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Original research

Tourniquet use during total knee arthroplasty does not offer significant benefit: A retrospective cohort study

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HIGHLIGHTS

- Tourniquets are routinely employed during total knee arthroplasty; however, their use remains controversial.
- Thus, the routine use of tourniquets during knee arthroplasty may need to be reconsidered.
- Tourniquet use provided no overall benefit.

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ABSTRACT

Introduction: Tourniquets are routinely employed during total knee arthroplasty; however, their use remains controversial.
Methods: This study investigates the efficacy and safety of this practice. A retrospective analysis of 186 patients was performed to assess benefits and/or risks associated with tourniquet use during knee arthroplasty. Total knee arthroplasty was performed using the Biomet Vanguard® PCL Prosthesis (Biomet, Warsaw, IN, USA). In total, 126 patients who had undergone total knee arthroplasty were included in our final analysis.
Results: Patients with tourniquets had significantly less intraoperative blood loss than patients without ($P < .001$); patients without tourniquets required more blood transfusions ($P = .551$), and had significantly longer surgical times ($P = .011$). However, patients with tourniquets had more postoperative blood loss ($P < .001$), longer hospital stays ($P = .013$), and more frequent complications ($P = .571$). Blood transfusion requirement was significantly associated with complications ($P < .001$).
Conclusions: Tourniquet use provided no overall benefit.

1. Introduction

Total knee arthroplasty (i.e. total knee replacement) is a surgical procedure in which a diseased or damaged knee joint is replaced with an artificial joint. It is routinely performed to relieve the disabling pain associated with severe arthritis when nonsurgical treatment options, such as medical therapy, are insufficient. Although recent advances in surgical materials and techniques have increased the efficacy of the procedure, patients remain concerned about the pain and length of recovery associated with arthroplasty [1,2].

During knee surgery, intraoperative tourniquets are often placed on the upper thigh to reduce blood flow to the extremity. Tourniquets have been proposed to have various benefits (e.g. drier surgical field, improved implant adhesion to bone, and decreased surgical blood loss) that can enhance procedural speed and patient recovery [3,4]. However, the use of these devices has remained controversial for decades [5,6], and several studies have identified a negative relationship between tourniquet use and postoperative pain, swelling, and recovery [7–12]. Additionally, a recent systematic review found that tourniquet use provides no advantage with regard to transfusion requirements [13]. Although total and/or

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intraoperative blood loss are reportedly reduced by tourniquet use [9,12,14,15], various other studies have failed to observe these purported reductions in blood loss [7,16,17]. Controversy exists regarding the effects of tourniquets on thromboembolic risk [18,22] and operating time [7,9,23].

Based on current conflicting evidence, there is a fundamental need to further investigate the efficacy and safety of tourniquets during arthroplasty. This is highlighted by the fact that randomized clinical trials continue to be performed to assess the effectiveness of knee replacement surgery in the absence of tourniquets [24]. We thus conducted a retrospective analysis of patients to examine the benefits and/or risks associated with the use of tourniquets during total knee arthroplasty. Overall, our findings will contribute to improvements in procedural recommendations for knee replacement surgery.

2. Materials and methods

The present study was a retrospective analysis of 186 patients who had undergone total knee arthroplasty. Patients who met the following criteria were excluded: bilateral replacement surgery, history of bleeding diathesis, revision of previous total knee arthroplasty, or history of peripheral vascular disease. In total, 126 patients who had undergone total knee arthroplasty were included in our final analysis. This study complied with the Declaration of Helsinki and informed consent was provided by all patients.

Total knee arthroplasty was performed using the Biomet Vanguard® PCL Prosthesis (Biomet, Warsaw, IN, USA). The tourniquet was set to 150 mmHg above the patient's systolic blood pressure and was deflated after setting of the bone cement. Electrocautery was subsequently used for hemostasis. In addition, enoxaparin sodium (4000 IU) was delivered for 12 h to 3 weeks postoperatively to prevent thrombosis, and cefazolin sodium was used during the first 24 h for antibiotic prophylaxis.

