

Incidence of Post-Operative Wound Infections and Bacterial Antibiotic Sensitivity Patterns in Compound Fractures

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Abstracts: Objectives: To know the incidence of post-operative wound infections in compound fractures & to evaluate the bacterial isolate and to identify the antibiotic sensitivity patterns in compound fractures to facilitate the use of effective prophylactic antibiotics to prevent infections. **Methodology:** This was a prospective study conducted at Jawahar Lal Nehru Medical College and Hospital between 1st may 2014 to 31st July 2014. This study included all the patients with Compound fractures of extremities, presenting to Orthopaedic emergency. All the open fractures were classified according to the Gustilo and Anderson's classification. Two pus culture swabs were taken in all patients under all aseptic precautions. First sample was taken at time of arrival of patient at emergency department, and immediately sent for culture and sensitivity. Prophylactic antibiotic (i.v. cefoperazone) was started immediately after taking the first culture. Second pus culture swab was taken after three days, at the time of wound inspection. All the fractures were managed with thorough wound debridement and fracture stabilization. Data was collected according to set proforma, regarding the results of initial and post-operative swab cultures and were analysed. **Observation & Results:** This study involved forty patients with compound fractures of extremities presenting to the emergency department. The incidence of wound infection before any operative procedure i.e, first pus culture in the study was fifty five percentage.. Out of twenty two infected cases thirteen patients had staphylococcus aureus as the growing organism. All Staph.aureus were found to be sensitive to amikacin, vancomycin. The incidence of wound infection in second pus culture report was found to be thirty percentages. In the second swab culture sample which was taken on third day, eight (twenty percentage) cultures showed Staph. aureus. Six were sensitive to amikacin, six were sensitive to cefazoline. **Conclusion:** Compound fractures are associated with high incidence of infection. Antibiotics should be such that it covers all the commonly infecting organisms. In this study the commonest infecting organism was found to be Staph. aureus followed by E. fecalis, Citrobacter, E. coli and Klebsiella. It indicates that antibiotics should be given initially empirically to cover the Gram positive and negative bacteria followed by giving specific antibiotics following pus culture report to combat and eradicate wound infection. Most of these organisms were found to be sensitive to Cephalosporins, Vancomycin and Aminoglycosides. Thus it is highly recommended that Prophylactic antibiotics in the management of compound fractures should always include one Cephalosporin or Vancomycin and one Aminoglycoside to cover the commonly infecting organisms. The results of this study may hold true for elective Orthopaedic procedures also.[Khan N NJIRM 2015; 6(1):21-26]

Key Words: wound infection, compound fractures, and antibiotics.

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Introduction: The incidence of fractures with open wounds is increasing because of increase in high velocity trauma due to road traffic accidents, farm yard injuries and civil casualties. These compound fractures are prone to get infected as protective cover of skin is lost and fracture haematoma communicates with the external environmental micro-organisms. Inoculation and colonization of bacteria may occur either at the site of accident or in the hospital. If not properly treated, this infection may lead to infected non-unions, chronic osteomyelitis with discharging sinuses, septicemia

& septicemia shock and sometimes amputation of involved extremity.

The increased incidence of road traffic accidents, household & machinery injuries have led to a significant increase in the number of compound fractures thereby posing a great burden on the medical facilities. The concurrence of colonization of bacteria and subsequently the development of wound infection pose an additional threat to the management of the compound fractures. Lack of proper first aid care, logical antibiotic prophylaxis and delay in the arrival of patient to the hospital

has further increased the chance of wound infection. Management of infected compound fractures is challenging as it poses an economic burden on the patients, their family as well as the society. Infected compound fractures may cause huge morbidity, financial loss, and loss of occupation, psychological problems and sometimes death due to fulminant infection in immuno-compromised patients.

