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ORIGINAL ARTICLE

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Efficacy of primary wound cultures in long bone open extremity fractures: are they of any value?

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Abstract The management of long bone open extremity fractures has included initial wound cultures, antibiotics, operative debridement, and fracture repair, if indicated. The value of initial wound cultures is unclear. We examined whether primary wound cultures predict which wounds will become infected, and whether bacterial growth on primary wound cultures correlates with bacteria cultured from infected wounds. This prospective study involved patients presenting to a regional trauma center. Before any interventions were performed, initial aerobic and anaerobic cultures of the wounds of 117 consecutive open extremity fractures grades I-III were obtained. The results of these cultures were correlated with the development of a wound infection, and if an infection occurred, the organism grown from the infected wound was compared with any organism grown from the primary wound cultures. Of the initial cultures, 76% (89/117) did not demonstrate any growth, while the other 24% (28/117) only grew skin flora. There were only 7 (6%) wound infections, and 71% (5/7) initially did not grow any organisms. Of the isolates that grew from the initial cultures, none were the organisms that eventually led to wound infections. The use of primary wound cultures in open extremity injuries has no value in the management of patients suffering long bone open extremity fractures.

Keywords Infection · Primary culture · Fracture

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Introduction

The management of long bone open extremity fractures has included initial wound cultures, antibiotics, aggressive operative debridement, and fracture repair, if indicated. An important goal in the management of open extremity injuries is preventing wound infections, which have the potential for significant osseous and soft-tissue morbidity [14]. Infection is a serious complication associated with open extremity fractures, with rates as high as 26% [12]. An infection may negatively influence the long-term functional outcome of the extremity. The value of initial wound cultures in helping with infection is unclear. We believe that primary wound cultures do not predict which wounds will become infected, nor do they predict the infecting organism when an infection occurs. Hence, it is our contention that primary wound cultures are not useful in the management of open extremity injuries. It has been previously suggested that primary wound cultures had the ability to predict which wounds will become infected. Kreder and Armstrong, Lee's and findings of the present study contradict that idea [7, 8].

Patients and methods

Culture swabs were taken from a total of 117 consecutive open fractures of the extremities at the time of arrival at the trauma resuscitation area, prior to any antibiotic administration. This occurred over a 13-month period. Fractures were classified using the Gustilo Anderson criteria [4].

The results of the primary cultures were compared against patients who developed wound infections, and the respective bacteriological results were compared with wound cultures taken from wounds that eventually became infected.

Patients were observed for signs of wound infection, particularly erythema, pain, drainage, and fever >38.5ºC. If a wound was deemed to be infected, the edges were cleaned with sterile alcohol, and aerobic and anaerobic cultures were taken of the wound bed. The results of these cultures were compared with those of the primary wound cultures of the specific patient.

In addition to examining the stated hypothesis, we looked at the financial expense of performing these bacteriologic exams.

Results

During the 13 months of the study, 173 patients presented to this regional trauma center with long bone open extremity fractures. The mechanism of injury for all patients was blunt in nature. Fifty-six patients were excluded from the study predominantly because of lack of follow-up, but in a small number primary wound cultures were not available or antibiotics were given before primary wound cultures were collected. The final study group consisted of 117 patients.

There were 32 grade I fractures, 51 grade II fractures, and 34 grade III fractures. Of the patients with grade I fractures, 25 (78%) had negative primary wound cultures. Seven patients (22%) had positive growth from the primary wound cultures, but none developed a wound infection. One patient from the grade I fracture group developed a wound infection, and this patient had negative initial cultures.

Of the 51 patients with grade II fractures, 39 (76.4%) had negative initial wound cultures. Two patients (4%) from the grade II group subsequently developed a wound infection. Neither wound infection correlated with the initial cultures; one patient had negative initial wound cultures. For the other patient, *Staphylococcus aureus* grew in the initial culture, but the wound was infected with *Enterobacter cloacae*.

There were 34 patients with grade III open fractures. Twenty-five (73%) of them had negative initial wound cultures. Of the patients with negative wound cultures, 3 developed wound infections (2 with *Pseudomonas* infections, and one with *Enterobacter cloacae*). Nine patients in the grade III group had positive initial cultures. Seven grew *Staphylococcus epidermis*, and two grew both *S. epidermis* and diphtheroid bacillus. Of these 9 patients, only one developed a wound infection, which turned out to be *Pseudomonas auriginous* (Fig. 1).

In all, we found that 76% (89/117) of the initial cultures were negative, while the other 24% (28/117) only grew skin flora. There were seven (6%) wound infections; five (71%) of them did not demonstrate any growth on primary cultures. Of the isolates that grew from the positive initial cultures, none were the organisms that ultimately were cultured from the infected wounds.

