

# Pre-operative urinary tract infection: is it a risk factor for early surgical site infection with hip fracture surgery? A retrospective analysis

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## Summary

**Objective:** The aims of the current study were to determine whether pre-operative urinary tract infections in patients presenting acutely with neck of femur fractures resulted in a delay to surgery and whether such patients were at increased risk of developing post-operative surgical site infections.

**Design:** A retrospective review of all patients presenting with a neck of femur fracture, at a single centre over a one-year period. The hospital hip fracture database was used as the main source of data.

**Setting:** UK University Teaching Hospital

**Participants:** All patients ( $n=460$ ) presenting across a single year study period with a confirmed hip fracture.

**Outcome measures:** The presence of pre-operative urinary tract infection, the timing of surgical intervention, the occurrence of post-operative surgical site infection and the pathogens identified.

**Results:** A total of 367 patients were operated upon within 24 hours of admission. Urinary infections were the least common cause of delay. A total of 99 patients (21.5%) had pre-operative urinary tract infection. Post-operatively, a total of 57 (12.4%) patients developed a surgical site infection. Among the latter, 31 (54.4%) did not have a pre-operative urinary infection, 23 (40.4%) patients had a pre-operative urinary tract infection, 2 had chronic leg ulcers and one patient had a pre-operative chest infection. Statistically, there was a strong relationship between pre-operative urinary tract infection and the development of post-operative surgical site infection ( $p$ -value: 0.0005).

**Conclusion:** The results of our study indicate that pre-operative urinary tract infection has a high prevalence amongst those presenting with neck of femur fractures, and this is a risk factor for the later development of post-operative surgical site infection.

## Keywords

Hip, delay, urinary, infection

## Introduction

With an increasingly ageing UK population, the annual incidence of hip fractures has continued to

rise year on year, with this pattern expected to continue. The reported incidence in 2015 from the UK national hip fracture database was 65,000, costing an estimated £2 billion.<sup>1,2</sup> Hospital stay and theatre time constitute the majority of the cost of hip fracture management.<sup>3</sup>

Superficial and deep surgical site infections, although rare, can result in significant patient morbidity following hip fracture surgery. Risk factors for the development of post-operative surgical site infection are poorly understood in the literature.<sup>4</sup> The majority of such infections are superficial and cause minimal disruption to patient rehabilitation. Deep infections (those extending beneath the fascia lata) represent a more severe complication with a much worse prognosis for patients.

Surgical site infections following hip fracture surgery result in prolonged antibiotic treatment, the need for further potential operative interventions, increase in the overall hospital stay time and higher overall financial inferences.<sup>3</sup> The cost of proximal femoral fracture management can rise threefold in the presence of deep infection, with an estimated expense of £24,410 compared to £7,210 for a non-infected case.<sup>5</sup>

The timing for hip surgery is a crucial factor in minimising morbidity and mortality in this patient group.<sup>6</sup> Current practice in the United Kingdom follows the Department of Health's best practice tariff, advocating surgery for hip fractures within 36 hours of presentation, which is closely in line with the British Orthopaedic Association (BOA) guidance of 48 hours.<sup>7</sup> There is currently no general consensus with regard to the timing of operative intervention for hip fractures in those with confirmed urinary tract infections.

The aims of the current study were twofold. We first wanted to assess whether current practice led to delays in surgery for hip fractures in those

with confirmed pre-operative urinary tract infection. In addition, we wanted to determine whether there was an association between a diagnosis of pre-operative urinary tract infection at presentation and the later development of post-operative surgical site wound infection.

## Methods

In this retrospective cohort analysis, we reviewed 460 patients over a one-year period at a major United Kingdom trauma centre. All patients presenting with a neck of femur fracture were included in the current study. Those patients deemed not medically fit for surgery and hence not undergoing any form of intervention were excluded.