Continuous variables are presented as means with ranges, whereas categorical data are shown as percentages. All numerical data were submitted to normality testing using the Shapiro–Wilk test. The Mann–Whitney test was used to determine the statistical significance of numerical data, whereas the z-test was used to determine the significance of non-numerical data (e.g. yes/no criteria for complications or transfusions). The Pearson chi-squared test was used to assess the relationship between transfusions and complications. SigmaPlot software was used for all analyses. P values of $< .05$ were considered to indicate statistical significance. Our work is fully compliant with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) criteria.

3. Results

In total, 126 patients who had undergone total knee arthroplasty were included in our final analysis. The characteristics of these patients are presented in Table 1.

Approximately half (48.4%) of these patients had undergone operations with the use of a tourniquet. Upon comparison of these individuals with those who had not had a tourniquet applied, it was found that the patients in both groups had a similar mean age. Although there were slightly more female patients within the tourniquet subset, both groups comprised a majority of female patients. Many patients displayed osteoarthritis, with a higher prevalence in the tourniquet group than in the non-tourniquet group (90.8% *vs.* 85.7%, respectively). Although few patients presented with rheumatoid arthritis, the frequency of this condition was higher in the non-tourniquet group than in the tourniquet group (14.3% *vs.* 9.2%, respectively). Spinal anesthesia was more common than general anesthesia during surgery, with slightly more patients in the tourniquet subset undergoing spinal blockade. In contrast, more patients in the non-tourniquet group were placed under general anesthesia.

Table 1
Characteristics of all patients undergoing total knee arthroplasty.

	With tourniquet (n = 61)	Without tourniquet (n = 65)
Mean age (years)	67.2 (54–80)	65.8 (56–81)
Female (%)	78.1	72.2
Osteoarthritis (%)	93.8	88.9
Rheumatoid arthritis (%)	6.3	11.1
Spinal anesthesia (%)	84.4	80.6
General anesthesia (%)	15.6	19.4

Data related to the knee arthroplasty procedure are presented in Table 2. The tourniquet group had less than half the amount of intraoperative blood loss than that of the non-tourniquet group ($P < .001$). In contrast, postoperative blood loss (i.e. Hemovac drainage) was significantly lower in the non-tourniquet group ($P < .001$). Although the postoperative hematocrit and hemoglobin levels were similar between the two groups, the preoperative levels were significantly higher in the tourniquet group ($P = .009$ and $P < .001$, respectively). Slightly more patients received blood transfusions in the non-tourniquet group than in the tourniquet group (72.2% *vs.* 62.6%, respectively); more than twice the number of patients in the non-tourniquet group than in the tourniquet group required two units of erythrocyte suspension (13.9% *vs.* 6.3%, respectively). However, while these findings suggest a tendency toward increased transfusion requirements in the absence of tourniquets, the differences between the two groups were not statistically significant (Table 2). Surgical time was significantly longer in the non-tourniquet group ($P = .011$), whereas the duration of the hospital stay was significantly shorter ($P = .013$).

The number of surgery-associated complications within the two patient subsets was analyzed. Few adverse events were observed overall, although the tourniquet group had almost twice as many complications as the non-tourniquet group (16.1% *vs.* 8.2%, respectively). However, this difference was not statistically significant **($P =$ n.s.)**. The most common complications seen within the tourniquet subset were superficial infections, which were treated with oral antibiotics. Additionally, one patient in this group developed skin blistering, while another developed a wound hematoma that did not require treatment (see Table 3). In the non-tourniquet group, delayed wound healing was observed in one patient, while other patients developed superficial infections and wound hematomas similar to those in the tourniquet subset. Notably, although not statistically significant, superficial infections were approximately three times more frequent within the tourniquet group than within the non-tourniquet group (9.3% *vs.* 2.8%, respectively; **$P =$ n.s.**).

The association between the requirement for a blood transfusion and the presentation of complications was also analyzed. Patients who required two units of erythrocyte suspension displayed a statistically significant increase in arthroplasty-related complications ($P < .001$).

4. Discussion

The most important finding of the present study was that the routine use of tourniquets during knee arthroplasty may need to be reconsidered. The present retrospective analysis of patients that underwent total knee replacement surgery was performed to examine the benefits and/or risks associated with tourniquet use during surgery. Patients with tourniquet use showed significantly