Hip fracture surgery in mixed-use emergency theatres: is the infection risk increased? A retrospective matched cohort study

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ABSTRACT

INTRODUCTION The National Institute of Health and Care Excellence recommends that people with hip fracture should have surgery on the day of, or the day after, admission. However, there remains unacceptable variation in performance around the country, with a range of 13–91% of patients meeting this target. Dedicated trauma lists have insufficient capacity in many hospitals. We occasionally employ a mixed-use emergency theatre to facilitate early surgery. Increased risk of infection has been raised as a concern owing to microbial surface contamination from a preceding unclean case and lack of laminar flow in these theatres. The objective of this study was to investigate whether there is an increased risk of surgical site infections in patients who had hip fracture surgery in a mixed-use emergency theatre.

METHODS Between August 2010 and July 2014, 74 patients had hip fracture surgery in a mixed-use emergency theatre without laminar flow. This group was compared with a control group of patients who had hip fracture surgery in dedicated orthopaedic theatres with laminar flow. Infection was the primary outcome measured.

RESULTS There was no statistically significant difference in the rate of infection, length of stay or 30-day mortality, readmission or reoperation rates between the two groups.

CONCLUSIONS Operating on hip fractures in mixed-use theatre did not lead to an increase in infection or other complications in our series. We feel that the risk of infection can be balanced against advantages of timely operation and it may therefore be justified to use these theatres when faced with lack of time on the trauma list. A much larger series would be required to investigate the effects of confounders.

KEYWORDS

Hip fractures – Infection – Mixed-use emergency theatre

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Introduction

Early operation and multidisciplinary treatment of hip fractures have shown to reduce morbidity and death in elderly patients.^{1–4} Several guidelines exist to improve management of these patients.^{5–7} One of the key recommendations is that surgery should be within 36–48 hours of arrival in the emergency department. The hip fracture ‘best practice tariff’ encourages NHS trusts to use dedicated trauma lists to help meet this target but an unacceptable variation in performance around the country is noted, with only 72% of patients having their surgery within this time frame, primarily due to insufficient time on dedicated trauma lists.^{8,9}

At the Royal Surrey County Hospital, we have been using available space in the emergency theatre or in theatres used by other specialties to facilitate early surgery for hip fractures. However, an increased risk of infection from a preceding dirty case is frequently raised as a concern. While there is increasing evidence to suggest that laminar flow ventilation is not

essential for orthopaedic surgery,^{16–20} not much evidence exists to support the common practice of delaying an urgent hip operation for the lack of time on a dedicated orthopaedic theatre. Our null hypothesis is that patients who had their hip fracture surgery in a mixed-use plenum ventilated theatre have the same infection rate as those operated in an orthopaedic dedicated laminar flow operating theatre. We tested this by comparing the infection rate and other surrogate outcome measures with a matched group.

Materials and Methods

Between August 2010 and July 2014, 1,444 patients had surgery for a proximal femur fracture in our unit. Of these, 74 patients (5%) had hip fracture surgery in a shared emergency theatre without laminar flow. All these patients formed part of the CEPD group (CEPD cohort). Almost all of the patients in this CEPD cohort were preceded by drainage of an abscess, laparotomy or other ‘dirty case’. Of

the remaining 1,370 patients who had their operation in a dedicated orthopaedic laminar flow theatre, 85 were selected as the best possible match for the patients in the CEPOD cohort (matched group). Matching was for age, American Society of Anesthesiologists (ASA) grade, Abbreviated Mental Test score and residence status, using MS Excel. Some patients in the CEPOD group had more than one exact match in the mixed-theatre group. A statistician blinded to the outcome measured selected the matches.