Efficient management of compound fractures involves early wound debridement and stabilization of the fracture under the appropriate antibiotic cover. The prophylactic antibiotic should be such that they can cover all the commonly infecting bacteria. Therefore it is important to know exact incidence of post-operative wound infection and bacterial antibiotic sensitivity patterns in compound fractures.

This study has focused objectives to know the incidence of post-operative wound infections in compound fractures and to evaluate the bacterial isolate and to identify the antibiotic sensitivity patterns in compound fractures to facilitate the use of effective prophylactic antibiotics to prevent infections.

This will help in deciding the most appropriate and rational prophylactic antibiotic regimen for these fractures.

Materials and Methods: This study type was observational studies in epidemiology. It is prospective incidence study carried out to observe the association between incidences of bacterial isolates in compound fractures occurred in various accidents and antibiotic sensitivity pattern of wound infections.

This study conducted at Dept. of Orthopaedics and Emergency of Jawahar Lal Nehru Medical College and Hospital between the periods of 1st may 2014 to 31st July 2014. This study included all the patients with compound fractures of extremities, presenting to Orthopaedic emergency. Pus culture swabs were taken in all patients under all aseptic precautions. First sample was taken at time of arrival of patient at emergency department, and immediately sent for culture and sensitivity.

Prophylactic antibiotic (i.v. cefoperazone) was started immediately after taking the first culture. All the fractures were managed with thorough wound debridement and fracture stabilization. Antibiotic given prophylactically in the starting after taking first culture was the potential confounder which might affect the outcomes of second pus culture sensitivity tests.

Data was collected according to set proforma, regarding the results of initial and post-operative swab cultures and were analyzed.

All the patients with compound fractures of extremities, presenting to Orthopaedic emergency were the source of participants. Informed consent was taken from all the patients for inclusion in this study. All the patients of open fractures were selected for studied and their fractures were classified according to the Gustilo and Anderson's classification¹.

All the fractures were managed with thorough wound debridement and fracture stabilization. Stabilization was done with external fixator in compound (Type 3b) fractures and fixation with internal fixation devices for compound Type 1 and 2 fractures. For compound grade 3a fractures decision regarding type of stabilization was taken after evaluating the wound condition individually.

The average time of presentation of the patient to the emergency after sustaining the injury, Average time gap between presentation and operative intervention and type of fractures are the potential source of bias.

Our study sizes have 40 patients with compound fractures of extremities presenting to the emergency department. There were 9 females (22.5%) and 31 males (77.5%). We had taken simple random sampling from the patients coming to casualty of J.N. Medical College.

About the statistical methods, Incidence of wound infection was calculated as given formula within a specified period of time i.e., 03 months. Its unit was denoted as per 100 patients per quarter year. Pus culture sensitivity of first swab taken at the time of arrival and second pus swab taken post

operatively was done. Gender wise distribution of the patients, distribution of patients according to Gustilo’s classification of fracture, Bacterial isolates from 1st culture taken at the time of arrival in emergency, bacterial isolates in second pus culture taken on the 3rd day and their Antibiotic culture sensitivity tests were depicted by pie charts. Pus culture sensitivity of first swab taken at the time of arrival and second pus swab taken post operatively was done in the microbiology laboratory.

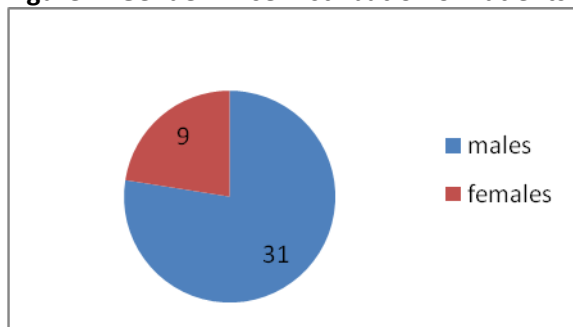
Incidence of wound infection was calculated as given formula within a specified period of time i.e., 03 months:

$$\text{Incidence} = \frac{\text{No. of new cases of fracture having infection}}{\text{Total no. patients}} \times 100$$

Since we have measure only incidence of wound infection in patients of compound fracture before any operative procedure and after post-operative on 3rd day on the same group of patients and same duration of time i.e., 03 months so there was no need for comparison by any assessment methods. Ethical approval has been taken from Institutional ethical committee prior to start of study.

