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Waiting time to surgery is correlated with an increased risk of serious adverse events during hospital stay in patients with hip-fracture: A cohort study

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ABSTRACT

Background: Hip fractures are common in the elderly and are associated with a high adverse event and mortality rate. Time to surgery is one of the major modifiable risk factors influencing adverse outcomes in hip-fracture patients. National guidelines and recommendations have been introduced which advocate specific time frames in which surgery should be performed i.e. within 24–48 h. These time constraints have been arbitrarily set without being modelled on the linear assumption i.e. that risk increases continually over time and not within specific cut-off times.
Objectives: To investigate how waiting time to surgery influenced the risk of serious adverse events in hip-fracture patients during the hospital stay and to examine how the risk increased over time.
Design: An observational single cohort study Participants 576 patients (72.4% females, mean [SD] age 82 [10]) years, with a hip fracture were included in the cohort study.
Methods: The outcomes of the study were the occurrence of serious adverse events during hospital stay, length of stay and one-year mortality. A structured medical record review was carried out to identify outcomes and mortality data was obtained from the Swedish National Death Registry. Waiting time to surgery was used as the exposure variable and age, sex, type of fracture, comorbidities using the American Society of Anaesthesiologists classification score and the presence of cognitive dysfunction were identified as confounders. A logistic regression analysis was performed to identify risk factors influencing outcomes.
Results: A total of 119 patients (20.6%) suffered 397 (range 1–5) serious adverse events during hospital stay. Every 10 h of waiting time to surgery increased the risk of serious adverse events by 12% (odds ratio 1.12 [95% confidence interval 1.02–1.23]). We found no optimal cut-off times for waiting time to surgery. For every 24 h of waiting time, the length of stay from surgery was increased by 0.6 days (95% CI 0.1–1.1). We found no correlation between waiting time to surgery and one-year mortality.
Conclusions: A large proportion of patients suffered from at least one serious adverse event after hip-fracture surgery and there are no safe limits for waiting time to surgery for hip-fracture patients. As the risk increases with every hour of waiting time, patients with higher American Society of Anesthesiologists classification scores, males and those with subtrochanteric fractures should be prioritized for surgery.

1. Introduction

Hip fractures are one of the most common fracture types worldwide. (Johnell and Kanis, 2006). In Sweden annually, approximately 18,000 individuals sustain a hip fracture (Rikshöft, 2014) and this figure is predicted to almost double by the year 2050 (Rosengren and Karlsson, 2014). Surgery is the preferred treatment, but historically hip-fracture patients have not been a prioritized group. Traditionally they have been considered sub-acute patients whose surgery could be postponed to provide theatre space for more acute cases.

Patients with hip fractures are one of the largest groups occupying acute beds in orthopaedic wards. They are typically

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elderly, the mean age in Sweden is 82 years and the majority (69%) are female (Rikshöft, 2014). They frequently have coexisting health problems and are subsequently often not in optimal condition for surgery. Because of their advanced years, frailty and the presence of pre-existing health issues they normally require advanced medical and nursing care both in the pre, peri and post-operative stages of their treatment. Adverse events (AEs) in the postoperative period are a major problem presenting challenges in the care of this patient group and are costly from a health-economic perspective (Khasraghi et al., 2003). The one-year mortality rate after hip fracture is high, ranging from 21 to 29% (Haleem et al., 2008; Mundi et al., 2014) which is comparable with the figures for the one-year mortality rate of 29.6% for all cancers combined (Cancer Research UK, 2014).

In recent years, time to surgery has emerged as one of the major modifiable risk factors influencing complications in hip-fracture patients (Belmont et al., 2014). Current systematic reviews and meta-analyses of the literature have established that early surgery is associated with a decreased risk of pressure ulcers and post-operative pneumonia (Simunovic et al., 2010), a reduced length of hospital stay and a reduction in complications and mortality (Khan et al., 2009). Undergoing surgery within 12 h after admission significantly decreases the 30-day mortality rate (Bretherton and Parker, 2015). Delays of 48 h or more to surgery are associated with a significantly increased risk of mortality (Moja et al., 2012; Shiga et al., 2008) and no unfavourable outcomes have been reported with early surgery (Khan et al., 2009). In the studies reviewed (Simunovic et al., 2010) the cut-off times to surgery have been arbitrarily set and vary widely, but generally early surgery was regarded as surgery performed within 24–48 h after admission to hospital.