Patients in both groups received antibiotic prophylaxis according to the standard protocol. All were subject to standard preoperative optimisation and postoperative care. Drains were not used routinely and wounds were covered with an occlusive dressing. Surgery in both groups was performed within the framework of the NCEPOD recommendations and the National Institute of Health and Care Excellence guidelines, which included operating during the day under supervision of orthopaedic and anaesthetic consultants and with the help of orthopaedically trained scrub nurses.^{7,10} Pre- and postoperative care in both groups was multidisciplinary, in accordance with British Orthopaedic Association standards for trauma and was led by an orthogeriatric consultant.⁵

The primary outcome measured was diagnosis of a wound infection. Patient records were examined for a minimum of 6 months from the index procedure for any documentation of wound leakage, treatment with antibiotics and any microbiology culture or swabs from the hip, readmission or reoperation. Reoperation rates, length of stay, readmission and 30-day mortality were measured as surrogate outcomes as any infection could have indirectly affected these.

The minimum follow-up period was six months, to allow for any delayed wound problems to be included. Admission to the accident and emergency department, hospital notes and laboratory results were reviewed to identify any late infections. The outcome data were analysed by a biostatistician using SPSS Statistics version 17.0.

Results

Group demographic details, including the accuracy of matching of the study and control groups, are shown in Table 1. Both groups were comparable, with no significant differences in patient age, Abbreviated Mental Test score, ASA grade or residence status at the time of admission. Forty-four (59.5%) patients in the CEPOD group had cemented hemiarthroplasty. Twenty-nine patients (39%) had a dynamic hip screw and one (1.4%) had an open intramedullary nail of the femur.

The outcome is summarised in Table 2. None of the 74 patients in CEPOD cohort had a wound infection or repeat surgery within 30 days. Two patients in the matched group had a second operation within 30 days. One of these was a washout for persistent wound ooze and the second was for a periprosthetic fracture of the femur after hip hemiarthroplasty.

The 30-day mortality in the CEPOD cohort was 5.2% ($n = 2$) compared with 6.2% in the matched group. This was

not statistically significant (Chi-square test; $P = 0.805$). Mean length of hospital stay for the CEPOD group was 21.6 days (median 14 days, range 3–117 days) compared with a mean of 16.5 days for the control group. This difference, although seemingly noteworthy, failed to reach statistical significance (Chi-square test for 95% limit showed a P value of 0.110). We further examined the case notes of patients in CEPOD group with a hospital stay of over 14 days and surgical site infection was not found to be the cause for their prolonged stay.

Discussion

The reported infection rate in hip fracture surgery is between 0.7% and 1.2%.^{11–15} An optimal operating theatre environment and the use of laminar flow ventilation have been shown to reduce the infection rate.¹⁴ However, a better understanding of other risk factors has also developed over time, leading to parallel improvements in theatre design, discipline and practice, implants and prosthesis, operating technique, cement impregnation with antibiotics and antibiotic prophylaxis. Many recent papers have attempted to analyse patient-related factors (age, gender, comorbidities, type of fracture) and treatment variables (duration of surgery and grade of surgeon) as risk factors for surgical site infection in the elderly population.^{11–15,15} No studies have specifically analysed the effect of a shared theatre on infection rate. However, it appears to be current standard practice to perform all orthopaedic hip and knee implant surgery exclusively in dedicated orthopaedic theatres with modern laminar flow, owing to concerns that a shared theatre room may be excessively contaminated from a preceding 'dirty' case.

Early operation for fractures of hip in the elderly has produced better outcomes. Approximately 72% of patients in the UK with hip fracture had surgery on the day of, or the day after, admission in 2014, despite dedicated trauma lists and prioritisation of these operations.^{7,8} Lack of space on the trauma list is thought to be the most common cause for this delay.⁹ At the Royal Surrey County Hospital we occasionally use an available mixed-use emergency theatre to facilitate timely surgery of these hip fractures when faced with lack of space on the trauma list. The issue of air contamination has been extensively debated and published, with some recent evidence raising doubts on the usefulness of laminar flow in preventing infection in orthopaedic surgery.^{16–20} There are, however, few publications to study the effect of mixed-use theatres and microbial surface contamination in causing infection in orthopaedic surgery. The British Orthopaedic Association's published guide to good practice for primary total hip replacement states that 95% of bacteria are cleared from a conventional theatre within 11 minutes and if the theatre has been used for a dirty case, at least that period of time should pass before a total hip replacement is undertaken.²¹ A recent study from the Johns Hopkins University, Baltimore, USA, measured microbial surface contamination from different surfaces in operating rooms after standard operating room turnover (without deep cleaning between infected and non-infected cases).²² No significant difference

