ORIGINAL ARTICLE

Outcome of Infection Following Internal Fixation of Closed Fractures

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Summary

A retrospective study was done in 30 patients with infected closed fractures treated initially by open reduction and internal fixation. Nineteen fractures involved the femur, 8 the tibia, 2 the radius and 1 the ulna. Twenty-five were diaphyseal and 5 metaphyseal. Twenty-two fractures had initially been treated with plating and 8 with intramedullary nailing. Thirteen patients presented in the acute phase and 17 in the subacute phase of infection. Twenty-two patients presented with low grade infection and 8 with florid infection. The commonest organism isolated was *Staphylococcus aureus* (80%), of which fifty four percent was resistant to Methicillin (MRSA). This study showed that 77% of infected fractures with a stable implant united even in the presence of infection.

Key Words: Infected closed fracture, Internal fixation, Outcome

Introduction

Osteomyelitis, unlike other infections is not always successfully treated despite the use of an extensive array of antibiotics currently available. Although such antibiotics have improved the prognosis in acute hematogenous osteomyelitis, they have not been as successful in chronic osteomyelitis or in sepsis that develop around implants [1]. Several studies have shown that an infected fracture can unite either by callus or primary bone union. It is not necessary to remove a stable implant in an infected fracture because stabilization is important for the union to occur. The primary aim is to get the fracture to heal before tackling the sepsis [2, 3, 4]. The purpose of this study is to determine the outcome as a result of retaining a stable internal fixation and the risk for non-union in infected fractures.

Materials and Methods

This is a retrospective study involving patients with infected fractures treated at Hospital USM from January 1995 to December 1999. The medical records and the plain radiographs of the patients were reviewed. The patients included in this study were those who were treated for deep infection following internal fixation of closed traumatic fracture in long bones. Patients who are excluded in this study are those whose implants were removed during the initial debridement, either because of loosening or the fractures were already united. Also excluded were those whose stable implants were removed before the fractures have united. In addition, patients with superficial infection, pathological fracture, open fractures or infection following corrective osteotomy were also excluded.

The subjects were evaluated preoperatively with regards to the severity of infection, type and site of fracture, onset of symptoms, type of organism, associated medical problem and injuries and methods of stabilisation. The outcome was considered successful if there was bony union with control of infection following final removal of implant. Persistent infection or non union following removal of implant

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was considered as failure. Data were analysed using the SPSS version 9.0 software for personal computers and Epi info 6.

At the University Sains Malaysia Hospital, treatment of patients with infected fractures was based on the severity of infection and stability of the implant. Patients who had evidence of pus formation at the fracture site underwent incision and drainage. During the surgery, the implants were removed if found to be unstable or the fractures had united. The wounds were either closed primarily or allowed to heal by secondary intention.

Otherwise, the infection was treated with appropriate antibiotic and dressing after culture swabs was taken. The antibiotics given were based on the bacterial culture and sensitivity results. The duration of antibiotic therapy is guided by the clinical state, the Erythrocyte Sedimentation Rate (ESR) and radiological evidence. The patients were followed up until the wounds had completely healed and that there was no evidence of continuing infection.

Definitions

The diagnosis of infection was based on the criteria used by the Orthopedic Trauma Association [5]. Deep infection is defined as infection involving bones occurring when the infectious process involves tissues deep to the muscular fascia [6]. Bony union is regarded to have taken place when pain, swelling, tenderness or motion at fracture site had disappeared and when there is partial or complete obliteration of the fracture line on plain radiograph [5]. The onset of infection is divided into 3 phases; acute, subacute and chronic. The acute phase is when infection developed within two weeks of operation, the subacute phase is when infection develops after 2 weeks of operation and the chronic phase is when there is infected non union or the infection developed after the fracture has united [7].

Florid infection is defined as when there are systemic signs of infection, abscess collection, cellulitis or discharging pus from the sinus tract. Low grade infection is defined by persistent watery sinus track discharge with radiological evidence of osteomyelitis and loosening of implant [2].

Results

During the study period there were 41 patients treated for infection following internal fixation of closed fractures of long bones. However, only 30 patients fulfill the inclusion criteria (Table I). The youngest patient was 14 years of age and the oldest was 64 years. The mean and median ages of the patients were 29.5 and 21.0 years respectively. There were 28 males and 2 females with 28 Malays and 2 Chinese.

The breakdown of the infected bone were 19 femur, 8 tibia, 2 radius and 1 ulna. Twenty-five infected fractures were in the diaphysis while 5 were in the metaphysis. Fourteen (47%) were simple fractures while 16 (53%) were comminuted fractures. Of the 30 cases infected, eight were associated with intramedullary nails and 22 were plates (Table Ill). Seventeen patients presented during the subacute phase as compared to 13 who presented during the acute phase. There were 8 patients with florid infection as compared to 22 who presented with low grade infection. (Table III)

Staphylococcus aureus was identified in 24 (80%) patients, of which 14 (54%) were Methicillin Resistant *Staphylococcus aureus* (MRSA). In 3 (10%) patients the culture failed to grow any organisms. Mixed gram negative *Bacillus* was cultured from 2 (7%) patients which probably represented contaminated specimens. *Pseudomonas aeroginosa* were cultured in 3 (10%) patients. Other organisms cultured were *Klebsiella* species in one patient and *Enterobacter species* in one patient. (Table Il)

There were 19 patients (63%) with other injuries and only 11 patients (37%) presented with isolated injuries (Table IV). Twenty-eight patients were otherwise healthy with one patient having hypertension and one had a combination of hypertension, diabetis mellitus and ischaemic heart disease. Seven (23%) implants became loose and had to be removed. Twenty-three (77%) fractures united without any residual infection. The mean time of union was six months (range 2 to 12 months).

