Journal of Orthopaedics 15 (2018) 624–629

Contents lists available at ScienceDirect

Journal of Orthopaedics

journal homepage: www.elsevier.com/locate/jor

Original Article

What is the incidence of inadvertent hypothermia in elderly hip fracture patients and is this associated with increased readmissions and mortality?

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ARTICLE INFO

Keywords:
Inadvertent hypothermia
Hypothermia
Hip fracture
Neck of femur fracture
Mortality
Readmissions

ABSTRACT

Background: Globally the incidence of fragility hip fractures is rising with increasingly elderly and co-morbid patients. These injuries are associated with a high morbidity and mortality.

Aims: This clinical study's primary outcome is to establish the rate of operative inadvertent hypothermia (< 36 °C) in elderly hip fracture patients (> 65 years old). We also aimed to identify risk factors and outcomes in patients with inadvertent hypothermia.

Patients and Methods: A single centre, retrospective study of 929 hip fracture patients managed operatively between June 2015 and July 2017 was conducted. Patients' demographic, anaesthetic and surgical variables were analysed together with outcomes for length of stay (LoS), 30-day re-admissions, and 30-day mortality.

Results: Overall rates of inadvertent hypothermia in elderly hip fracture patients undergoing surgery were 10%, with increasing age ($p = 0.006$) and pre-operative hypothermia ($p < 0.0001$) as risk factors. Patient's hypothermic pre-operatively compared with normothermic patients were 1.9 times more likely to be < 36 °C on leaving theatre. There was a trend towards a higher 30-day mortality ($\chi^2(1) = 2.818$, $p = 0.093$), and a significantly higher mortality in patients undergoing SHS ($p = 0.03$). No survival differences for LoS were observed between hypothermic and ≥36 °C patients ($\chi2(1) = 0.069$, $p = 0.79$). 30-day re-admissions were higher in hypothermic patients ($\chi2(1) = 16.301$, $p < 0.0001$).

Conclusion: Rates of inadvertent hypothermia are high in operatively managed hip fracture patients and are significantly associated with a higher 30-day readmission rate with a trend towards higher 30-day mortality.

1. Introduction

Around 65,000 hip fractures occur annually in the UK, with a reported incidence between 349 per 100,000 for females and 140 per 100,000 for males.[1] According to epidemiologic predictions and as a result of an aging population, the incidence of hip fractures is projected to increase to 6.26 million globally by the year 2050.[2] Currently, the majority are managed operatively but often with a poor prognosis; in the United Kingdom the average 30-day mortality rate for all hip fractures is 6.7% and the one year mortality is up to 30%.[3,4] Despite recent improvements in reducing mortality, these patients remain high risk with significant opportunities existing to improve their care.

The World Health Organisation (guidelines for safe surgery) and the National Institute for Health and Care Excellence (NICE Guidelines - CG65) offer recommendations for maintaining perioperative normothermia (defined as a core body temperature > 36 °C), to minimise morbidity and mortality.[5,6] Despite this, Gurunathan et al, observed up to one third of hip fracture patients experience inadvertent hypothermia on entering the recovery ward. In addition, they report an average 0.7 °C drop in patient's core body temperature during hip fracture surgery.[7] As a consequence of inadvertent hypothermia, patients may experience unpleasant shivering post–operatively.[8,9] Furthermore, in non-orthopaedic cohorts, perioperative inadvertent hypothermia is associated with significant complications such as surgical site infection, raised mortality together with an increased need for blood transfusion and assisted ventilation.[10,11] Inadvertent hypothermia also has subsequent cost implications, with longer reported ITU stays and overall length of stay (LoS).[9,12,13] Orthopaedic surgeons have extrapolated these findings and aim to maintain patient normothermia by warming fluids and using patient warming devices. However, little evidence delineates the risk factors and outcomes associated with hypothermia in hip fracture patients. The null hypothesis that hypothermia is associated with no difference in post-operative complications, in hip fracture patients, requires further examination.

We hypothesise that elderly hip fracture patients experiencing operative hypothermia have poorer outcomes. This study aims to

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https://doi.org/10.1016/j.jor.2018.05.020
Received 23 March 2018; Accepted 6 May 2018
Available online 07 May 2018

