International Journal of Medical Research Professionals
P-ISSN: 2454-6356; E-ISSN: 2454-6364
DOI: 10.21276/ijmrp

IJMRP

Original Research Article

Observation on the Pattern of Bacterial Isolates in Compound Fractures

Shankar Niwas[1], Ashok Kumar Sharma[2*], Manoj Kumar[2]

[1]Specialist Orthopedics, ESIC Model Hospital, Ranchi, Jharkhand, India.
[2]Associate Professor, Dept. of Microbiology, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India.

ABSTRACT

Introduction: The number of compound fractures is increasing day by day in developing countries. Cause for compound fractures are road traffic accident, machine injuries, assault, gunshot injuries and fall from height. Infections, chronic osteomyelitis, nonunion, loss of function or even limb loss are some serious outcome of deep fracture site infections. The primary goal in management of compound fracture is prevention of infection of bones & soft tissue by early debridement, irrigation of wound and administration of board spectrum antibiotics with stabilization of fractures.

Aim: The aim of the study is to observe the pattern of microbial isolates in compound fractures so as to form rationale antibiotic regimen for treating compound fractures.

Methods: 40 patients were taken into study of all ages, both the sexes with compound fracture classified according to Gustilo Anderson classification. Primarily wound was examined and classified with 1st culture swab taken at that time followed by 2nd culture swab on 1st dressing and 3rd culture swab if infection continues further. Culture and sensitivity reports were collected for studying pattern of bacterial isolate and their sensitivity.

Result: Pre-debridement cultures are of no importance. Post-debridement cultures are important in formulating an antibiotic regime. Gram negative organisms are the most probable cause of infection. Aminoglycosides are the most sensitive group of drugs in both gram +ve & gram –ve bacteria. Cephalosporins or quinolones should be used in combination with aminoglycosides in all cases of compound fracture in our vicinity.

Conclusion: All institutions and hospitals should find out the most common infecting pathogen in their environment and formulate an antibiotic policy accordingly.

Key words: Compound Fractures, Debridement, Culture, Antibiotic Policy.

***Correspondence to:**

Dr. Ashok Kumar Sharma,
Associate Professor,
Department of Microbiology,
Rajendra Institute of Medical Sciences,
Ranchi, Jharkhand, India.

Article History:

Received: 11-02-2017, **Revised:** 07-03-2017, **Accepted:** 28-03-2017

Access this article online	
Website: www.ijmrp.com	Quick Response code
DOI: 10.21276/ijmrp.2017.3.2.080	

INTRODUCTION

The grave nature of compound fractures has been understood since antiquity.[1] Compound fractures are fractures that communicate with the external environment through a wound.[2] They are usually caused by high energy trauma.[3] Infection at the site of traumatic wounds is a common complication of compound fractures.[4]

About 60-70% of contamination of the compound fractures occur at the time of injury.[5] Bacteria originate both from the skin and outside environment.[6] In some cases, the organism is not present at the time of injury and the wound becomes infected later.[7] The dynamics of bacterial population in soft tissue wounds and bone differ greatly over time.[8] The primary goal in the management of compound fracture is the prevention of infection of the bone and soft tissue. To achieve this goal the most widely accepted treatment protocols include early surgical debridement, irrigation of open wounds, administration of board spectrum antibiotics and stabilization of fractures.[9]

In this study, I studied that pattern of bacterial isolates in all cases of compound fractures of extremities that came to our hospital.

MATERIALS AND METHODS

In the present descriptive observational study, forty consecutive patients of all ages, both the sexes with compound fractures of all the grades as per Gustilo Anderson classification[10], coming to orthopaedic emergency and Outpatient Department of ESIC Model Hospital, Ranchi were selected.

All patients with compound fracture who had taken definitive treatment before coming to our hospital or patients having diabetes mellitus were excluded from the study.

All the patients meeting the inclusion criteria were selected to study bacterial flora in compound fractures and their antibiotic sensitivity after taking written - informed consent from the patient and ethics committee of the institution as well. On arrival in the emergency, wound was examined and the description of the

wound was recorded and then sequential swabs for aerobic culture and sensitivity were taken in three phases.

I. At the time of admission on first inspection of the wound.
II. After debridement on first dressing of the wound.

Culture was taken immediately on the first inspection, and the patient was taken for emergency debridement because wounds were properly scrubbed and painted with antibacterial solution before debridement followed by thorough debridement and copious lavage, cultures were not taken at that time. If the wound was primarily closed on the day of debridement then on the first dressing of the wound if any discharge was present, culture was taken before applying any type of antibacterial solution or cleaning the wound with saline.

III. Third was taken in infection continued.

All the culture and sensitivity reports were collected for the pattern of bacterial isolates and their sensitivity.