At our institution, the cost of performing a negative aerobic wound culture is about $39.50, while a positive wound culture with one isolate costs $54.50. The cost of a negative anaerobic culture is $35.00; while a positive culture with one isolated bacteria is $80.50.

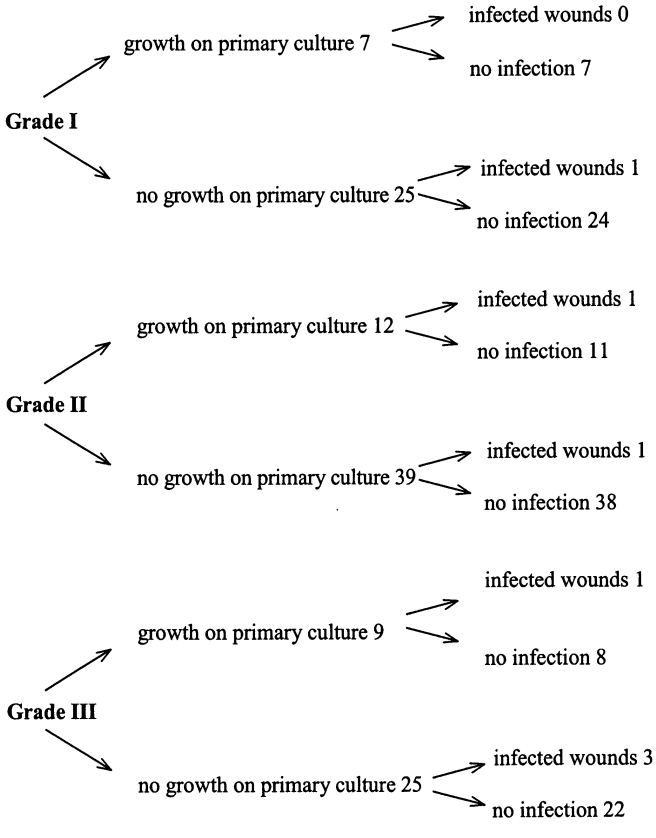

Fig. 1 Breakdown of patients by fracture grade and by primary culture results and the presence of infection where appropriate

Discussion

Prophylactic broad-spectrum antibiotic therapy after injury [11] and aggressive operative debridement [13] have been documented to decrease the incidence of infections in open extremity fractures. Preventing wound infections has the potential for significantly improving the functional outcome of open fractures. If clinicians have the ability to predict which wounds will become infected, interventions can be carried out to avoid infectious complications. Initial cultures of open fracture wounds have been routine in the past, with the intention to identify any infecting organism at the earliest possible time so as to be able to refine specific antibiotic therapy. Gustilo et al. and Moore et al. have recommended that wound cultures be taken before antibiotics are given [5, 10]. Moore and associates examined pre-debridement bacteriologic cultures and felt that their use in open injuries is merited. However, others found that pre-debridement cultures did not predict which wounds would become infected [7, 8, 9].

A likely explanation for the inadequacy of primary wound cultures is sampling error. That is, when taking the culture, the infecting pathogen is not obtained either because of poor technique or, more likely, because the organism is present in small numbers, making it difficult to collect adequate samples. An additional explanation may be that the antibiotics given are bactericidal to organisms grown from primary wound cultures, allowing the emergence of certain resistant strains of bacteria which were present in small quantities when cultures were taken. Debridement and irrigation of the injury change the ecology of the local wound and are critical to decrease any load of

contaminant or dead tissue. Finally, it is possible that the infecting bacteria are nosocomial and were not present when the cultures were taken, as others have suggested [3, 14]. Our findings and previous studies have identified skin flora pathogens as the primary organisms identified on initial wound cultures. However, as the present study has demonstrated, nosocomial pathogens such as *Pseudomonas aeruginosa*, *Enterobacter cloacae*, and *Enterococcus* species are the culprits that lead to wound infection [6, 8, 9, 14].

In the current environment where health care professionals are being asked to make conscious decisions about health care costs, physicians must critically evaluate the usefulness and costs of treatment practices. If a test is to be performed, it should provide information that is needed for the treatment plan for the best possible outcome of the patient. It appears that initial wound cultures of open long bone fractures do not fall into this category.

In the past when prophylactic antibiotic administration and aggressive operative debridement may have not been routinely practiced by clinicians, primary wound cultures may have had some role in the management of long bone open extremity fractures. With today's empiric treatment of long bone fracture utilizing immediate prophylactic antibiotic, irrigation, and debridement, we conclude that obtaining initial wound cultures offers no benefit. We have demonstrated that the patients' clinical outcome is not affected if primary wound cultures are not performed, and although modest, there is some savings in dollars and lab time that is incurred.

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