

Surgical Site Infection Complicating Internal Fixation of Fractures: Incidence and Risk Factors

Lateef O.A. Thanni, FWACS and Nofiu O. Aigoro, FWACS
Sagamu and Abeokuta, Ogun State, Nigeria

Background: There is a dearth of data on surgical site infections (SSIs) complicating internal fixation of fractures from Nigeria.

Aims: To determine the incidence and risk factors for SSIs following internal fixation of fracture.

Methods: A cohort of 90 patients with long bone fractures that were stabilized internally with metallic devices was studied prospectively and retrospectively.

Results: The incidence of SSI was 12%. The isolated organisms were *staphylococcus aureus* in four patients, *pseudomonas* spp. in three, and *escherichia coli* in one patient. Diabetes mellitus and perioperative transfusion with allogeneic blood were not predictive of SSI. Duration of operation longer than 120 minutes was a strong predictor (OR 2.25, 95% CL 0.48–10.16). Other risk factors were male sex (OR 2.01, 95% CL 0.44–10.45), injury-operation interval less than six months (OR 2.00, 95% CL 0.22–46.08), fracture fixation with plates and screws (OR 1.51, 95% CL 0.36–6.40), white blood cell count (WBC) less than 5,000 per cumm (OR 1.50, 95% CL 0.15–16.37), preoperative urinary catheterization (OR 1.48, 95% CL 0.00–16.19), and postoperative urinary catheterization (OR 1.24, 95% CL 0.29–5.00).

Conclusion: The incidence of SSI after internal fixation of long bone fractures in our centers is 12%, and this is within the previously reported range. Use of plates and screws, WBC less than 5,000 per cumm, and perioperative urinary catheterization are important risk factors.

Key words: antimicrobial prophylaxis ■ perioperative ■ fracture ■ internal fixation ■ wound ■ surgical site infection ■ incidence ■ risk factors

INTRODUCTION

Operations involving implantation of metallic devices are important orthopedic operations, with attendant risks of wound infection. Use of perioperative antimicrobial prophylaxis is essential in preventing such infections.¹⁻³ Knowledge of risk factors for infection of the surgical site is of clinical value as the presence of some of them may enable the identification, preoperatively, of patients at risk. This knowledge may also promote perioperative practices aimed at reducing such risks. Previously reported risk factors for surgical site infection (SSI) include male gender, operation duration, diabetes mellitus, and perioperative allogeneic blood transfusion.^{1,4}

This study was designed to determine the incidence of SSI following internal fixation of long bone fractures in the surgical setting of southwest Nigeria, as well as the predictive value of some risk factors for SSI.

MATERIALS AND METHODS

Ninety consecutive adult patients that underwent an operation for internal fixation of long bone fractures at Olabisi Onabanjo University Teaching Hospital, Sagamu and the General Hospital, Abeokuta were prospectively studied from June 1998 to May 2002. Exclusion criteria were open and pathological fractures, while closed fractures were included. All patients received perioperative antimicrobial prophylaxis starting from at least 30 minutes before induction of anaesthesia and continued for less than 24 hours. When a tourniquet was used, antimicrobial prophylaxis was commenced at least 30 minutes before its application. Follow-up, although varied, was for at least six weeks.

Risk Factors

The variables selected for study as risk factors for SSI were empirically chosen. They include gender, diabetes mellitus, fracture fixation device, operation duration, interval between injury and operation, total white blood cell count (WBC), pre- and postopera-

© 2004. From the Department of Orthopedics and Traumatology, College of Health Sciences, Olabisi Onabanjo University, Sagamu, Ogun State, Nigeria (Thanni, senior lecturer/consultant orthopedic surgeon) and General Hospital, Abeokuta, Ogun State, Nigeria (Aigoro, senior consultant orthopedic surgeon). Send correspondence and reprint requests for *J Natl Med Assoc.* 2004;96:1070-1072 to: L.O.A. Thanni, Department of Orthopedics and Traumatology, College of Health Sciences, Olabisi Onabanjo University, PMB 2022, Sagamu, Ogun State, Nigeria; e-mail: loathanni@yahoo.com

tive urinary catheterization as well as perioperative allogeneic blood transfusion.

Definition of Infection

Materials that drained from wounds were obtained for culture studies.² An infection was taken to be present when pus discharged (whether or not culture was positive) or a nonpurulent discharge was culture positive.² When the bone or implanted device was not exposed, the infection was deemed to be superficial.

Statistical Analysis

Analysis of data was done with the statistical package Epi info version 6 (Centers for Disease Control and Prevention, Atlanta, GA, 1997). Odds ratio (OR) was determined for all risk factors.

RESULTS

Of the 90 patients, 37 (41%) were females and 53 (59%) were males. Their average age was 40 ± 17 years (range 16–86 years). Male sex was predictive of SSI (OR 1.86; 95% CL 0.44–10.45).

Internal fixation was with intramedullary nails in 43 patients (47.8%), with plates and screws in 41 (45.6%) and with other devices in six patients (6.7%) (Table 1). The use of plates and screws was

found to be predictive of SSI (OR 1.51; 95% CL 0.36–6.40). The incidence of SSI was 12% (11/90). Discharge from the surgical site was pus in seven patients and serosanguinous in four. Culture studies identified *staphylococcus aureus* in four patients, *pseudomonas spp.* in three, *escherichia coli* in one and no organism in three patients. All discharges were noted at about the time of removal of sutures, 14 days postoperatively.

Three patients had diabetes mellitus, but none of them had SSI. The mean duration of operation was 87 ± 28 minutes (range 40–180 minutes). After stratification of operation duration with a cut-off value of 120 minutes, duration 120 minutes or longer was found to be a strong predictor of SSI, OR=2.25; 95% CL 0.48–10.16. The mean interval between injury and operation was $15.7 + 24$ weeks (range 1–156 weeks). Using six months as a cut-off value for stratification, intervals less than six months were found to be a strong predictor of SSI, OR=2.00; 95% CL 0.22–46.08.

