ORIGINAL ARTICLE

Bacteriology of open fractures, experience at a tertiary care hospital

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Abstract

Open fractures are still considered a major challenge for surgeons and frequently require a series of complex surgical procedures for achieving proper limb function. Documented incidence of infection in open wound fractures varies in the literature.

Objective: To determine the frequency of different organisms cultured from open fractures within 24 hours of presentation at Department of Orthopedic Surgery, Khyber Teaching Hospital, Peshawar from 1st January to 31st December 2019. The duration of the study was 01 year. A total of 162 trauma patients with an open fracture of extremities who presented within 24 hours after trauma were studied and cultures from their wounds were collected.

Results: Gender-wise distribution among 162 patients showed 88(54.3%) as male and 74(45.6%) as female. The mean age was 27.23±3.633. Fractures distribution according to the anatomic location showed 74(45.67%) patients with tibia fractures, 23(14.19%) with the femur, and 18(11.11%) with ankle fractures. Micro-organism distribution showed Staphylococcus aureus as 43(26.8%) Streptococcus 33(20.37%), Staphylococcus Epidermidis 28(17.28%), E. coli 21(12.96%), and Klebsiella aerogenes in19 (11.72%) cases.

Conclusion: All open compound fractures should be considered infected until proved otherwise. The patient needs good antibiotics coverage both for Gram-positive and negative coverage besides wound care till the availability of the culture and sensitivity reports.

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Introduction:

Management of open fractures is still considered a challenging task and often requires a series of complex surgical procedures for achieving proper limb function. Open fractures are considered heavily contaminated. Documented incidence of infection in open fractures varies in the literature. Spencer et al. documented a 10.4% incidence of infection in open wound fractures,[1] whereas Weitz-Marshall and Bosse published an infection rate between 0% and 50%.[2]

The evaluation and management procedure for open wound fractures is a set of principles that have evolved with time. This set of principles includes both the initial management as well as subsequent surgical intervention. The initial step is to make a correct diagnosis. Proper debridement with adequate wound coverage and splinting of the fractured wound is performed along with appropriate antibiotics coverage and tetanus prophylaxis. Surgical intervention usually dealt with both bony fractures and soft tissue management. Adjuncts to the surgical management of open fractures often also include delivery of antibiotics drugs to the fracture site.[3,4]

The severity of the fracture, comorbidities, presence of de-vascularized soft tissue, and treatment delay are all contributing risk factors for bacterial wound infection.[5] Prophylactic empirical antibiotic therapy is started to reduce the incidence of wound infection.[6]

As the documented incidence of infection in open wound fractures varies in the literature, also micro-organism distribution in open fractures varies in different parts of the world and we have no local statistics available in our country. So, the purpose of this study was to determine the frequency of various organisms from culture reports of open fractures of extremities that will give us an idea about the local distribution of common organisms involved in open fractures and will help us in choosing proper antibiotic therapy. Results will be shared with local health professionals. Ultimately, it will help to decrease the incidence of wound infection, related morbidity, and associated financial burden.

Material and Methods:

This descriptive cross-sectional was carried out at the Department of Orthopedic Surgery, Khyber Teaching Hospital, Peshawar, from 1st January to 31st December 2019. The duration of the study was 12 months. Sampling was done through a non-probability consecutive technique. The total numbers of patients studied were 162. Approval from the Hospital Ethical Committee was taken.

Patients of either gender with an age range between 18 to 60 years, who presented with an open fracture of the extremity with a duration of <24 hours were included in this study. Those with life-threatening abdominal, head, and chest injuries, patients with a history of burn injury, systemic illnesses like diabetes, those who were on steroids, and immuno-suppressants (immuno-compromised) were excluded from this study.

All patients who were admitted through the emergency department meeting the above inclusion criteria were included in the study. Prior to the conduct of the study, verbal and written-informed consent was obtained. A presentation of open wounds were thoroughly evaluated and fracture grading was done according to Gustilo and Anderson classification. Management of these open fractures was carried out as per departmental protocol. 1st wound swab was taken for culture after surface cleaning followed by proper wound irrigation at an emergency department. Broad-spectrum antibiotics were given Intravenous (IV) in the form of injection amoxicillin + clavulanic acid 1.2 g BD, injection metronidazole 500 mg TDS, and injection amikacin 500 mg OD, for at least 5 days after wound debridement, which was done within 1st 6 hours of hospital presentation along with thorough irrigation of the wound with 03 liters of normal saline solution. Primary wound closure was carried out only in those cases that were found suitable. Secondary wound closure was preferred in heavily contaminated open wounds. In cases with delayed wound closure, repeatedly wound dressing was done after every 48 hours. For larger wound defects, skin grafting or flap coverage was preferred as early as possible. Fixation consisting of external fixation /internal fixation or cast immobilization was carried out if needed. Analgesia and intravenous fluids administration were done on a need base. Infection documentation was done irrespective of the type of wound closure, fixation and culture report. At 1-week intervals, cultures were repeated except when definitive wound closure was carried out.