Observation & Results: This study involved 40 patients with compound fractures of extremities presenting to the emergency department. There were 9 females (22.5%) and 31 males (77.5%).

Figure 1: Gender-Wise Distribution of Patients



Male to female ratio was 3.4 : 1.

Average age was 37.25 years (range 18 to 57 yrs.) Mode of injury was road traffic accident in 37(92.5%) patients and fall from height in 3(7.5 %) patients.

The average time of presentation of the patient to the emergency after sustaining the injury was five hours (ranging from 1 hour to 20 hrs).

Average time gap between presentation and operative intervention was 3 hours (ranging from 1 to 7 hours).

Type of fractures- 16(40%) patients had compound grade 1 #, 11 (27.5%) had compound grade 2 #, 13(32.5%) patients had compound grade 3 #

Figure 2: Showing Distribution of Patients according To Gustilo’s Classification of Fracture

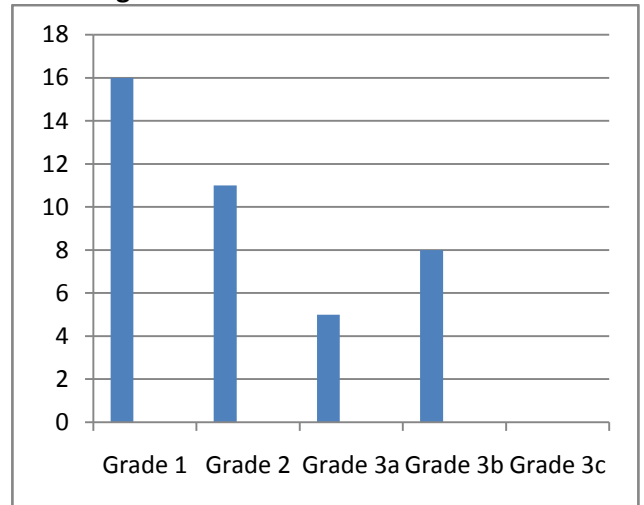
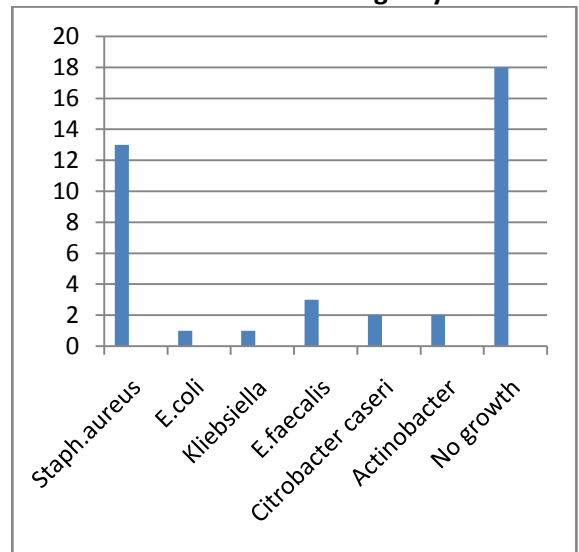


Figure 3: Bacterial Isolates from 1st Culture Taken At the Time of Arrival in Emergency

