The use of qualitative cultures for detecting infection in open tibial fractures

A D’Souza, N Rajagopalan, RS Amaravati
Department of Orthopaedics, St John’s Medical College Hospital, Bangalore, India

ABSTRACT

Purpose. To determine the role of qualitative cultures for detecting infection in open tibial fractures.

Methods. From January 2003 to December 2004, 95 men and 13 women (mean age, 34 years) with open tibial fractures in one or both limbs and without any other sites of infection were prospectively studied. Patients who had been treated with intravenous or oral antibiotics before presentation and/or had undergone debridement or other surgery were excluded.

Results. Infection was not correlated with age, sex, interval from injury to debridement, and cause of fracture. The association of infection with predebridement cultures was stronger (odds ratio=12.5) than that with postdebridement cultures (odds ratio=4.7).

Conclusion. Pre- and post-debridement cultures have a role in detecting infection in open tibial fractures. For detecting infection, predebridement cultures have better sensitivity, while postdebridement cultures have better specificity.

Key words: debridement; fractures, open; infection; tibial fractures

INTRODUCTION

Treatment for open fractures is a challenge. It involves early wound debridement with copious irrigation, prompt initiation of intravenous antibiotics, good coverage for the bone and soft tissue, as well as adequate, rigid stabilisation.1-10

We aimed to determine the role of qualitative cultures (both pre- and post-debridement) in detecting infections in open tibial fractures, and to highlight any correlation between infections and other variables (age, sex, interval to debridement, cause of fracture, and the Gustilo classification).
MATERIALS AND METHODS

From January 2003 to December 2004, 95 men and 13 women (mean age, 34 years) with open tibial fractures in one or both limbs and without any other sites of infection were prospectively studied. Patients who had been treated with intravenous or oral antibiotics before presentation and/or had undergone debridement or other surgery were excluded.

All patients were clinically examined and their medical history recorded. Their open fractures were classified based on the Gustilo classification. Under strict aseptic precautions, the wound was cleaned with saline soaked gauze. Swabs were taken before and after a standard debridement procedure, and necessary stabilisation performed. Intravenous cefazolin, gentamicin, and metronidazole were prescribed for grade-I and -II open fractures. For grade-III fractures, the cefoperazone/sulbactam combination as well as amikacin and metronidazole were prescribed. The wound was inspected for signs of infection. If infected, a repeat culture was obtained and appropriate antibiotics started. If there was no evidence of infection, the antibiotics were discontinued after the third day.

Data were tabulated and analysed using Chi squared and Fisher’s exact tests to determine any correlation between infection and other parameters. Diagnostic statistics were used to derive predictive values for pre- and post-debridement cultures showing infection.

RESULTS

Infection did not yield a significant correlation with age (p>0.05), sex (p=0.48), and interval from injury to debridement (p=0.756) by Chi squared test. Nor was there a significant correlation with the cause of fracture (p=0.851, Chi squared test), because of small numbers and unequal distribution of cases in different categories, although ‘assault’ and ‘fall from height’ showed a positive trend (Table 1). The association of infection with predebridement cultures was stronger (odds ratio=12.5) than that with postdebridement cultures (odds ratio=4.7) [Table 2]. The grade of fracture correlated with infection (p=0.39, Chi squared test) [Table 3]. The most common organisms cultured were non-fermenting Gram-negative bacilli, followed by pseudomonas and mixed growths. Their antibiotic sensitivities are shown in Table 4.

DISCUSSION

Infection is the main complications following open fractures, and may result in limb loss, sepsis, and death. Despite improvements in open fracture management, late infection continues to occur in 2 to 25% of all open fractures.