All the patients after the first debridement were given antibiotics in the form of amoxicillin, clavulanic acid, and aminoglycoside according to their body weight. Later on according to the culture and sensitivity report, antibiotics were changed if needed. Considering the sensitivity pattern of bacteria in the past, Department of Orthopedics had the protocol of using the same antibiotics.

Table 1: Analysis of bacterial growth on the basis of time lapse between injury and presentation to hospital

Time lapse (hr.)	Total Cases	Pre-debridement	Post-debridement	Third Culture
Before 6 hr.	15	3	4	2
After 6 hr.	25	17	10	4

Table 2: Overall bacterial growth pattern in different culture sample

Culture Sample	No growth	Growth seen in	Gram-positive (%)	Gram-negative (%)
Pre-debridement (n=40)	20 patients (n=40)	20 patients (n=40)	13 (65) (n=20)	7 (35) (n=20)
Post-debridement (n=40)	26 patients (n=40)	14 patients (n=40)	7 (50) (n=14)	7 (50) (n=14)
3rdCulture (n=14)	2 patients (n=8)	6 patients (n=8)	01 (16.6) (n=6)	05 (83.3) (n=6)

Table 3: Culture analysis based on Gustilo-Anderson classification

Classification	Total number of patients	Pre-debridement culture	Post-debridement culture	Third Culture
Open Grade I	3	2	0	0
Open Grade II	14	6	4	2
Open Grade IIIA	6	3	3	1
Open Grade IIIB	14	6	4	2
Open Grade IIIC	3	3	3	1

RESULTS

Forty cases of compound fractures of upper and lower extremity were admitted and treated over a period of 2 years. Out of these 40 patients, 36 (90%) were male and 4 (10%) were female. Age of the patient ranged from 3 to 75 years. A maximum number of patient 19 (47.5%) were found in the age group of 21-40 years. The most common cause of compound fracture in our vicinity was found to be road traffic accident, accounting for 29 cases (72.5%). Compound fracture of lower limb was found in maximum cases 30 (75%) among which tibia was the most common fractured bone with 21(70%) cases. Nearly 25 (62.5%) patient were brought to hospital after 6 hours from the time of injury [Table1]. Patients who were brought after 6 hour showed maximum growth of bacterial isolates. Predebridement culture were taken in all forty patient, and the presence of growth of organism was found in 20 patients (50%) [Table 2]. Out of the positive 20 patients, 13 (65%) were found to have Gram-positive bacterial growth. Coagulase negative *Staphylococcus aureus* was the most common Gram-positive bacteria isolated. Gram- negative bacteria were found in 7 (35%), which showed different isolates occurring in same number.

Post debridement cultures showed growth in 14 (35%), patients with no growth in 26 patients [Table2].

Out of the 14 patients, Gram-positive bacteria were isolated in 7 (50%) patients and Gram-negative in rest 7 (50%). Coagulase-negative S. *aureus* was the most common Gram-positive bacteria isolated with Acinetobacter calcoaceticus baumannii complex as the most common Gram-negative bacteria.

In our study, we had 8 patients in whom the discharge continued; the third culture was taken in all these 8 patients, out of these which 6 (75%) patients showed growth of organism [Table 2]. Of these 6 patients, 5 (83.33%) showed growth of Gram-negative bacteria and 1 (16.66%) showed Gram-positive bacteria. A calcoaceticus baumannii complex was the most common Gram-negative bacterial isolate.

On analysis of all the pre and post debridement cultures, we found high growth of isolates in pre-debridement cultures and reduced in post debridement cultures. We also found that in our study infection was common in compound Grade II and compound Grade IIIB fracture [Table 3].

DISCUSSION

It has been observed that most compound fracture infections are caused by Gram negative rods and Gram positive staphylococci, and so antibiotics should cover both types of organism.[11] However recently Methicillin resistant S. *aureus* has been found to be associated with open lower limb fractures in some series. The optimal antibiotic regimen to combat the infection rate with compound fracture is not clear from the literature.[12] It is important that in the setting of compound fracture, antibiotics should not be considered as prophylactic. As infection commonly occurs in compound fractures not treated with antibiotics, their administration should better be viewed as therapeutic.[13] Many studies have shown all compound fractures should be treated with combination of a first generation cephalosporin and an aminoglycoside.[14]

It has also been observed that a significant percentage of late infections occur with hospital-acquired organisms, suggesting that inoculation of pathogens occurs subsequent to the initial injury.[11]

The constantly changing local wound ecology and sampling variations led to the proposition of different ideas by different authors in the orthopedic literature. Based on the types of organism causing infection compared with those on early wound cultures, several authors have proposed that many infections of open fracture wound are nosocomial.[7]

Wound contamination occurs with both Gram-positive and Gram-negative microorganism; therefore the antimicrobial regimen should be effective against both the types of pathogen.[15]

In my study, on analysis of the pre-debridement, post-debridement, and third culture, positive pre-debridement culture showed maximum growth of Gram-positive bacteria. However, majority of these patients were found to have growth of different organism in their post-debridement culture reports. These positive post-debridement culture patients either showed no growth or the microbial isolate was totally different from the pre-debridement culture. A positive pre-debridement culture does not conclude that the patient is infected or going to have infection later on and similarly, negative pre-debridement cultures does not rule out the probability of infection later on, as many cases negative for growth of organism in pre-debridement phase showed growth of organism in post-debridement cultures.

