

## Surgical Site Infection in Hip Fracture Surgery; Reducing the Incidence of Infection and Correlation With co Morbidities and Blood Parameters

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### ABSTRACT

Surgical site infections (SSIs) are associated with considerable morbidity and mortality. We aimed to reduce the infection rate in patients being treated for hip fractures at our unit over a period of two years by introducing an SSI policy incorporating the NICE

guidelines. We compared the rate of superficial and deep wound infections prior to and after these measures in our unit and compared this to national data for surgical site infection in fracture hip patients. A comparison was also made between those patients with a wound discharge treated non-operatively (group A) versus operatively (group B). Haematological parameters were collated for patients with wound discharge in the hope of determining a cut off point at which Hb CRP and WCC might predict those patients requiring wound washout or debridement. 1101 patients underwent hip fracture surgery during 2010-2012. Of 62 patients with a wound discharge, 16 patients required surgical intervention of which 15 had a positive wound culture swab. The commonest pathogen was staph aureus. Although we were unable to find a single cut off point using ROC curves, we demonstrate that WCC and CRP are strongly correlated to the need for requiring surgical intervention. The infection rate at our unit was reduced to 1.36 % compared to a national rate of 2-3%. The presence of a senior surgeon performing or supervising these cases (78%) was an important component of reducing the SSI rate.

**Key words:** Surgical site infection (ssi); Hip fracture; Wound discharge

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### INTRODUCTION

Surgical site infection in the elderly population presents a special problem leading to longer hospital stay, increase in morbidity, mortality and cost of treatment<sup>[1-2]</sup> SSIs also have a case fatality rate of 4.5%, and 38% of these deaths are directly attributable to the SSI (Astagneau *et al*, 2001). In the UK, Coello *et al* (2005) demonstrated that SSIs, regardless of severity, doubled the length of post-operative hospital stay with attributable increased costs of £1,000-6,000 per

infection, depending on the type of surgery.

Others have found that when readmissions to hospital, re-operations and other treatments are considered in patients undergoing proximal hip fracture surgery, a severe SSI can quadruple the costs of care and decrease patients' quality of life (Whitehouse *et al.*, 2002). Whitehouse JD *et al.* (2002), the impact of surgical-site infections following orthopaedic surgery at a community hospital and a university hospital: adverse quality of life, excess length of stay, and extra cost. *Infection Control and Hospital Epidemiology*; 23: 4, 183-189. Coello R *et al.* (2005) Adverse impact of surgical site infections in English hospitals. *Journal of Hospital Infection*; 60; 2, 93-103.

Implementing cost-effective preventive and therapeutic measures pre intra and post operatively will undoubtedly ameliorate the long term financial burden of NHS and may significantly improve the overall outcome and quality of life for the elderly patients after hip fracture<sup>[3,4]</sup> surgery.

To manage these patients effectively and provide best practise in care our trust adheres to the NICE guidelines and published standards of national hip fracture data base<sup>[5]</sup>. Our unit also introduced additional measures to reduce surgical site infection<sup>[6]</sup>.

Since the literature correlating co morbidities and haematological parameters in such patients is sparse, we hoped to research these further.

## METHODS

All patients who underwent hip surgery between 2010-2012 were studied. This period correlates with the introduction of the measures taken to reduce surgical site infection. During this period patients were monitored for any surgical site infections by a robust post operative SSI policy incorporating the NICE guidelines 2008 figure Surgical site infection to be placed in an appendix.

Prevention and treatment of surgical site infection. But also, incorporating the following: (1) No routine wound inspection; (2) Dressings stay on for 14 days (unless clinically indicated to review); (3) If the clinical need arises to review the wound it was communicated to defined single contact point, Trauma Nurse Practitioner; (4) Involvement of dedicated hip surgeon from day one when possible; (5) Early involvement of multidisciplinary team (microbiologist, orthogeriatric, Tissue viability and senior ward nursing staff).

The Surgical methods introduced to reduce infection were: (Figure 1 Methods to reduce infection): Senior surgeon operating or /Direct supervision; Pre-operative on table skin wash with chlorhexidine soap solution; Use of alcoholic Betadine and Chlorhexidine; Two opsite technique while draping of groin; Non-braided suture for closure and layered washout; Re application of Chlorhexidine to skin; Absorbable skin sutures with buried knots; Use of steristrips and Fria balsam; Opsite, wound pad for dressing wound inspection for 14 days unless clinically indicated.