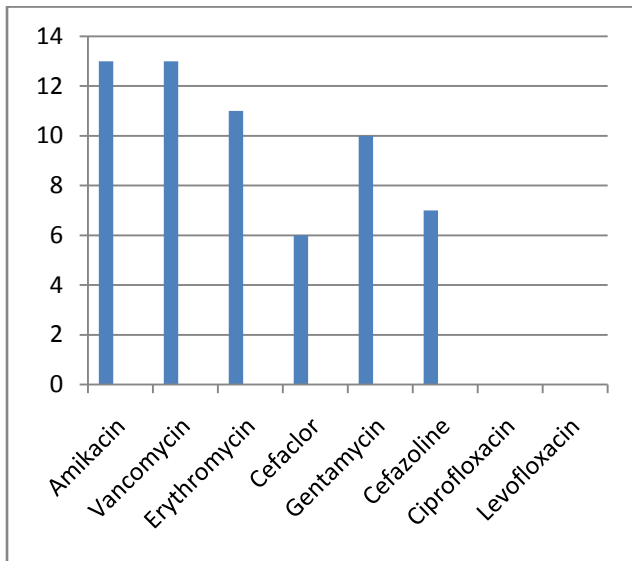


Out of 40 patients, initial swab culture was positive in 22 cases i.e. incidence of bacterial inoculation in

the wounds of compound fractures was 55 per 100 patients per quarter year. The incidence of wound infection before any operative procedure i.e, 1st pus culture in the study was 22/40 = 55 per 100 patients per quarter year. Out of 22 infected cases 13 patients had staphylococcus aureus as the growing organism (Figure – 3)

All Staph.aureus were found to be sensitive to amikacin, vancomycin .

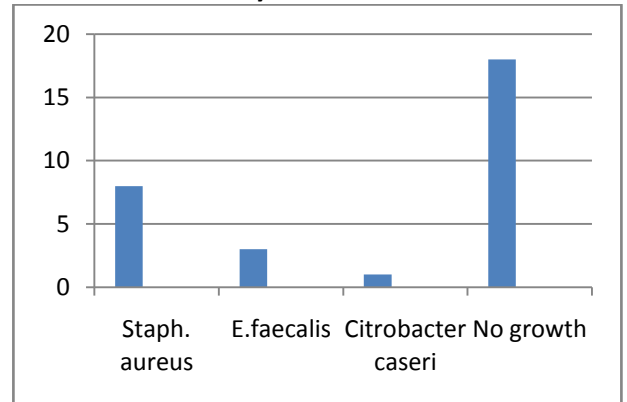
Figure 4: Antibiotic Sensitivity Patterns of Isolates from 1st Culture



11 out of 13 Staph. aureus were found sensitive to erythromycin. 6 out of 13 Staph. aureus were found to be sensitive to cefaclor. 10 out of 13 Staph. aureus were sensitive to gentamycin . 7 out of 13 were found to be sensitive to cefazolin. All were found resistant to ciprofloxacin. 12 out of 13 bacteria were found to be resistant to levofloxacin. 1 (2.5%) sample showed E.coli which was sensitive to amikacin, ceftriaxone and imipenem.1(2.5%) sample showed Klebsiella. Klebsiella was found sensitive to ceftriaxone and imipenem.3(7.5 %) culture showed growth of E.faecalis where all the 3 were found resistant to all antibiotics except vancomycin.2 (5%) samples showed Citrobacter koseri which were found to be sensitive to imipenem. 2(5%) showed acinetobacter. 1 Acinetobacter was found to be sensitive to amikacin and tobramycin and the other was found sensitive to sparfloxacin. Rest 18(45%) samples did not show any growth.