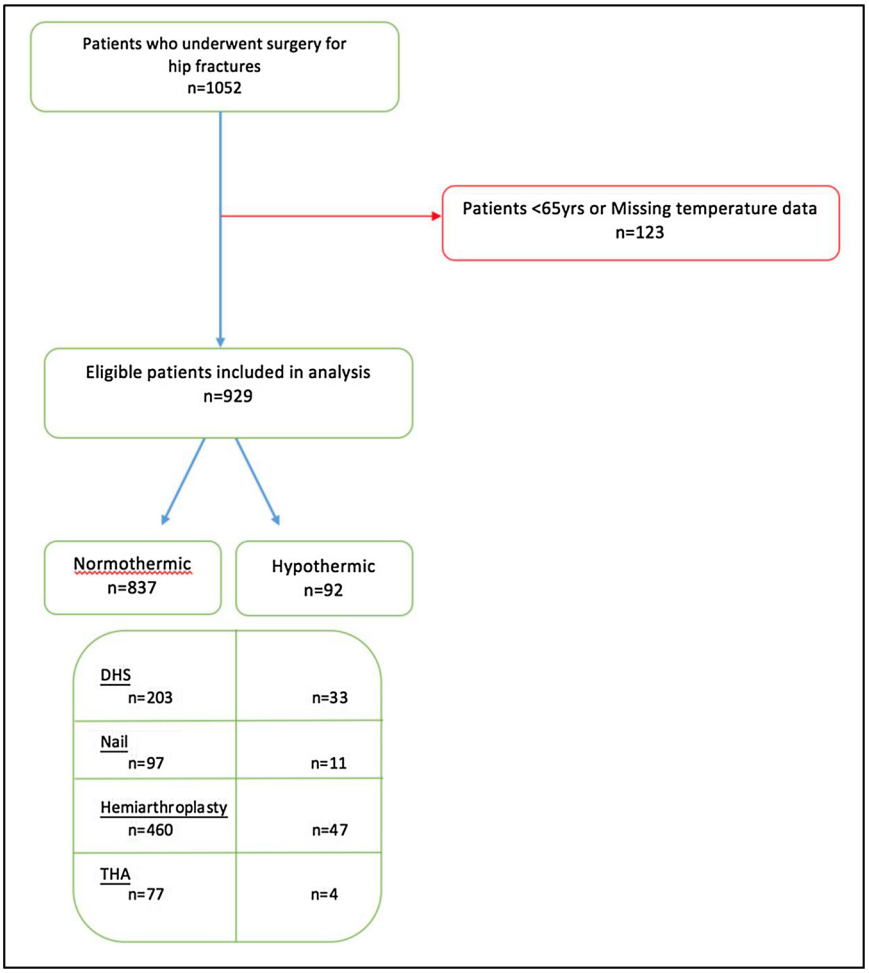

Fig. 1. Flowchart of patients who underwent surgery for hip fracture included in the study.

determine the rates and risk factors for developing hypothermia and the outcomes of hypothermia including mortality (which has not been previously published).

2. Methods and patients

We conducted a single centre, retrospective study of 1052 consecutive hip fracture operations (1052 patients) from June 2015 to July 2017. Patients under 65 years old and those with missing temperature data were excluded from analysis (n = 123), giving 929 operations for analysis, (Fig. 1).

Surgeries were performed per standard practice using the following treatment algorithm: Intracapsular fractures (Arbeitsgemeinschaft für Osteosynthesefragen (AO) 31-B2 and B3) underwent either Exeter total hip replacement (THA) or hemiarthroplasty with cement (Exeter bipolar or Thompson hemiarthroplasty). Patient selection for THA was at the operating surgeon's discretion. Surgeons in our institute tend to employ a two-hole SHS for intracapsular fractures selected for fixation. 1 patient had 3 cannulated screws for an undisplaced intracapsular fracture, however they were subsequently excluded based on age criteria.

Extracapsular fractures were fixed depending on fracture characteristics, with either a sliding hip screw (SHS) (typically for AO 31-A1 and A2) or intramedullary (IM) nail (typically for AO 31-A3).[14] Fractures with a subtrochanteric extension were managed with IM nails and included in the analysis. No change to warming protocols or change in device supplier or manufacturer occurred during the study period. Our hip fracture patients are not routinely followed up, apart from THA patients who are seen at 6 weeks and 1 year.

The primary outcome measure was presence of hypothermia, defined as core temperature < 36 °C, measured upon entering recovery after surgery was concluded. Tympanic membrane/auxiliary temperature was used as it is readily obtained, reflects current practice and has been validated to reflect core temperature.[15]

An enquiry of theatre records obtained demographic data to include: age, gender, American Society of Anasthesiology (ASA) grade, and ethnicity. Anaesthetic and surgical data collected included: surgical procedure and side, anaesthetic type, theatre location (all within same building), operative time, time in theatre, and presence of active rewarming devices (blanket, forced air blanket, fluid warmer, and/or heated mattress).

Secondary outcome measures included 30-day mortality, LoS, 30-day readmissions, and subsequent diagnosis (chest infection, wound complication, deep vein thrombosis (DVT), pulmonary embolism (PE), prosthesis complication, joint pain, and complications unrelated to surgery). All patients received a dose of prophylactic antibiotic at induction prior to incision and all were prescribed chemical thromboprophylaxis whilst inpatients.

2.1. Statistical analysis

Statistical analysis was performed on two cohorts: hypothermia patients and ≥36 °C patients. Nominal and ordinal data are described as case numbers and percentages with comparison using chi-squared analysis. Continuous data is presented as mean and range with comparison using t-test. A binary logistic regression was performed to