Infection was defined as positive microbiology culture from deep tissue or wound swabs. All patients with a post operative wound infection (identified by the surgical surveillance team) and patients whose had samples sent to microbiology for culture and sensitivity were included.

We excluded patients who sustained polytrauma, early ward discharges < 5 days, age less than 60 yrs, referral from other hospitals for re interventions as well as all patients who were on antibiotics prior to surgery for urine infection, respiratory tract.

The incidence of SSI before these measures were put in place were taken from previous departmental audits, hospital statistics,

governance department and microbiology department.

We analysed treatment received by the patients, demographic data, male to female ratio, complications, any predisposing co morbidities and subsequent surgical interventions were analysed. The cohort who had wound oozes were divided into two categories Group A includes all patients with positive culture results and Group B with negative cultures.

All washouts were performed by a dedicated hip surgeon and a through layered debridement till hip joint was performed and deep tissue specimens sent for microbiology.

Data collection. Data was collected from microbiology department, prescribing information and communication system (PICS) and medical records (Figure 2).

## Statistical analysis

Data was analysed using SPSS. Variables with continuous data with normal distribution curve (parametric) was identified and a paired t-test was used to determine statistical significance. Mann Whitney U was used to compare abnormally distributed data for one variable. To determine the correlation of variables between group A and Group B binary logistic regression was used. A variable that had abnormally distributed data showed no statistical significance. Receiver operating characteristic (ROC) curve (Figure 3) is used to determine the best cut off point, area under curve (AOC) which predicted best result has an AUC of 1.0 and a point at 0.8 was identified to be best predictor.

Statistical significance throughout was defined as  $p < 0.05$ . The specificity and sensitivity were found to be 87% and 49% respectively for variable-white blood corpuscle that showed statistical significance. To determine the range for individuals who went for wound wash out box bar is used to estimate a cut of numerical value (Figure 4), which would determine if the patient needs a washout.

## RESULTS

1101 patients with primary hip fracture surgery were followed up prospectively. The study included 1101 patients over a 2-year period, with a mean age of 79.3 years, 45 females and 16 male patients. 1040 patients had clean wounds and sixty-one 61 patients were identified with wound discharges and subsequently deep wound swabs performed. Fifteen patients (group A) were identified with positive microbiology result and all those patients underwent wound debridement and washout Group B patients were managed conservatively with antibiotics, except for one patient warranting operative intervention due to profuse wound discharge and no growth of microorganism on prolonged culture.

Hypertension was the most common among 60% of which patients, followed by respiratory and other cardiac causes as depicted in pie diagram above. Seventy percent of the patients had two or more associated co morbidities and only 5% of patients had no co morbidities. The other Co morbidities that were looked in include renal failure, cancers, endocrine abnormalities, central nervous system and psychiatric causes. Patients were scored per number of co morbid disease and scored. Minimum score of zero when no disease was found and maximum depending on number of disease association noted.

Haematological parameters that may be indicative of infection from both patient group A and B ( $n = 61$ ) were analysed. The parameter (Table 1) include anaemia (Hb drop), C reactive protein, Albumin, pre-operative and post-operative waterlow score, WBC count. The mean time from index surgery to further intervention was thirty days ( $n = 30.1$  days) for Group A and seventeen days ( $n$

= 17.6 days) for Group B. The mean values of haemoglobin drop in both groups were noted to be 2 gm percent, Albumin-33.9, WBC-11, waterlow score of 24, CRP of 151 were noted. The most common organism isolated was staph aureus in 62.5% (n-10), pseudomonas in 18.75% (n-3), micrococcus (n-2), and E coli (n-1). Any patient with mixed skin organism was excluded from the data. Only patients with deep cultures positive were included in Group A. The other group had only wound ooze but no positive culture. All the Group A patients received antibiotics as per the local policy and sensitivity of the organism. Two patients needed repeat wound debridement and required prolonged antibiotics.