The mean age of patient successfully treated with this method is 27.4 years (range 14 – 61 years) as compared to 35.3 years (range 19-64 years) in the failure group. However, the difference is not significant ($p = 0.23$). The average time of follow up was 25 months (range 10 to 60 months).

All the 7 failures were lower limb diaphyseal fracture in otherwise healthy patients. Six fractures were initially treated with plating while one of them with an intremedullary nailing. Six patients had a low grade infection while one had a florid infection. Five patients presented during the subacute stage and two during the acute stage. Five patients had other associated injuries while the remaining two did not. (Table lII)

Table I: Categories of patient according to the stability of internal fixation and fracture union

Category	Infection	Internal fixation	Union	n
A	yes	stable	Yes	7
B	yes	stable	No	31
C	yes	unstable	No	3

Patients who were included in this study were those in category B. One patient was excluded because the stable implant was removed before the fracture united leaving 30 patients suitable for this study.

Table II: Distribution of organism isolated

Organism isolated	Success	Failure	n
MRSA	11	3	14
Staphylococcus aureus	10	2	12
Pseudomonas aerogenosa	2	1	3
Klebsiella sp.	1	0	1
Enterobacter sp.	1	0	1
Organism not identified			
Mix gram negative	2	0	2
No growth	1	2	3

Six patients have 2 different organism isolated from them.

Mix gram negative culture is considered a negative culture result because of contamination.

The difference in the outcome was not statistically significant (p = 0.59).

Table III: The outcome of treatment based on various factors

Variables		Success	Failure	p
Sex	Male	21	7	0.42
	Female	2	0	
Race	Malay	21	7	0.42
	Chinese	2	0	
Bone	Femur	14	5	0.8
	Tibia	6	2	
	Radius	2	0	
	Ulna	1	0	
Site	Metaphysis	5	0	0.18
	Diaphysis	18	7	
Fracture severity	Simple	12	2	0.27
	Comminuted	11	5	
Implant	Plate	18	6	0.46
	Intramedullary nail	7	1	
Onset	Acute	11	2	0.37
	Subacute	12	5	
Infection severity	Low grade	16	6	0.4
	Florid	7	1	
Culture	Positive	20	5	0.57
	Negative	3	2	
Associated injuries	None	9	2	0.6
	Present	14	5	
Associated medical problems	None	21	7	0.42
	Present	2	0	

Table IV: The outcome of treatment according to associated injuries

Associated injuries	Success	Failure
Close fracture of radius	1	0
Close fracture of tibia	1	0
Fracture neck of femur	1	0
Pelvic fracture	0	1
Open fracture of femur	1	0
Open fracture of fibula	1	0
Open fracture of radius	2	0
Open fracture of tibia	0	1
Open fracture of humerus	0	1
Chest injury	1	0
Head injury	6	1
Fat embolism	0	1

Discussion

This study showed that it was important to identify the infecting organisms in ensuring the success of treatment. The failure rate was higher when the infecting organism was not identified (67%) in contrast to a failure rate of 19% when the organism was identified. However, the difference is not statistically significant (p=0.13).

Staphylococcus aureus remained the commonest organism in infection around the bone. Contributing factors to this include its predilection for this tissue, presence of the surface receptor for the human intracellular proteins and the Staphylococcal toxins. In addition, this organism commonly colonise the skin and the nares, hence a ready source of infection[7].

Staphylococcus aureus had been identified in 23 (77%) patients and out of this, 14 (54%) of them were resistant to Methicillin (MRSA). The common gram negative bacteria cultured were *Pseudomonas aeroginosa* and *Enterobacter species* i.e. positive in 3 samples (10%).

In similar studies on infection following internal fixation, Patzaki et al.[4] had cultured *Staphylococcus aureus* in 28% of his patients, Court-Brown et al.[9] in 50% and Zych and Hutson[7] in 68% of his patients. However they did not mention whether the organisms were resistant to Methicillin or otherwise.

Meyer et al.[2] found no correlation between the types of infecting organisms and the outcome of treatment. The findings in this study showed a worrying trend since the commonly used prophylactic antibiotics (Cloxacilline or Ceforexime) did not cover for the MRSA and the *Pseudomonas species*. A review of bacteriological pattern of post operative wound infection needs to be done to establish the appropriate antibiotics for prophylaxis. Burri (1975) who applied this method of treatment in 213 cases reported an amputation rate of 4.5% and residual infection 5.5% with no residual non union. In a similar study, Weber (1973) reported union in 120 out of 122 patients treated for post traumatic osteomyelitis and only 15 cases had residual infection. The present study showed a lower success rate of only 77% as compared that of Burri (1975) and Weber (1973) who reported a success rate of 86% and 90% respectively[3].

Conclusion

A stable fixation in a fracture which is still not united should be retained and need not be removed even in the presence of infection because the infection did not prevent subsequent bone union.

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