

## Research Article

# Tourniquets for the Use of Total Knee Arthroplasty: Are Patients Aware of the Risks?

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## Keywords

• Tourniquets; Total knee arthroplasty; Bleeding

## Abstract

**Background:** Tourniquets are routinely used in total knee arthroplasty (TKA) with an estimated use by up to 93% of surgeons. Advantages include the ability to provide a bloodless field of view to facilitate cement application and increase the success of the procedure. Overall reduction in blood loss is another perceived advantage; however recent research has demonstrated no measurable reduction and conversely a substantial increase in complications such as deep vein thrombosis and systemic emboli. Given the significant complications of tourniquet use we aim to identify patients' views on tourniquets and of emphasis their awareness of the possible risks involved prior to the procedure.

**Method:** A questionnaire - based study was carried out on 35 patients attending an elective orthopaedic centre for TKA surgery. Ethical approval was granted by NRES committee - East of England (REC Ref: 14/EE/1265). Patients were provided with an information sheet detailing the reasons for the tourniquet use and the associated risks and benefits. They were then provided with a questionnaire to ascertain their views and previous understanding of the subject. Simple statistical measures were implemented to analyse the data.

**Results:** Only 32% of patients were aware of the use of tourniquets during the operation. 19% were aware of the benefits prior to reading the information sheet provided with 29% understanding the risks involved prior to their procedure. Finally we found 97% of patients would like more information on the use of tourniquets preoperatively.

**Conclusion:** Tourniquets are widely used in TKA surgery; however, they carry significant risks which are not clearly relayed preoperatively to all patients. Given that 91,000 TKA operations are performed per year we believe it is of paramount importance that all patients are appropriately counselled on the risks and benefits of its use and fully informed consent, including risks of tourniquet use, should be obtained prior to the procedure.

## INTRODUCTION

Arthritis of the knee is a common pathology with literature reporting 50% of patients developing symptomatic knee arthritis before the age of 85 [1]. Total knee arthroplasty is an effective means of alleviating symptoms of end stage arthritis [2]. The incidence of TKA surgery is increasing with an estimated 91,703 TKRs being performed within England, Wales and Northern Ireland in 2013 [3]. Many lower limb orthopaedic operations, including TKR surgery, are undertaken with the aid of a tourniquet around the thigh during the procedure. A tourniquet is an occlusive device, which holds air under pressure (when inflated) and squeezes the thigh (including the blood vessels within the thigh). It is generally a decision taken by the lead surgeon as to whether a tourniquet should be used [4]. A survey in 2010 found that 95% of surgeons in the USA use a tourniquet for TKR surgery, and the National Joint Registry (NJR) reported that 93% of primary TKRs were done with a tourniquet in 2003 [5,6].

A tourniquet helps provide a bloodless field [7] during surgery therefore helping improve the operative field of view. In addition some surgeons believe that a bloodless field during surgery improves the quality of cement application, which is used

in many TKRs to help hold the components in place [8]. Cement which is initially soft when it is inserted interdigitates into the porous bone forming a strong bond to the bone as it sets. There is no good quality clinical data to support a relationship between bloodless fields during surgery aiding better cementation of improving the longevity of the implants. Smith et al produced a systematic review of 15 RCTs in 991 knees which found a significantly greater intra-operative blood loss in non-tourniquet group compared to tourniquet assisted surgery ( $p=0.004$ ) [9]. Jiang et al. [10], published the most recent systematic review of 26 RCTs concluding that tourniquets significantly decreased intra operative blood loss, transfusion rate, and operation time but not postoperative blood loss, measurable total blood loss or duration of hospital stay

There is clear evidence that using a tourniquet is associated with a greater risk of complications including increased postoperative pain [11], swelling, nerve palsies and most significantly increased risk of Venous thrombolism (VTE) [4,8]. In TKR, a tourniquet causes both arterial and venous stasis within the lower leg for the duration that it is inflated (typically over an hour). The increased risk of symptomatic Venous Thromboembolism (VTE) following major surgery, whether joint replacement or other has been known for many years. Routine

measures including low molecular weight heparin, anti-embolism stockings and pneumatic calf compression devices following all such surgery are recommended by National Institute for Health and Care Excellence (NICE), subject to contraindications. It is therefore unsurprising that the use of a surgical tourniquet might increase the risk of post-operative symptomatic VTE [5].