The *p* values for each variable are mentioned in table 1. Sixteen patients underwent hip wound washouts out of which 15 patients were confirmed culture positive and 1 was from the culture negative

group. The raised WBC count in Group A patients showed statistical significance of  $n=0.027$ . Combined WBC and CRP analysis using binary logistic regression has not demonstrated a positive correlation. We assume this bias may be due to small insufficient sample numbers in Group A. The co-morbidities were converted into numerical scoring (Table 2) considering the number of pre-existing systemic diseases prior to surgery. This showed no statistical significance likely influenced by the pre-existing disease burden in the cohort. When compared to national data<sup>[8]</sup>, the overall infection rate in our unit is significantly less ~1.36% (n-16) as compared to the national data base suggesting 2%-3%. The simple methods adopted such as senior surgeon operating or /direct supervision, pre operative on table skin wash with chlorhexidine soap solution, use of alcoholic betadine and Chlorhexidine, two opsite technique while draping of groin,

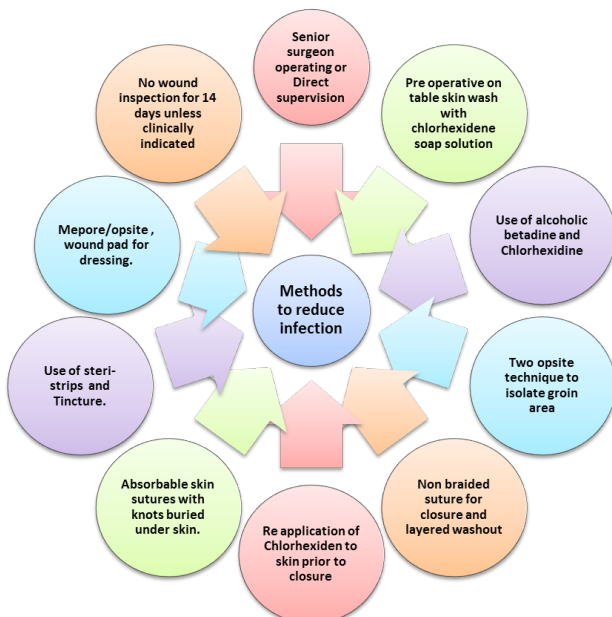


Figure 1 Methods to reduce infection.

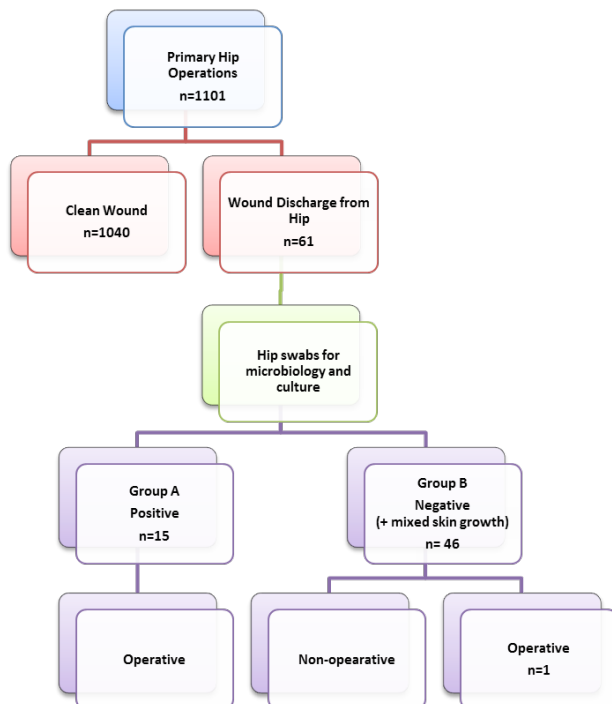


Figure 2 Flow chart of data.

Table 1 Haematological and waterlow score of both groups.

Variable	Positive (n = 16)	Negative (n = 44)	p value
Hb drop	2.19 ± 2.33	1.92 ± 1.79	0.64
CRP change	51.5 ± 73.2	86.9 ± 87.2	0.25
Albumin	32.1 ± 7.3	34.5 ± 5.6	0.19
Waterlow	18.7 ± 6.1	18.8 ± 6.0	0.95
WBC	12.8 ± 2.8	10.4 ± 3.7	0.027
CRP post op	93.4 ± 54.4	130.1 ± 69.1	0.061

