises the question of whether the potential benefits of tourniquet avoidance might be married with the benefits of a dry interface for cementing if the tourniquet is used from cementation. To our knowledge, previous randomized studies mainly focused on the comparison between no tourniquet use at all and tourniquet use during the operation [1,3,4,6,16]. At the time the current study was conducted, there are no published studies in the literature that compared the limited use of a tourniquet starting from the cementation to the completion of the procedure with tourniquet use during the entire operation procedure.

The aims of our study were to determine whether the limited use of a tourniquet (compared with the use of a tourniquet throughout the procedure) would affect (1) operation time, tourniquet time, total measured blood loss, and complications; (2) hemoglobin concentration; (3) limb swelling and postoperative pain, or (4) knee flexion range of motion. We hypothesize that limited tourniquet application would reduce the complications associated with tourniquet use but still prevent blood loss and aid the recovery after TKA.

2. Patients and methods

2.1. Patients

The study was approved by the Ethics Committee of Peking Union Medical College Hospital, China, and written informed consent was

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Table 1
Patient characteristics (n = 60, mean ± SD).

Groups	Sex (n)		Age (years)	ABP (mm Hg)	ROM (°)	FC (°)	ICH (mm Hg)	FTA (°)	BMI (kg/m^2)	ASA classification (n)		
	Male	Female								I	II	III
Group A	7	23	65.37 ± 7.11	95.26 ± 8.33	106.47 ± 19.29	8 (5, 12)	90.26 ± 8.34	172.2 ± 3.96	27.24 ± 2.69	1398		
Group B	9	21	63.27 ± 7.39	94.84 ± 3.43	107.77 ± 12.56	7 (5, 10)	89.77 ± 2.85	171.2 ± 4.21	26.26 ± 1.52	1211	7	
Statistic	$\chi^2 = 0.617$		t = 1.122	t = 0.253	t = −0.309	Z = 0.379	t = 0.302	t = 0.000	t = 1.742	Z = −0.032		
P values	0.432		0.266	0.801	0.758	P = 0.705	0.764	1.000	0.088	0.975		

ABP = Arterial blood pressure; ROM = Knee flexion range of motion and was given in degrees; FC = Flexion contracture and was expressed as median and range; ICH = Intra-operational controlled hypotension; FTA = Femoro-tibial angle and was given in degrees; BMI = Body mass index; ASA = American Society of Anesthesiologists.

obtained from all subjects. Between August 2011 and December 2011, 60 patients who underwent routine TKA were included in this randomized study (Fig. 1). Patients were classified according to the American Society of Anesthesiologists (ASA) physical status classification system. Patients eligible for the study included those who underwent initial unilateral TKA for osteoarthritis or rheumatoid arthritis. Patients with diabetes, hemorrhagic disease, peripheral neurovascular disease, malignant tumors, history of vascular thrombosis, history of infection in the lower limb, or Hb < 100 g/L were excluded from the study. Patients taking anti-platelet agents due to cardiovascular disease were also excluded. The patients were randomly divided into two groups using a successive random number table, with odd numbered patients (group A) receiving a full time tourniquet, and even numbered patients (group B) receiving non-full time tourniquet. Randomization was blinded to the nurses on the inpatient unit, physical therapists, and the patients. The randomization was performed by a research fellow (TX) who was not involved in patient care. In group A, tourniquet was applied during the whole operation if the procedure lasted less than 90 min. In cases where the operation lasted longer than 90 min, the tourniquet was released after implantation of the patellar implant. In group B, the tourniquet was applied from cementation to the completion of the procedure and was released after implantation of the patellar implant. Each group contained 30 cases and the characteristics of patients in both groups are summarized in Table 1.

2.2. Surgical procedures

Standard techniques were used in all of the cases. In group A, 19 patients received general anesthesia and 11 received spinal anesthesia, while in group B, 17 patients received general anesthesia and 13 received spinal anesthesia. Each procedure was performed by a group of four experienced staff surgeons. Intramedullary instrumentation of the tibia was used in all patients. After opening up the femoral canal using a 9.5 mm drill, the valgus alignment was sided to touch the distal femur at least one side. Then, the distal femur was resected. After the assembly was placed in neutral rotation, the floating spike was impacted into the distal femur and secured on to the distal block with pins. The sizing guide was positioned flush with the distal femur against the distal femur, while ensuring that the posterior paddles are contacting the underside of both posterior condyles. To anterior reference, the sizing guide stylus was positioned to contact the lateral ridge of the anterior cortex and the size determined from the

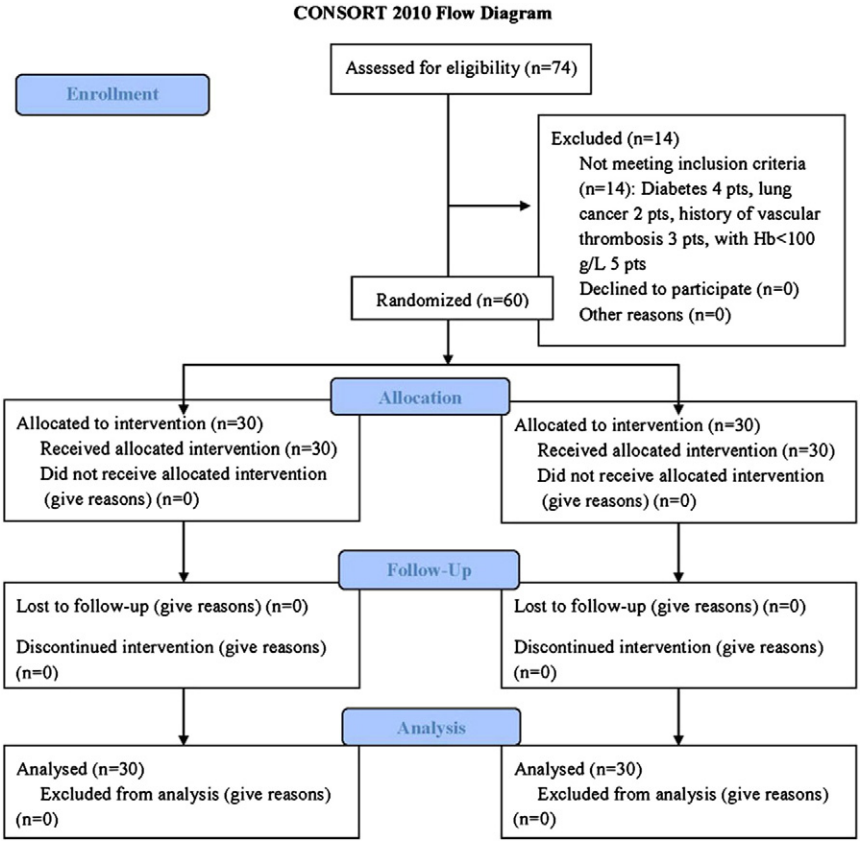

Fig. 1. The CONSORT flowchart of subject screening and enrollment.