Journal of Clinical Anesthesia (2015) **27**, 380–384

ELSEVIER

Journal of Clinical Anesthesia

Original Contribution

Tourniquet use during ankle surgery leads to increased postoperative opioid use☆,☆☆

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Received 3 February 2015; revised 26 March 2015; accepted 30 March 2015

Keywords:
Anesthesia recovery period;
Opioid;
Orthopedics;
Postoperative pain;
Reperfusion injury;
Tourniquets

Abstract

Study objective: Ankle surgery is often done using a tourniquet. Ischemia/reperfusion injury caused by the tourniquet may increase postoperative pain. The study objective was to investigate the amount of opioids given to patients after ankle surgery with and without tourniquet.

Design: We did a cohort study based on data from patient's records between January 2008 and December 2011.

Setting: Information is gathered from operating room, postanesthetic care unit, and surgical ward in a university hospital.

Patients: We identified patients undergoing reconstructive ankle fracture surgery from hospital records. We excluded multiple fractures of the same extremity, major trauma, reoperations, arthrodesis of the ankle joint, and missing data on tourniquet use. We included 603 patients.

Interventions: For each patient, we registered for how long (minutes) the tourniquet was inflated.

Measurements: Main outcome was opioid use during first 24 hours postoperatively (in equipotent intravenous morphine doses). Secondary outcomes were the peak pain on a verbal rating scale, time in postanesthetic care unit, and additional antiemetic medicine. We performed multiple regression to analyze the primary outcome.

Main results: Three hundred fifty-eight patients underwent surgery with tourniquet. There was a correlation between tourniquet time and postoperative opioid use (*P* value = .001) after controlling for confounders. The slope of the correlation was 0.04 mg/min (95% confidence interval, 0.02-0.07), which means there is an increase in postoperative opioid use by 0.43 mg for every 10 minutes of tourniquet time.

Conclusion: We found an increase in postoperative opioid consumption correlated to tourniquet use. Possible preventive measures with antioxidant treatment to prevent ischemia/reperfusion injury should be investigated.

☆ Disclosures:
- Conflict of interest: None declared.
- Financial support and sponsorship: None declared.

☆☆ Author's contribution: HK: study conception, study design, data analysis and interpretation, writing up of the first draft of the paper, and approval of final manuscript. KPC: data collection and approval of final manuscript. AMM: study conception, study design, data interpretation, revised draft, supervision, and approval of final manuscript. IG: study conception, data interpretation, revised draft, supervision, and approval of final manuscript.

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http://dx.doi.org/10.1016/j.jclinane.2015.03.034
0952-8180/

1. Introduction

Postoperative pain after ankle surgery is common, and controlling pain is important for optimal recovery and patient satisfaction [1-3].

Ankle surgery is often done using a tourniquet [4-7], which gives the surgeon a bloodless field and decreases blood loss, but it also leads to a number of challenges for the anesthesiologist both during and after surgery [6]. In a systematic review, it was shown that tourniquet use increases hospital length of stay and makes the postoperative period more painful in relation to foot and ankle surgery [6].

Ischemia/reperfusion (*I/R*) *injury* is defined as cellular damage after reperfusion of previously viable ischemic tissue [8]. Ischemia/reperfusion injury involves a complex cascade of responses and local inflammation resulting in swelling and pain. Ischemia/reperfusion injury after tourniquet use occurs despite improvement of patient security [9].

The hypothesis behind this study is that tourniquet use is associated with increased postoperative pain, and the aim of our study is to determine the opioid use in patients undergoing ankle fracture surgery with and without use of tourniquet.

2. Materials and methods

Data collection was approved by the Danish Data Protection Agency (J-no. HEH-750.16-32, I-Suite no. 01788). According to Danish legislation, database studies do not require ethics committee consideration.

2.1. Database: patient selection

All ankle fracture patients undergoing open reduction and internal fixation surgery at University Hospital Herlev between January 2008 and December 2011 were identified from hospital records. Data collection was initiated in 2012 and took place throughout 2013.

Data were entered into standard hospital records by treating personnel and subsequently extracted for this study. Patient's records include several digital and nondigital clinical records and databases used by physicians and nurses.

We also used Danish Anaesthesia Database for data collection, which is a quality assurance initiative.

Inclusion criteria were the unique Danish Social Security Number, reconstructive surgery of the ankle at Herlev University Hospital within the time span 2008-2011, and correct registration of the surgical procedure. Exclusion criteria used were multiple fractures of the same extremity and/or major trauma; operations in the same ankle within 30 days or without intercurrent injury, as they were considered reoperations; arthrodesis of the ankle joint; and missing data on tourniquet use. We defined tourniquet data as missing if anesthesia chart or surgery description included reference to tourniquet being used, but no tourniquet time could be found.

2.2. Database: data collection

Information on exposure to tourniquet was found in the anesthetic chart, which is used to document perioperative events, and it is registered in minutes of inflated tourniquet.

We defined primary outcome as opioid consumption during the first postoperative 24 hours. This was measured by extracting data on the doses of any opioid drug administered to the patient and then converting this dose into equipotent doses of intravenous morphine in milligrams. In the electronic system used for managing medicine, it is registered what medicine is prescribed to the patient by the doctor and what medicine is given to the patient by the nurses. In our study, we extracted data on the medicine that had been administered by the nurses to the patient.

Secondary outcomes used in this study were peak pain score (PPS), time in postanesthetic care unit (PACU), and need for additional postoperative antiemetic medication.

Peak pain score is the highest registered pain score with the standard scoring system used in the PACU. The scoring system used is based on a 100-mm visual analogue scale (VAS) score and registered as 1 of 4 categories: "no pain," 0 mm; "light pain," 1-29 mm; "moderate pain," 30-69 mm; and "severe pain," 70-100 mm. The staff registers this on a scale 0-3 where 0, no pain; 1, light; 2, moderate; and 3, severe pain. Patients were scored at rest every hour.

Almost all patients received 4 mg ondansetron to prevent nausea; therefore, we defined the outcome related to nausea as a dichotomous outcome: yes/no to additional antiemetic medication as registered in the patient's record. Time in PACU was defined as the time recorded in the anesthesia chart from arrival to discharge.

To characterize the cohort and identify possible confounders, we also gathered and analyzed demographic, anamnestic, and perioperative information. The demographic factors we analyzed were age and sex. Anamnestic factors we investigated were American Society of Anesthesiologists (ASA) score, body mass index (BMI), diabetes mellitus, smoking, pretraumatic use of prescription pain medication, and type of fracture. We registered patients as having diabetes mellitus if they had stated so in the hospital admission interview or if their medication included drugs used in diabetes treatment (ie, insulin and metformin). Smoking and pretraumatic use of prescription pain medication were determined from admission interview as well. Information on time under anesthesia and type of anesthesia (general or spinal anesthesia ± peripheral nerve blockade and miscellaneous) was also gathered for analysis.

2.3. Statistical analysis

We visually inspected all outcome data for normal distribution. We detected no severe deviations from normal distribution, and because the sample size is relatively large, we deemed it reasonable to conduct parametric analysis for all outcomes. Hence, we analyzed outcome data using either linear regression or logistic regression where the outcome