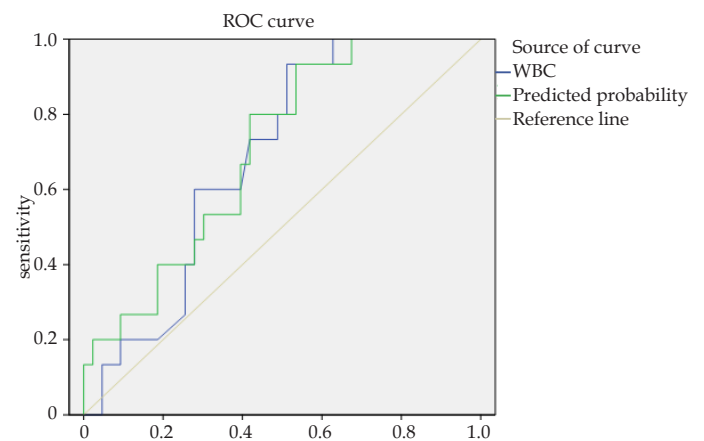


Figure 3 ROC curve depicting the best cut-off value for WBC and CRP. The arrow mark depicting the best cut-off for sensitivity and specificity.

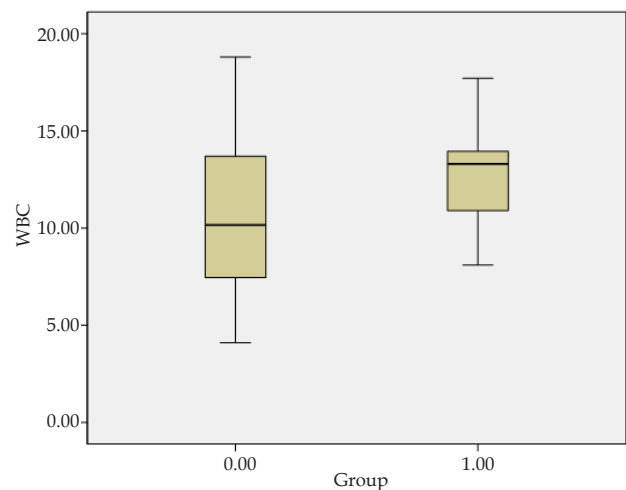


Figure 4 Box diagram indicating range for WBC in Group A and B.

Table 2 (Group A-co morbidities scoring)

Patient	CO morbid	Cardio	Resp	Renal	Liver	Psych	Endo	Rheum	Cancer	Total
1	HTN, RA, ASTHMA	1	1					1		3
2	HTN	1								1
3	Gout, NIDDM, Renal failure	1		1			1	1		4
4	NIDDM, polytrauma						1			1
5	Nil									0
6	Nil									0
7	Alcoholic liver disease				1					1
8	AF, Angina, NSTEMI, warfarin	3								3
9	HTN, CVA	2								2
10	HTN, angina, AF, flutter	4								4
11	Cancer, psych					1			1	2
12	Osteoporosis							1		1
13	Lymphoma, RA, AF	1						1	1	3
14	HTN	1								1
15	IHD	1								1
16	Nil									0

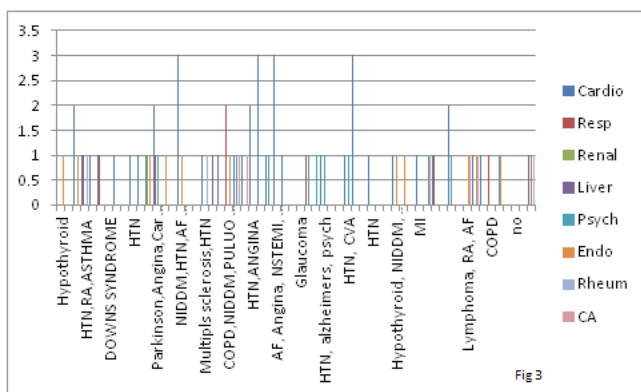


Figure 5 The prevalence of co morbidities are demonstrated in the bar representation.