Potentially of much greater concern is that VTE may not be the only thromboembolic risk associated with using a tourniquet. Systemic emboli can occur following the deflation of a tourniquet [12]. Transesophageal echocardiography has demonstrated shower-like echogenic materials circulating from the lower limbs to the right atrium, ventricle, and pulmonary artery after the release of a thigh tourniquet and also macroscopic emboli in the central circulation [12]. As the carotid arteries are the first branches from the aortic arch in a straight line orientation, some of these clots may enter the cerebral circulation. Transcranial Doppler ultrasound studies show a 60% prevalence of echogenic material in the Circle of Willis after a tourniquet is released and that micro embolism can occur even in the absence of a patent foramen ovale (connection between the left and right side of the circulation within the heart) [13]. The most likely route for emboli in these circumstances is through the pulmonary capillaries or the opening of other pulmonary vessels [13]. The critical time is immediately after release of the tourniquet when there is potential hemodynamic instability and evidence to suggest a five-fold increase in the amount of embolic material [14,15]. The presences of cerebral emboli which can cause cerebral damage may explain the higher than expected prevalence of post-operative cognitive deficit following TKR. In the literature this varies from 41% - 75% at 7 days to 18% - 45% at 3 months post-operatively [16]. These percentages are much higher than recorded in other major lower limb procedures with similar types of anaesthetic, but where a tourniquet is not used [17].

Evidence suggests that surgeons throughout the world routinely favour the use of tourniquet. However, the aim of this study was to identify whether patients undergoing TKR are that may be used and whether they were aware of the potential risks and benefits of these devices.

## METHOD

Ethical approval was granted by NRES committee - East of England (REC Ref: 14/EE/1265). A single centre survey was undertaken of patients undergoing TKR surgery at an elective orthopedic unit in a large university teaching hospital. Patients were eligible to take part if they aged above 18 and able to provide informed consent. We excluded patients undergoing revision TKR surgery and in whom English was not the first language.

Consecutive eligible patients were approached and recruited by a trained research associate. Figure (1) demonstrates the flow of patients in the study.

### Eligibility Criteria

#### Inclusion Criteria

1. Patients who have undergone TKR surgery at the elective orthopaedic unit
2. Aged above 18 and able to provide informed consent



### Exclusion Criteria

1. English not the first language
2. Cognitive impairment or lack of mental capacity
3. Revision TKR surgery
4. Unable to provide consent

Patients were provided with an information sheet (see Appendix 1) detailing the potential benefits and risks of using a tourniquet during TKR surgery. Patients were the asked to complete a questionnaire (see Appendix 2) to design to capture their understanding of the subject and views about the use of tourniquets. The questionnaires were collated by the research team in an anonymised fashion and simple summary statistic used to represent the results.

## RESULTS

Thirty-five consecutive eligible patients took part in the survey over a three week period at our single centre.

Table (1) demonstrates the baseline characteristics of the patients included in this study. We aimed to include the first 35 consecutive patients who had a primary total knee from the start date of our trial. 5 patients refused to take part and 1 other was taking part in another related study as a result we continued to include patients until we reached our target of 35. Of the patients included as Table (1) demonstrates the majority were operated on by a consultant (80) whereas in a small proportion the lead surgeon was either a specialist registrar (11%) or an associate

specialist (9%). There were 13 different lead surgeons included in our study as a result we captured the practice of a range of different surgeons at different points in training.

As demonstrated by Table (2) our study demonstrated that less than a third of patients were aware of tourniquet use before their procedure, despite providing informed consent for the procedure. A smaller percentage (29% and 19% respectively) was aware of the risks and benefits of tourniquet use prior to the procedure. Having read the information sheet and completing the questionnaire, 97% of participants highlighted the fact that they would like more information on tourniquets specifically pre-operatively.