The hospital hip fracture database was used as the main source of data. This database contains information regarding all hip fracture admissions at the unit, including demographic patient data, timing to surgery, cause of delay to surgery, type of surgical intervention, post-operative complications, timing to discharge and cause of delay to discharge. All patients on admission with a hip fracture underwent routine pre-operative chest radiograph, electrocardiogram, routine blood tests and urine dipstick. Those patients in whom a pre-operative urinary tract infection was diagnosed were treated with an immediate three-day course of antibiotics, in the form of trimethoprim (200 mg twice daily), with regular urine dipstick testing review. Furthermore, all patients received surgical prophylaxis in the form of a stat dose of flucloxacillin and gentamicin during anaesthetic induction and a further dose of flucloxacillin 4 hours after their respective procedure. The type of intervention for each hip fracture followed the principles of the The National Institute for Health and Care Excellence hip fracture management guidelines.<sup>8</sup> Patient case notes and electronic laboratory reports were scrutinised to determine whether patients were positive for a urinary tract infection and which organisms were responsible for each infection. All data were collected and stored on Microsoft Excel™ (2010, Microsoft, Redmond, WA, USA). Data were analysed using Stata ver. 8.2 (Stata Corp., College Station, TX, USA).

A contingency table was constructed comparing the outcome of post-operative surgical site infection with the pre-operative urinary tract infection and non-urinary tract infection infection groups. Fisher's exact test was selected in view of the relative smaller patient numbers to examine for significance of association between pre-operative Urinary tract infection and post-operative surgical site infection.

**Table 1.** Home circumstances.

Home circumstances	Number	%
Home alone	180	39
Home family	177	38
Home care	13	3
Nursing home	33	7
Residential home	27	6
Hospital inpatient	17	4
Unknown	13	3

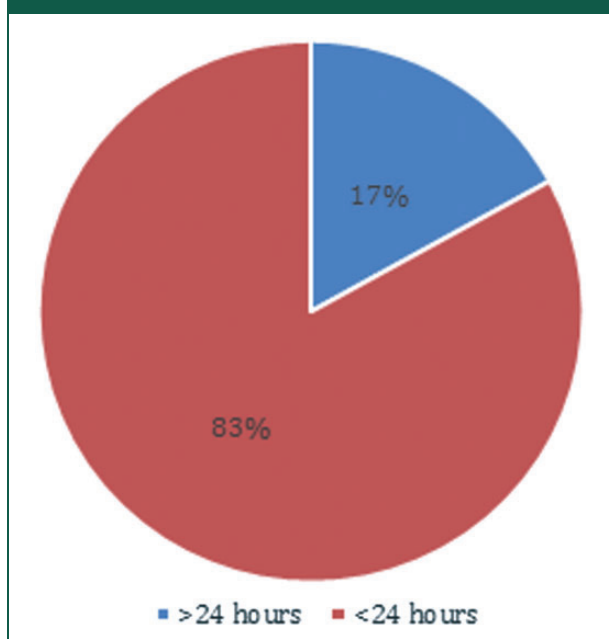
**Table 2.** Pre-admission mobility status.

Pre-admission mobility status	Number	%
No Aids	194	42
Stick	127	28
Crutches	5	1
Zimmer	77	17
Wheelchair	9	2
Housebound	16	3
Unknown	32	7

## Results

A total of 460 patients met the inclusion criteria. There were 124 males (27%) and 336 females (73%), with an average age of 80.9 years. The majority of patients lived at home, either alone or with family requiring no care prior to injury; see Table 1. Furthermore, most patients (70%) were either completely independently mobile or required the aid of a stick only, see Table 2. A total of 367 (79.8%) patients were operated on within less than 24 hours (Figure 1). The most common procedure performed for hip fractures during the study period was a hemiarthroplasty, followed closely by fixation using the dynamic hip screw (DHS); see Table 3. Total hip replacement (THR) was the least performed operation for hip fractures in the cohort we analysed. The commonest cause for delay in surgery was lack of theatre time. UTI was the least likely reason for delaying surgery (Figure 2).