Total Comorbidities in Infected Population Group A Fig 5

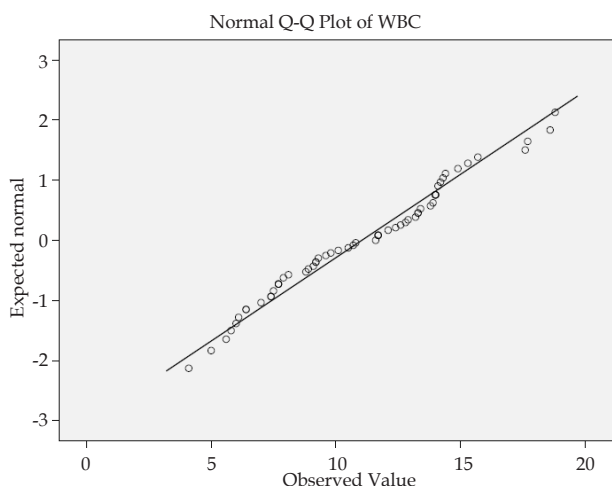
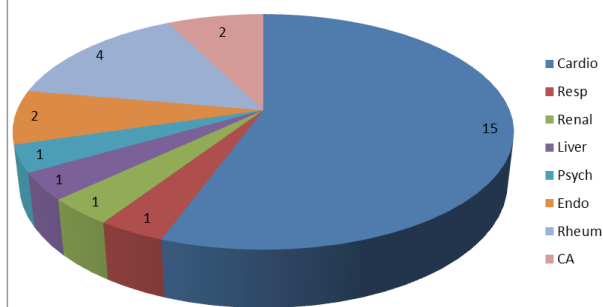


Figure 6 Binary Logistic regression plot.

non braided suture for closure and layered washout, reapplication chlorhexidine to skin, absorbable skin sutures with buried knots, use of steristrips and Fria balsam, me pore/opsite, wound pad for dressing, no wound inspection for 14 days unless clinically indicated. Dedicated hip surgeon, or senior surgeon, had significant positive effect to reduce the overall infection rate in the cohort. This conclusion was drawn by comparing to previous departmental

audits<sup>[9]</sup> prior to initiation of current practice. Forty-five ( $n = 45$ ) patients of sixty one ( $n = 61$ ) were operated by dedicated hip surgeon as a primary surgeon or direct supervision of junior doctors.

We noticed a trend of raised WBC count above  $10 \times 10^9/L$  in patients requiring surgical washout which had a statistical significance (Table1) with a sensitivity of 80% and specificity of 49% fig 4. However, when a binary logistic regression is applied to the data comparing WBC and CRP we were not able to demonstrate a significant cut-off for patients needing wound washout. The results are influenced by low patient numbers in the infected group and we believe a positive numerical cut off can be determined by using WBC and CRP dictating if the individual patient needs a surgical wash out or to be managed non operatively. The limitation of the study includes low number of inclusion in infected group and leaves a scope to consider multicentre study.

## DISCUSSION

The reduction in wound infection rates is attributed to the introduction and rigorous enforcement of the guidelines implemented by the dedicated hip surgeon in our unit. Total percent of surgeries performed by dedicated hip surgeon 77.7%, other consultants 14.7% and registrars only 11.4%. Our studies support the findings that operations by consultants or a specialist hip fracture surgeon had half the rate of deep infection compared with junior grades<sup>[9]</sup>. Many

studies<sup>[10-14]</sup> considered the ASA class and associated it strongly with medical problems in the perioperative period following hip fracture surgery in the elderly and recommends that patient with ASA class 3 or 4 should be managed by closed supervision but the study identifies the risk with co morbidities<sup>[15]</sup> but gives no conclusive pragmatic approach to prevent complications, we were unable to stratify the co morbidities with risk of infection.

This research work aims to provide a novel yet simple approach to reduce infection rate, the results indicate a lower rate of infection after introduction of this approach. We have also tried to establish a numerical value to determine if an individual can be managed conservatively or need surgical intervention. Haematological parameter that is sensitive to infection were considered and found that a raised WBC count above  $10 \times 10^9/L$  suggested surgical washout which had a statistical significance  $p 0.027$  and a sensitivity of 80% and specificity of 49% but when a binary logistic regression is applied to the data comparing WBC and CRP we were not able to demonstrate a significant cut-off for patients needing wound washout. The limitation of the study is low number of infected wound patients, we suggest a prospective multicentre study to formulate a cut of value of combined WBC and CRP to determine and help surgeons to decide in determining patients needing surgical intervention. We can conclude that overall rate of infection was reduced to 1.36% as compared to national data indicating overall infection rate of 2-3% after initiation of the dedicated hip surgeon and above mentioned simple yet effective techniques. In conclusion, the measures adopted significantly reduced the overall infection rate. WBC and CRP are good predictors to decide if patients require a surgical intervention or conservative management. However, from our analysis it is not possible to predict a range of CRP or WBC at which patients should be taken for wound washout. Whilst the power of the analysis was increased by combining CRP and WBC, there was not significant improvement in sensitivity and specificity to give a cut-off at which patients should be managed actively. Prospectively there is scope to include more data in the analysis to improve the significance and predict a cut-off value.

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