Emergency wound debridement, copious irrigation, and intravenous antibiotics use are mandatory for avoiding infection. The use of qualitative culture swabs to detect infection...
remains controversial. Some authors consider predictability of infection from pre- and post-debridement wound cultures to be poor; if used at all, postdebridement samples are regarded as having better prognostic value. Others consider both quantitative smears and cultures are of predictive value in the management of traumatic wounds when taken immediately, or when the bacterial load exceeds $10^5$ colonies/gram in skin tissue, or when any level of bacterial load is present in muscle. Some authors found no correlation between the interval elapsing from fracture to debridement and quantitative bacterial count levels. Others suggested that postdebridement quantitative bacterial counts are more predictive of infection. 35% of initial cultures do not yield any bacterial growth; if a culture is positive and the wound is infected, then the organism isolated has the highest probability of being the cause. However, another study found little correlation between initial quantitative bacterial counts and subsequent sepsis. In our series, predebridement cultures were found to have high sensitivity in detecting infection; if infection was present, then the chance of detecting the offending organism was almost 84%. Invasive procedures such as repeated debridement and multiple antibiotic therapy were performed, based mainly on the clinical status of the wound and patient’s condition (not positive culture). Postdebridement cultures yielded good specificity; if an open fracture wound did not display any evidence of infection, then no organism was isolated in almost 87% of cases. Thus, our findings are contrary to other studies that have suggested that culture swabs do not have a role in detecting infections.

Infection rates correlate with the extent of soft tissue damage and the classification of the open wound. The infection rate for grade-I open fractures is reportedly 0 to 2%. For grade-II fractures it is 2 to 7%. For grade-III fractures the overall rate is 10 to 25%, being 7% in grade-III A, 10 to 50% in grade-III B, and 25 to 50% in grade-III C fractures. The beneficial effects of antibiotics for patients with open fractures have been well documented. Infections occur in 13.9% of open fractures in which management is exclusively surgical (without antibiotics), compared to 2.3% in open fractures treated with cephalothin and surgical debridement. The chosen antimicrobial should provide Gram-positive and -negative cover.

The microbial flora of open fractures has been changing since the late 70s. Coagulase-positive Staphylococcus aureus was predominant in the 70s and early 80s. Infections were also caused by penicillin-resistant coagulase-positive bacteria. Gram-negative bacteria and mixed growths (for which use of combined antibiotic therapy was needed).

We recommend that all antibiotic usage be tailored according to the type of fracture, level of contamination, soft tissue status, and most importantly the prevailing infection and culture sensitivity patterns in the hospital.

**CONCLUSION**

Pre- and post-debridement cultures have a role in detecting infection in open fractures. Predebridement cultures have better sensitivity, while postdebridement

<table>
<thead>
<tr>
<th>Organism</th>
<th>No. of infections</th>
<th>Debridement</th>
<th>Antibiotic sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-fermenting Gram-negative</td>
<td>15</td>
<td>18</td>
<td>Cefoperazone sulbactam&gt;gentamicin&gt;ciprofloxacin&gt;amikacin&gt;ceftazidine</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>14</td>
<td>13</td>
<td>Amikacin&gt;ceftazidine&gt;ciprofloxacin&gt;cefoperazone&gt;gentamicin</td>
</tr>
<tr>
<td>Enterococcus</td>
<td>3</td>
<td>4</td>
<td>Gentamicin&gt;vancomycin&gt;penicillin</td>
</tr>
<tr>
<td>Enterobacter</td>
<td>4</td>
<td>4</td>
<td>Amikacin&gt;gentamicin&gt;ciprofloxacin&gt;ceftazidine/cefotaxime</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>4</td>
<td>4</td>
<td>Amikacin&gt;gentamicin&gt;ciprofloxacin&gt;ceftazidine/cefuroxime</td>
</tr>
<tr>
<td>Methicillin-resistant Staphylococcus aureus</td>
<td>1</td>
<td>-</td>
<td>Vancomycin&gt;chloramphenicol&gt;teicoplanin&gt;ciprofloxacin</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>1</td>
<td>2</td>
<td>Cefoperazone sulbactam&gt;amikacin&gt;gentamicin &amp; netilmicin</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>-</td>
<td>3</td>
<td>Cloxacillin/methicillin</td>
</tr>
<tr>
<td>Mixed growth</td>
<td>13</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

Table 4

Infective organisms and corresponding antibiotic sensitivity
cultures have better specificity for detecting infection. There is no correlation between the development of infection in open fractures with age, sex, and the interval between injury and debridement.

ACKNOWLEDGEMENT

We thank Ms BS Rathna for her technical assistance in writing this manuscript.

REFERENCES