Of the 460 patients analysed, 99 (21.5%) patients were identified as having a pre-operative urinary tract

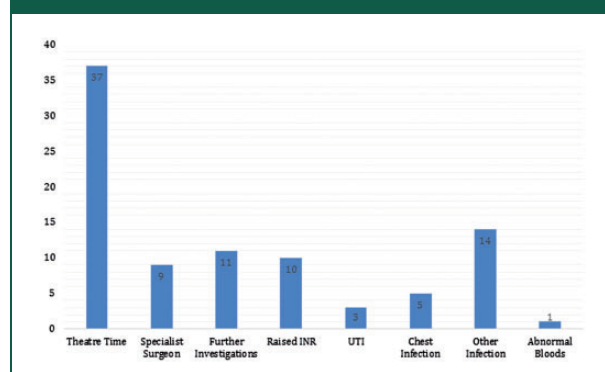
**Figure 1.** Compliance in early surgery.**Table 3.** Type of operation.

Operation type	Number	%
Hemi-arthroplasty	169	37
A-O screws	38	8
Nail	79	17
THR	23	5
DHS	115	25
Unclear/missing data	36	5

infection. A total of 57 (12.4%) patients were reported to have suffered from a post-operative wound infection. Of these with post-operative SSI, 31 (54.4%) did not show any evidence of pre-operative infection, 23 (40.4%) patients had pre-operative urinary tract infection, two had longstanding leg ulcers and one had a pre-operative chest infection; see Figure 3.

Fisher's exact test revealed a two-tailed  $p$  value of 0.0005, indicating a significant association of pre-operative urinary tract infection and post-operative surgical site infection in this subset of patients; see Table 4.

Among the patients with confirmed urinary tract infection, 13 had reported chronic infections. Of the group of patients with pre-operative urinary tract

**Figure 2.** Causes of delay of hip fracture surgery.**Figure 3.** Percentage of concomitant UTI and SSI.**Table 4.** Contingency table comparing our risk factor and primary outcome.

		Surgical site infection		Total
		Positive	Negative	
Urinary tract infection	Positive	23	76	99
	Negative	34	327	361
Total		57	403	460

infection and post-operative wound infection, five had the same causative organism isolated in both the urinary tract and wound. The most common causative organism of the urinary tract was *Escherichia coli*, followed by mixed growth of organisms, *Enterococcus faecalis* and *Pseudomonas*. The most common causative organism for post-operative surgical site infection was *Staphylococcus aureus* followed by mixed growth samples, *Staphylococcus epidermidis* and *E. faecalis*.

## Discussion

Post-operative surgical site infection following hip fracture surgery can have a spectrum of consequences ranging from delay in return to full mobility to mortality from the effects of sepsis and multiorgan failure.<sup>9</sup> Delay in performing hip fracture surgery is also known to have a negative effect with increased morbidity and mortality rates in comparison to those undergoing early surgical intervention. There is therefore a management dilemma in the timing of surgery in patients with concomitant hip fracture and urinary tract infection.

This retrospective study was conducted primarily to determine whether pre-operative urinary tract infection is related to post-operative surgical site infection, with the secondary aim of establishing whether delay in hip fracture surgery was warranted in such patients. To our knowledge, there are no previous studies addressing this specific subject. It has previously been speculated that risk factors for developing urinary tract infection following neck of femur fractures in the pre-operative period included: increasing age, intracapsular fracture patterns and operative delay of more than 48 hours.<sup>10</sup> Furthermore, in the same study, it was shown that prophylactic pre-operative antibiotics appeared to be ineffective in eradicating infection in the short term. This would support the case for performing early surgery despite a proven pre-operative urinary tract infection, which is in keeping with our current practice, with urinary tract infection causing only three delays to surgery in our study period.

A large retrospective study from the UK looking at risk factors for the development of surgical site infection following hip fracture surgery failed to identify any statistically significant pre-operative variables.<sup>11</sup> Although in this study, pre-existing renal disease was investigated, there was no mention of pre-existing urinary tract infection specifically. In a separate study focusing on hip hemi-arthroplasty surgery specifically, it was found that advancing age and American Society of Anesthesiologists class  $\geq 3$  were significant risk factors for developing post-operative surgical site infection.<sup>12</sup> Similarly, although multiple variables were assessed in this study, pre-operative urinary tract infection was not discussed.