Table 1 Demographic characteristics of two groups of patients (*N* = 159).

Patient characteristic	CEPOD group (<i>n</i> = 74)	Matched group (<i>n</i> = 85)	<i>P</i> value
Age:			
Mean at surgery, years (SD)	85.1 (7.9)	84.8 (8.4)	0.873 ^a
60–69 years (%)	5.2	6.2	
70–79 years (%)	24.1	22.2	
80–89 years (%)	41.4	38.3	
≥ 90 years (%)	29.3	33.4	
Gender:			
Female (<i>n</i>)	52	60	
Male (<i>n</i>)	22	25	
AMTS (SD)	6.6 (3.5)	7.0 (3.6)	0.496 ^a
ASA grade :			0.920 ^b
1 (%)	12.1	11.1	
2 (%)	39.7	39.5	
3 (%)	46.6	45.7	
4 (%)	1.7	3.7	
Residence at time of admission:			0.858 ^b
Nursing care (%)	12.1	8.6	
Own home/sheltered housing (%)	67.2	71.6	
Rehabilitation unit (%)	3.4	1.2	
Residential care (%)	12.1	13.6	
Acute hospital (%)	5.2	4.9	
^a Independent t test			
^b Chi-square test			
AMTS, Abbreviated Mental Test score; ASA, American Society of Anesthesiologists; SD, standard deviation.			

Table 2 Primary and surrogate outcome measures in the two groups.

Measure	CEPOD cohort (<i>n</i> = 74)	Matched group (<i>n</i> = 85)	<i>P</i> value
Infection, <i>n</i> (%)	0 (0)	1 (1.17)	–
30-day readmission	0	0	–
Length of stay, mean days (SD)	21.6 (± 23.8)	16.5 (± 13.5)	0.110
≤ 7 (%)	22.4	22.2	
8–14 (%)	36.2	34.6	
15–21 (%)	12.1	22.2	
> 21 (%)	29.3	21	
30-day mortality (%)	5.2	6.2	0.803

was found in microbial colony counts between infected and non-infected cases and no relationship was found between organisms isolated from infected cases and those from

operating-room surfaces. Furthermore, the largest colony count from both groups (0.08 cfu/cm²) was much less than the proposed 5-cfu/cm² thresholds for surface hygiene in

hospitals.²⁵ The authors concluded that standard operating-room turnover results in minimum surface contamination, regardless of the infection status of the previous case, and that there is no need for a more extensive deep-cleaning protocol after an infected case. This is supported by our results and helps to justify our clinical practice. However, we advise caution about making this choice routine for orthopaedic implant surgery, since our sample size is small and, with an incidence of 1% for infections, we would require a very large sample and a prospective cohort study maybe more appropriate.

This study has limitations. The aim of the study was to provide a retrospective snapshot and it was not feasible to account for numerous confounders. Future study designs should also consider accounting for confounders such as patients' medications, comorbidities, level of social support and immunocompromise. A randomised controlled trial would have its own ethical dilemmas and challenges.

Conclusion

Operating on hip fractures in mixed-use theatre did not lead to an increase in infection or other complications in our series. We consider that the risk of infection can be balanced against advantages of timely operation and it may therefore be justified to use these theatres when faced with lack of time on a trauma list. A much larger series would be required to establish safety.

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