These findings in my study led us to conclusion that pre-debridement cultures are of no importance. The findings supported the observation by Faisham et all.[16] and Lee,[11] who concluded that pre-debridement cultures are of little predictive value. In this study, post-debridement cultures were more representative then pre-debridement. Post-debridement culture in my study showed growth of both Gram-positive and Gram-negative bacteria in equal number; clearly indicating that there was increase in growth of Gram-negative bacterial isolates. Another important aspect was that majority of the patients who showed growth of the bacterial isolates in third culture or who showed signs of continued infection were found to have bacterial growth in their post-debridement culture. This finding in our study led us to the conclusion that post-debridement culture is best to formulate a proper antibiotic regimen according to the sensitivity pattern found in our vicinity for all patients with compound fractures. My finding of post-debridement culture being important coincides with study by Faisham et al.[16] Third culture analysis showed an increase in growth of Gram-negative bacteria, namely Acinetobacter Pseudomonas, Enterobacter, and Escherichia coli. 83.33% bacterial isolates were Gram-negative, probably indicating nosocomial infection because growth of organism was different from post-debridement culture. This finding coincides with finding of Lee[11] and Merritt[17] who were of the Opinion that infection in compound fractures are of nosocomial origin as causative microorganism of infection are different to that found in initial smears. Nosocomial organisms have emerged as the main source of infection in compound fractures in the developed world.[18] Pseudomonas and Enterobacter spp. are associated with hospital-acquired infection rather than initial contamination of the open fracture in the field.[19] Acinetobacter spp. is the most important nosocomial pathogen as it survives in dry environment and is multiple drug resistant.[20] Acinetobacter spp. is ubiquitous in the environment and transmitted through hands, clothing, contaminated surgical instruments, and air conditioning or ventilation devices.[21] On analysis of pre-debridement, post-debridement, and subsequent culture pattern in my study, I found that compound fractures of tibia showed more growth of pathogens as compared to growth seen in compound fractures involving any other bone. The high susceptibility can be explained on the basis of severe comminution, contamination, and devitalization due to superficial location, subcutaneous characteristic, delay in providing early coverage, and most importantly delay in getting proper medical care at right time, which coincides with the finding of Clancey and Hansen[22] and Ikem et al.[7] Lee[11] concluded in his study that both pre- and post-debridement cultures have essentially no value and is an unnecessary expense to the patient and hence should not be used. My study also shows no significant correlation between pre- and post-debridement cultures, but I found post-debridement culture to be important in formulating an antibiotic regimen to be started early in emergency and subsequent cultures to be taken as long as there is any discharge from the wound site, so as to study the bacterial isolate and its sensitivity pattern to change antibiotics if necessary.

Based on the results, I would like to reemphasize that all patients with compound fractures need to be assessed individually, and the basic principles of open fracture management including wound debridement, fracture stabilization, and soft tissue cover must be carried out with culture samples taken at appropriate time.

CONCLUSION

Pre-debridement cultures are of no importance in treating compound fractures. Post-debridement cultures are important in formulating an antibiotic policy to be started in patients of compound fractures as soon as possible. Gram-negative organisms are the most probable cause of infection in cases of compound fracture. Antibiotic policy should cover both Gram-positive and Gram-negative organisms with two antibiotic drug regimens if possible. Aminoglycosides are the most sensitive group of drugs in both Gram-positive and Gram-negative bacteria. Quinolones or cephalosporins should be used in combination with aminoglycosides in all cases of compound fracture in our vicinity. Absolutely considering the results of the study, I have to change the antibiotic choice and regimen in our department. I would like to suggest that, all institutions and hospitals should find out the most common infecting pathogen in their environment and formulate an antibiotic policy accordingly.

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Source of Support: Nil.

Conflict of Interest: None Declared.

Cite this article as: Shankar Niwas, Ashok Kumar Sharma, Manoj Kumar. Observation on the Pattern of Bacterial Isolates in Compound Fractures. Int J Med Res Prof. 2017; 3(2):382-85. DOI:10.21276/ijmrp.2017.3.2.080