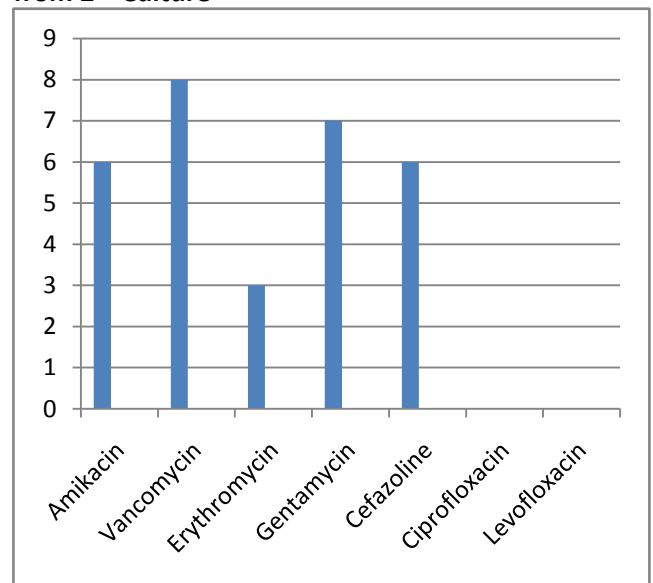
The incidence of wound infection in second pus culture report was found to be (12/40) = 30 per 100 patients per quarter year. In the 2nd swab culture sample which was taken on third day, 8 (20%) cultures showed Staph. aureus.

Figure 5: Bacterial Isolates in Second Pus Culture Taken On the 3rd Day



6 were sensitive to amikacin, 6 were sensitive to cefazolin, 3 were sensitive to erythromycin, 7 were sensitive to gentamycin, all were resistant to ciprofloxacin & levofloxacin, all were sensitive to vancomycin .

Figure 6: Antibiotic Sensitivity Patterns of Isolates from 2nd Culture



3(7.5%) showed E. faecalis. 1 out of 3 was sensitive to gentamycin, erythromycin otherwise they were found resistant to all antibiotics.

1(2.5%) culture showed Citrobacter. Citrobacter was found to be sensitive to imipenem.

Rest 28(70 %) showed no growth.

Discussion: Open fractures are a challenge to treat as they are associated with high incidence of wound infection. Soft tissue injury is present in all open fractures^{2, 3}. Compound fractures have been associated with high risk of wound infection and thus require utmost care during their management.

In our study we found that the incidence of wound infection from culture taken immediately at the time of presentation to the emergency was 55%. this incidence was higher than that (45%) reported by from Chandigarh, India by Sen et al., (2000)⁴ and 45.8% reported from Ile-ife, Nigeria by Ikem et al., (2004)⁵.

Robinson et. al. (1989)⁶ reported an incidence of 83% wound infection. This suggests that there is high level of contamination present in open fractures.

In our study we found that the most common organism present in open fractures was Staph aureus. Staph aureus has found to be the most common infecting organism in many studies^{7, 8, 9, 10, 11}. Staph.aureus was the commonest organism both in the initial culture as well as in the swab taken on third day. There seems to be a probable association between the bacteria inoculated at the time of injury in open fractures and same bacteria causing post-operative infection thus explaining the commonest occurrence of Staph.aureus in both the cultures.

We also found that most of the bacterial isolates were sensitive to amikacin, cephalosporins and erythromycin. Robinson et al 1989² also suggested that most of the bacteria were sensitive to cephalosporins. Therefore it is rational to use empirical antibiotics (cephalosporins, aminoglycosides) so as to combat the wound infection caused by the commonly infecting organisms.

Ali M H et.al.(2008)¹² also suggested that Empirical antimicrobial regimens for the management of

infection requiring surgical debridement following open, upper extremity agricultural injury should be active against staphylococci, aerobic gram-negative bacilli, and anaerobes.

There were 3 cases of hospital acquired Staph.aureus infection and 1 cases each of Citrobacter and E. Faecalis thus in our study we found that Staph.aureus was the most common bacteria responsible for hospital acquired infection. The rest of bacterial isolate in the 1st and the 2nd sample was same, meaning thereby that in most of the cases the bacteria was present in the wound at the time of fracture. Kindsfater et.al¹³ reported that the 25% of infections were caused by microorganism found in the initial examinations.