All the above information including age, gender, site of injury, grading of open fracture, and frequencies of micro-organisms were recorded on a pre-designed proforma. Data were analyzed in SPSS version 22. Mean±SD were calculated for numerical variables like age. Frequencies and percentages were calculated for categorical variables like gender, site of injury, grading of fracture, and micro-organisms documented in the culture report.

Results:

162 patients, the Male was 88(54.3%) and the Female was 74(45.6%). The mean age was 27.23±3.633. The distribution of fractures among 162 patients according to Gustilo classification is shown in figure no: 1. The majority of the patients i.e. 75(46.29%) were having Gustilo III A, 47(29.01%) patients were having Gustilo II grade, 30(18.51%) cases were graded as Gustilo I, 5(3.08%) cases graded in Gustilo Grade III B and III C each.

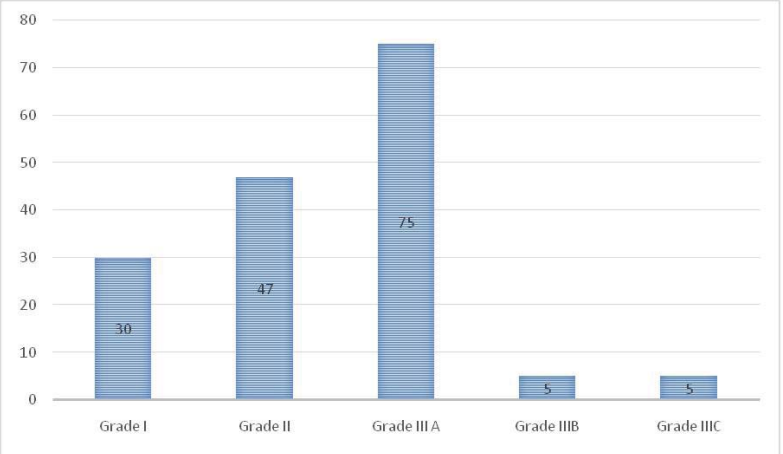

Figure 1: Distribution of fractures according to Gustilo classification (n=162)

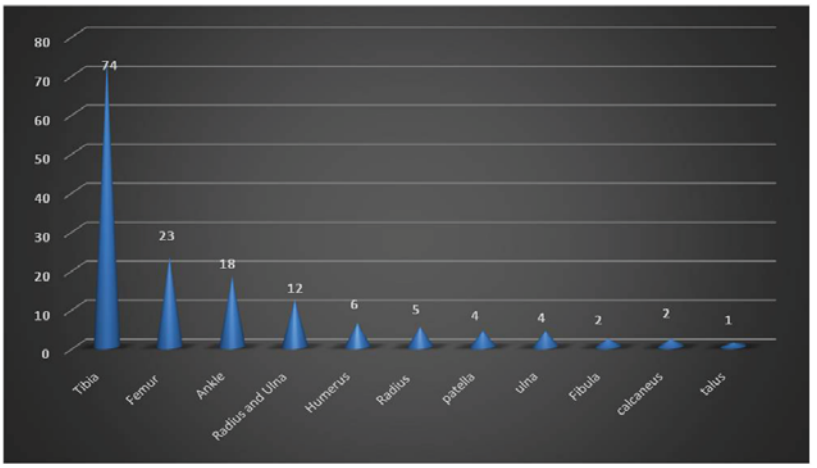

Figure 2: Fracture distributions in relation to anatomic location. (n=162)

Table 2: Frequency and percentage of microorganisms and their association with Gustilo classification. (n=162)