National guidelines and recommendations have been introduced which advocate specific time frames in which surgery should be performed. Some countries, have even introduced economic incentives to help further this end. Many of these encourage surgery on the day of or the day after admission (AAOS, 2014; ANZHFR, 2016; NICE, 2012). The definition of early surgery i.e. within 24–48 h is, in itself problematic, as these time constraints have been arbitrarily set without being modelled on the linear assumption i.e. that risk increases continually over time and not within specific cut-off times.

The aim of this study was to investigate how waiting time to surgery correlates to the risk of serious adverse events (SAEs) in hip-fracture patients during the hospital stay and to examine the influence of cut-off times on risk.

2. Material and methods

2.1. Study design, setting and participants

This observational single cohort study was carried out at the Orthopaedic Department of Danderyd Hospital, one of the acute hospitals servicing the Stockholm metropolitan area with a catchment area of approximately 500,000 inhabitants. The Orthopaedic Department has a 52-bed unit, where patients undergoing acute and elective surgery are cared for. A total of 5000 orthopaedic operations are performed annually, of these approximately 650 are hip-fracture operations. Patients with hip fractures constitute the largest in-patient group undergoing acute orthopaedic surgery. All patients admitted consecutively with an acute hip fracture during the inclusion period of one year were included in the study. No age limits were imposed. Patients with pathological fractures or peri-prosthetic fractures were excluded from participation in the study. The STROBE guidelines for reporting were adhered to (von Elm et al., 2014).

At the department, a fast-track system for hip-fracture patients has been in operation since the early 2000's. These patients normally receive initial pain relief administered in the ambulance prior to arrival at the hospital. After arriving at the Casualty Department, the patient is transferred to a trolley, triaged and prioritized by the admissions nurse. A nurse then performs an electrocardiogram; a short portable mental status questionnaire (Pfeiffer, 1975) is done to assess the patient's mental status and blood samples are then taken. While in the Casualty Department, the duty orthopaedic resident carries out a physical examination and assessment. The patient is then transferred to the Radiology Department for X-rays and following this, is transported to the orthopaedic ward and prepared for surgery. During the period of the study, no changes in the care regime of hip-fracture patients were implemented.

2.2. Variables

2.2.1. Outcomes and definitions

The outcomes of the study were the occurrence of any SAE during the hospital stay, the length of hospital stay and the mortality rate at one year. A modified version of the International Conference on Harmonisation—Good Clinical Practice (ICH-GCP, 1996) definition of an SAE was used. An SAE was defined as (a) any unfavourable or unintended sign, symptom or disease associated with the use of a medical treatment or procedure and that also was either (b) life threatening, (c) prolonged an existing hospitalization, (d) resulted in death or in a (e) persistent or significant disability or incapacity.

2.2.2. Data sources and quantitative variables

Using a standardized medical record review, data was collected from the electronic patient record of each patient, which includes entries by all staff-categories. A digital case report form was completed for each patient. The following data was recorded: age, sex, fracture type (cervical/trochanteric/subtrochanteric), waiting time to surgery (hours), type of surgery (internal fixation/hip arthroplasty/sliding hip screw or intramedullary nail), length of stay (days), cognitive dysfunction (yes/no), the American Society of Anaesthesiologists (ASA) classification score which gives an indication of the patient's health status (1 healthy – 5 moribund), (Owens et al., 1978). This score is widely used internationally by anaesthesiologists for the pre-operative assessment of physical health status and is used as a proxy for pre-operative comorbidity in research studies (Söderqvist et al., 2009). The medical records were reviewed by the first author (PKP) for the identification of any SAEs occurring during hospital stay. The length of hospital stay in days was recorded and data about the one-year mortality rate was obtained from the Swedish National Death Registry. We defined the length of stay as the number of days in hospital after surgery. The waiting time to surgery was then correlated to the number of SAEs occurring during each patient's hospital stay, as well as, to the length of hospital stay and the one-year mortality.

2.2.3. Exposure and confounders

The exposure variable in the study was the waiting time to surgery. This was defined as the time that had elapsed in hours, from time of arrival at the Casualty Department to actual time of first incision in theatre. Nine patients sustained fractures while in-patients for other medical conditions. Instead of arrival time at the hospital, the time of confirmed diagnosis i.e. time of X-ray was used in these cases. Confounders are factors with a possible causal effect on both the exposure variable and the outcome variables. The confounders identified in this study were age, sex, type of fracture, comorbidities as reflected in the ASA classification score and the presence of cognitive dysfunction. A directed acyclic graph