WBC was available for 29 patients. Three out of 15 patients that had WBC less than 5,000 per cumm had SSI (Table 1). The mean WBC was $5,068 \pm 1,643$ per cumm (range 2,200–9,000). WBC less than 5,000 was positively predictive of SSI (OR 1.50; 95% CL 0.15–16.37). The sensitivity of WBC as a predictor of SSI was 60% (three of five patients with SSI had WBC less than 5,000 per cumm), and its specificity was 50% (12 of 24 patients that had no SSI had WBC less than 5,000 per cumm). The negative predictive value was 85.7% (12 of 14 patients whose WBC were more than 5,000 per cumm had no SSI), and the positive predictive value was 20% (three of 15 patients whose WBC were less than 5,000 per cumm had SSI).

Pre- and postoperative urinary catheterization were found to be independent predictors of SSI (OR 1.48; 95% CL 0.00–16.19) and (OR 1.24; 95% CL 0.29–5.00) respectively. Preoperative catheterization, performed in six patients, was for a maximum of seven days, while postoperative catheterization

	Surgical Site Infection	
	Present (n=11)	Absent (n=79)
Sex		
Female	3	34
Male	8	45
Fixation Device		
IM nail	5	38
Plate/screws	6	35
Others	0	6
Operation Duration		
<120 minutes	7	63
≥120 minutes	4	16
Injury-Operation Interval		
<6 months	10	65
>6 months	1	13
* WBC		
<5,000 per cumm	3	12
>5,000 per cumm	2	12
† Urinary Catheterization		
Preoperative	1	5
Postoperative	2	12
* total no. = 29; † total no. = 20		

Number of Patients	(Percent)
Cefuroxime	40 (44.4)
Ceftriaxone	8 (8.9)
Ciprofloxacin	28 (31.1)
Pefloxacin	3 (3.3)
Ofloxacin	1 (1.1)
Ampicillin/cloxacillin	10 (11.1)
Total	90 (100)

was performed in 14 patients, lasting two- to 14 days. Perioperative blood transfusion was done in 49 patients (54%). Neither preoperative (n=7), nor intraoperative (n=19), or postoperative (n=49) blood transfusion was found to be predictive of SSI.

Table 2 indicates that the most frequently used antimicrobial for prophylaxes were cephalosporins (53.3%). Others were fluoroquinolones (35.6%) and ampicillin/cloxacillin combination (11.1%). Surgical site outcome in relation to the antimicrobial used was not an objective of this study. There were no adverse reactions to the antimicrobials and no mortality among the cohort.

DISCUSSION

One of the aims of this study was to identify the rate of SSI following internal fixation of fractures. The incidence of 12% in this study is within the previously reported range of 2–16%.^{1,4-6} All the infections were superficial, and promptly and effectively controlled by conservative measures.

The other objective of this study was the determination of the predictive value of selected risk factors for SSI. Previous reports have shown that there is a male preponderance among injured patients with fractures.⁴ This is true of this series, but there is no other evidence in our results to justify the finding of the male sex being positively predictive.

Bodoky et al.¹ identified the duration of operation as a powerful independent predictor of wound infection. Our results support that observation. The mean duration of operation in this report, 87 minutes, is similar to 77 minutes in the report of Bodoky. Specifically, this report indicates that two hours is the critical time beyond which the patient is at greater risk of wound infection.

Following trauma, many Nigerians believe in and commonly patronize the traditional bonesetter.⁷ This results in delays in the definitive treatment of fractures. A delay of less than six months was identified as a predictor for SSI, but this is difficult to explain. Traditional bonesetters are native doctors that treat musculoskeletal injuries, using bamboo sticks (bandaged to the injured limb) and topical native concoctions. They may or may not have any formal education, as training of bonesetting is by apprenticeship over a variable duration. WBC may be a useful predictor of SSI in poor countries. It is a readily available and cheap laboratory investigation. The normal WBC in native Africans (2,000–9,000 per cumm) is generally lower than in Caucasians.⁸ This observation is due to absolute neutropenia probably related to dietary factors. A low WBC may adversely affect immune response to invading micro-organism and so predispose to infections. Although its predictive value is low, it may be useful clinically in identi-

fying patients at risk.

Perioperative urinary catheterization is not commonly practiced at the study centers. This may be due to the relatively young age of the patients (mean 40 years), unlike in some other reports (average range 65–78 years).^{1,2} The identification of these risk factors as being predictive of SSI will reinforce our practice of keeping the duration of use of catheterization as short as possible. This report has shown that perioperative transfusion of allogeneic blood is not predictive for SSI. It has, however, been suggested that such transfusion may have an adverse immunomodulatory effect in the recipient⁹ and has been identified as a risk factor for postoperative infections in general.¹⁰ Further studies are required to confirm its relationship with SSI. Leucocyte depletion of allogeneic blood for transfusion may have a place in reducing the risk of infections associated with such a blood transfusion. It is available in Europe, but may not be available in sub-Saharan Africa in the short term.

Unlike previous studies, this report does not find diabetes mellitus to be a risk factor for SSI.¹¹ The bacteria associated with SSI in this study are similar to those isolated from infected surgical sites in other centers, although the prevalence varies.¹¹

In conclusion, the incidence of SSI following internal fixation of fractures in some centers in southwest Nigeria—12%—is similar to that reported from other countries. Internal fixation with plates and screws, WBC less than 5,000 per cumm, and perioperative urinary catheterization are clinically important risk factors for SSI.

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