Microorganisms	Gustilo-classification					Total
	Grade I	Grade II	Grade III-A	Grade III-B	Grade III-C	
Staphylococcus aureus	08 (12.96%)	15 (9.25%)	18 (11.11%)	01 (0.61%)	01 (0.61%)	43 (26.54%)
Streptococcus	05 (3.08%)	10 (6.17%)	16 (9.87%)	01 (0.61%)	01 (0.61%)	33 (20.37%)
Staphylococcus epidermidis	04 (2.46%)	09 (5.55%)	13 (8.02%)	01 (0.61%)	01 (0.61%)	28 (17.28%)
E. coli	05 (3.08%)	04 (2.46%)	10 (6.17%)	01 (0.61%)	01 (0.61%)	21 (12.96%)
Klebsiella aerogenes	02 (1.23%)	05 (3.08%)	10 (6.17%)	01 (0.61%)	01 (0.61%)	19 (11.72%)
No growth	06 (3.70%)	04 (2.46%)	08 (12.96%)	00 (0%)	00 (0%)	18 (11.11%)
Total	30 (18.51%)	47 (29.01%)	75 (46.29%)	5 (3.08%)	5 (3.08%)	162 (100%)

Fracture distribution in relation to anatomic location as shown in figure no. 2, 74(45.67%) patients with the tibia, 23(14.19%) with the femur, 18(11.11%) with ankle fractures, and 12(7.4%) cases were found with combined Radius and Ulna fracture.

The frequency and percentage of micro-organisms' distribution among 162 patients are analyzed as shown in table 1. While an association between micro-organisms and Gustilo classification is shown in table 2

Discussion:

The treatment approach to compound fractures varies. Friedrich suggested that open fractures treatment should be started less than 6-hours after injury. He demonstrated that in contaminated wounds during the initial phase, bacterial growth lasts for 6 to 8 hours after inoculation. After this time, wound debridement would not be much effective inthe prevention of infection. That's why Friedrich recommended wound cleaning with circumferential excision of wound edges during the first 6-hours. But it's not always possible to do wound debridement always during this time.[7]

On other hand, waiting periods between 6 to 24 hours for the surgical procedure for compound fractures management allow the surgeon to better identify the severity of injuries, proper pre-operative planning, and adequate patient stabilization. Current literature does not provide any scientific evidence that delaying wound debridement affects the incidence of infection.[4]

In a study, culture reports showed 54% cases with Gram-positive organisms, the most common was Staphylococcus aureus with 32% and Streptococcus with 18%. While 24% of cases showed Gram-negative organisms growth, the commonest were E.coli with 12%, also mixed growth was obtained in 12% of the cases while 10% of cases yielded no growth.[8] while our study showed micro-organism distribution as, Staphylococcus aureus were 26.8%, Streptococcus at 20.37%, Staphylococcus epidermidis at 17.28%, E. coli at 12.96%, and Klebsiella aero-

genes reported in 11.72% cases. Almost more or less the same result as the previous study.

In one another study, 151-patients with open fractures were studied. In 74.1% of cases mode of injury was road traffic accidents. Also, a change in wound flora was noted overtime during the hospital stay. Incidence of infection increased with delaying the wound coverage duration.[9]

Various observational studies have recorded a direct association between the fracture severity by Gustilo and Anderson classification and incidence of infection.[10,11] So, the recommendation is to operate on more severe fractures as early as possible.

Also, few studies established a direct association between the incidence of infection and delayed wound debridement[12,13] while few other studies observed no relationship between the incidence of infection, delayed wound debridement, and antibiotic administration.[14-16]

The infection rates in compound fractures vary to a large extent in the literature. Muller et al, documented infection rates up to 20.5% in open wound fractures.[17] Another international study has also documented an overall infection incidence of 10.4%.[1]

The limitation of this study was that patient with comorbid condition and other immunocompromised patients were not included in this study, micro-organisms involved in wound infection of this group of people varies and this group of people will need a separate study with a different set of protocols for exact documentation of incidence of wound infection and determination of involved organisms in wound infections.

We also believe that other factors that influence the infection rate like patient-related factors (diabetes, smoking, and steroid / immunosuppressant usage), the severity of fracture, proper debridement of devitalized tissues, and surgeon's experience cannot be ignored.

Conclusions:
All open fractures Gustilo type II and type III reached the hospital in more than 6-hours should be considered infected. Wounds should be properly washed and specimens were taken for culture and sensitivity. The patient should be started on intravenous 1st -generation cephalosporin and Aminoglycosides for both Gram-positive and negative coverage till the availability of the culture and sensitivity reports

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Role and contribution of authors:
Qaisar Alam, collected the data, references and did the initial writeup.

Nek Muhammad Khan, collected the references and helped in discussion writing.

Wali Muhammad, collected the data and helped in introduction writing.

Aimal Sattar, collected the data and helped in compiling the result.

Dr Naeem ullah, critically review the article and made final changes.

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