In a large series from the USA addressing urinary tract infection as risk factor for deep infection after joint arthroplasty, it was concluded that no association could be determined.<sup>13</sup> However, in the elective setting, most patients undergoing pre-operative assessments are diagnosed and treated for urinary tract infection well in advance of surgery. Furthermore, post-operative infection rates are significantly lower in elective arthroplasty surgery. For these reasons, the power of such studies tend to be

low and conclusions should not be generalised to the trauma setting. The results from our study demonstrate a significantly higher incidence in both the rate of pre-operative urinary tract infections and post-operative wound infections in the acute trauma setting.

Post-operative urinary tract infection has been shown to be an independently statistically significant risk factor for peri-prosthetic infection in elective arthroplasty surgery.<sup>14</sup>

Our study has shown a potential correlation between pre-operative urinary tract infection and surgical site infection. However, of the group of patients with pre-operative urinary tract infection and post-operative surgical site infection, only five had the same causative organism isolated in both the urinary tract and wound. The isolated organisms from the surgical site were different from the causative organisms in the urinary tract in the remaining 18 patients. The spread of infection from the urinary tract to the surgical site can take the form of haematogenous spread or direct contact due to the close proximity of the two areas. In both scenarios, it would be reasonable to assume that similar organisms should be isolated from both sites, if the two entities were in fact related. The significant number of patients with different organisms between the urinary tract and wound site would suggest a potential alternative causative mechanism such as immunosuppression associated with urinary tract infection.

The main limitations associated with this current study lie with the small numbers reviewed and the retrospective nature of its design. We were unable to determine key features around each urinary tract infection, including whether it was symptomatic or not and the potential etiologies behind the chronic urinary tract infection subgroup of patients. Furthermore, we were unable to control for nursing factors, including wound care, wound reviews and toileting considerations. The close proximity of the hip wound to potential urine contamination renders this a vital confounding variable in study design when determining a true relationship. Lastly, as this was a retrospective analysis, we were limited to the degree of correction we could perform against other known confounding variables from prior literature. Ideally, a prospective randomised design dividing patients with pre-operative urinary tract infection into those delayed to surgery for treatment of infection versus those undergoing immediate surgery would be most useful in addressing the current issue. Known confounding variables discussed earlier could be controlled amongst the two groups of patients with a prospective design. The acute nature of hip fractures and the cognitive impairment often associated with



urinary tract infection would raise several ethical issues in trial design.

## Conclusions

Research into the potential risk factors for post-operative surgical site infection is an important field. Several previous studies have outlined multiple risk factors. However, the majority of previous studies have looked at hip arthroplasty surgery in the elective setting. In this subset of patients, the overall post-operative surgical site infection rate is significantly low meaning most studies are underpowered. Furthermore, when looking at specific risk factors such as urinary tract infection, patients are often diagnosed in the pre-operative clinic and treated for the condition prior to any elective surgery, ultimately eliminating this comorbidity from elective practice. In the trauma setting, however, urinary tract infection is not an uncommon finding amongst this population group presenting with hip fractures.

This study has addressed an important risk factor for surgical site infection. We have demonstrated a possible link of urinary tract infection to surgical site infection. However, from the previous literature, it is clear there are likely multitudes of confounding variables, which have not been corrected for in this study. It would seem that in current practice a diagnosis of pre-operative urinary tract infection does not result in delay to hip fracture surgery, and early surgery is still deemed more beneficial to patients. We would advocate further prospective studies in this area controlling for patient, surgical and post-operative care risk factors.

## Declarations

**Competing interests:** None declared

**Funding:** None declared

**Ethical approval:** Approval obtained as appropriate

**Guarantor:** RRDY

**Contributorship:** RRDY: Study design, data collection, analysis of the results and preparation of the manuscript; MYK: analysis of the results and preparation of the manuscript; KV: Study design, data collection, and analysis of the results; DAE: Senior supervision.

**Acknowledgments:** We thank A Ahmed for help with data collection and J Russ for providing us the helpful lists of patients with fracture neck of femur.

**Provenance:** Not commissioned; peer-reviewed by Barry Fearn.

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