In the study the incidence of infection decreased in second culture taken on third day. This may be due to timely surgical wound debridement and empirical antibiotics. Thereby it is strongly recommended that all compound fractures should be treated with early surgical debridement and empirical antibiotics as there high incidence of infection in these cases especially with Staph.aureus. The major limitation of the study was small sample size and variation in types of fractures.

Conclusion: Compound fractures are associated with high incidence of infection. Aim of treatment in these fractures is to prevent the infection and achieve union. Early wound debridement, stabilization and effective prophylactic antibiotic therapy can achieve the desired results. Antibiotics should be such that it covers all the commonly infecting organisms. In this study the commonest infecting organism was found to be Staph.aureus followed by E. fecalis, Citrobacter, E. coli and Klebsiella. It indicates that antibiotics should be given initially empirically to cover the Gram positive and negative bacteria followed by giving specific antibiotics following pus culture report to combat and eradicate wound infection. Most of these organisms were found to be sensitive to Cephalosporins, Vancomycin and Aminoglycosides. Thus it is highly recommended that Prophylactic antibiotics in the management of compound fractures should always include one Cephalosporin or Vancomycin and one Aminoglycoside to cover

the commonly infecting organisms. The results of this study may hold true for elective Orthopaedic procedures also.

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Ethical consent: It was taken from institutional Ethical Committee prior to study.

References

1. Gustilo RB, Mendoza RM, Williams DN. Problems in the management of type III (severe) open fractures: A new classification of type III open fractures. *J Trauma*. 1984; 24:742–52.
2. Carsenti-Etesse H, Doyon F, Desplaces N, Gagey O, Tancrede C, Pradier C, Dunais B, Dellamonica P. Epidemiology of bacterial infection during management of open leg fractures. *Eur J Clin Microbiol Infect Dis*. 1999; 18:315–23.
3. Zalavras CG, Marcus RE, Levin LS, Patzakis MJ. Management of open fractures and subsequent complications. *J. Bone Joint Surg. Am* .2007; 89:884-95.
4. Sen RK, Murthy NRS, Gill SS, Nagi ON. Bacterial load in tissues and its predictive value for infection in open fractures. *J Orthop Surg*. 2000; 8: 1-5.
5. Kem IC, Oginni LM, Bamgboye EA, Ako-Nai AK, Onipade AO. The bacteriology of open fractures in Ile-Ife, Nigeria. *Niger J Med*. 2004; 13: 359-65.
6. Robinson D, On E, Hadas N, Halperin N, Hofman S, Boldur. East practice management guidelines work group: practice management guidelines for prophylactic antibiotic use in open fractures. *J Orthop Trauma* 1989;3:283-286.
7. Tewodros W, Gedebou M. Staphylococcus aureus isolated from a surgical department. *Ethiop Med J*.1983; 21:209-16.
8. Belihu A, Lindtjorn B. Increasing incidence of resistance to antimicrobials in Sidamo. *Ethiop Med J*.1999; 37:181-7.

9. Ahmed E, Chaka T. Orthopaedic and major limb trauma at the Tikur Anbessa University Hospital, Addis Ababa – Ethiopia. *ECAJS*. 2006;11: 43-50.
10. Biruk WL, Wubshet K. Chronic osteomyelitis at Tikur Anbessa Hospital, Addis Ababa University, Ethiopia. *ECAJS*. 2007; 12:33-41.
11. Woldetensaie Z. Staphylococci: Frequency of isolation and antibiotic susceptibility patterns in Jimma Hospital, South West Ethiopia. *Ethiop Med J*. 2000; 38:175-84.
12. Ali MH, Hoekzema NA, Bakleh M, Shin AY, Osmon DR. The microbiology and risk of infection following open, agricultural upper extremity injuries. *J Hand Surg Am*. 2008 Jan; 33(1):87-93.
13. Kindsfater k, Jonassen et al. Osteomyelitis in compound grade 2 and 3 open tibia fracture with late debridement. *journal orthop. Trauma*.1995; 9:121-127.

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