## DISCUSSION

The outcome of our study sheds lights over the lack of streamlined and tourniquet - specific information relayed to patients. Over two thirds of patients were not aware of the use of tourniquets during their operations. The principal reason for this lack of awareness could be that patients are not informed about tourniquet use prior to their operation. In addition to lack of information provided during informed consent there also seems to be a distinct lack of information of tourniquet use in the grey literature. A recent search web med [18] and the NHS website [19] demonstrated the lack of information of tourniquet use in TKR. The word 'tourniquet' was not mentioned at any point throughout both articles easily accessible to patients. Another reason for the lack of information pre-operatively is that the consenting surgeon may not believe it is essential to specifically mention a tourniquet. A TKR is a procedure with many steps and the operating surgeon may believe it is important to avoid overloading patients with information and mention the essential aspects. Given that the vast majority of surgeons [6] favour tourniquets and they present their own specific risks, providing pre-operative information on the use of tourniquets should be considered.

The results show that the majority of patients would like to have known more about tourniquet use. This survey highlights

**Table 1:** Baseline characteristics of included participants.

Baseline Characteristics	
Gender	37% Male : 63% Female
Grade of Surgeon	80% Consultant : 11% SpR : 9% Associate Specialist
L/R Knee	37% Right Knee : 63% Left Knee
Number of different Surgeons	13

**Table 2:** Table demonstrating results of questionnaire.

Question	Yes	No
Were you aware a tourniquet would be used in your operation?	32%	68%
Were you aware of the risks of tourniquet use in surgery?	29%	71%
Were you aware of the benefits of tourniquet use in surgery?	19%	81%
Do you believe more information is needed on tourniquet use pre-operatively?	97%	3%

the need to inform patient's pre-operatively on tourniquet use, this process could take place in different forms. Firstly the consenting surgeon could inform patients on tourniquet use during consultations. An information sheet giving an overview of the procedure in general, the use of a tourniquet and the risks could be provided to the patient pre-operatively to increase awareness. Finally, web based literature which is frequently visited by patients could provide information on tourniquet use including risks and benefits. The impact on patient education has been widely discussed in orthopaedics. One study demonstrating a reduction in anxiety, post-operative pain and time to mobilisation in patients who attended a collective information session pre-total hip replacement [20].

Consent for a procedure does not always require a detailed description of all the equipment and stages and it could be argued that patients are consented for TKR surgery as a whole. However, in light of established evidence that show specific complications related to tourniquet use including systemic emboli [11], increased post operative pain [16] and nerve palsies [8] and that surgery can be undertaken without a tourniquet it would seem reasonable to discuss this with a patient. This is corroborated by the 97% of participants who reported a preference for more information to have been provided prior to their procedure.

The study does have limitations including capturing only data from a single site. Although only one site patient were recruited from a number of different surgeon practices all of whom routinely use a tourniquet. Never the less information provided pre-operatively is likely to differ between sites and further cross sectional research across multiple centres should be considered. There is a possibility that the design of this study would lead to potential information bias. Given that we are raising patient awareness of tourniquet use and also providing information on the risks and benefits of tourniquet use, there is the possibility that patient are more likely to say they would like more information pre-operatively. However, given that tourniquets have specific risks and patients expressed their unawareness of this, the authors still believe it is important to provide more information on tourniquet use.

It would also be valuable to capture surgeons' views on this topic. Despite the evidence suggesting tourniquet use is potentially harmful; more than 93% of surgeons prefer to use them. The reasons for this are not clear but may be because of established practice (tradition), a belief that they facilitate better cementation which outweighs any risks or that they are convenient avoiding undue preoperative bleeding and shortening the surgical time.

In conclusion, this study suggests that the majority of patients are unaware that a tourniquet is frequently used to undertake TKR surgery and many would like more information preoperatively specifically related to benefits and risks. The current evidence suggests that the risks outweigh the benefits. Research suggests that tourniquets confer no appreciable benefit in terms of total blood loss; however, more research is required in order to understand any potential benefits related to cementation.

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