ORIGINAL ARTICLE

Micro-Organisms Isolated from Open Fractures of Extremities

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doi: 10.22442/jlumhs.2024.01157

ABSTRACT

OBJECTIVE: To determine the frequency of micro-organisms from culture reports of open fractures of extremities.
METHODOLOGY: In this descriptive cross-sectional study carried out in the orthopedic surgery department of Lady Reading Hospital in Peshawar, 173 patients with open fractures lasting more than five days were included. The trial lasted for six months. Consecutive non-probability sampling was used. Swabs were collected from the fracture wounds. Swabs were inoculated on Blood agar, MacConkey agar and chocolate agar. Different biochemical tests were used to identify the Micro-organisms.
RESULTS: Analysis of 173 patients' ages revealed that the patients were 18-67 years old, with a mean age of 28.6±3. Analysis of the gender-wise distribution of the 173 patients showed that 92(53.2%) were men and 81(46.8%) were women. Analysis of the distribution of micro-organisms among 173 patients revealed that 45(26%) and 36(20.8%) of them were *staphylococcus aureus* and Streptococcus. Staphylococcus epidermidis were 32 (18.5%). Pseudomonas aeruginosa were 34(19.7%) and *E Coli* were 26 (15.02%). The Gustilo classification was used to examine the distribution of fractures among 173 patients. Grade 1 consisted of 31, Grade II consisted of 48, Grade III consisted of 80, Grade IIIB consisted of 8, and Grade IIIC consisted of 6.
CONCLUSION: This study concludes that both staphylococcus aureus were the frequent micro-organisms involved in open fracture infections.

KEYWORDS: Micro-organisms, open fractures of extremities, Culture, Infection.

INTRODUCTION

For the treating surgeon, an open fracture still poses a significant difficulty since it often necessitates various intricate operations to promote undisturbed healing and proper limb function. The research shows considerable variation in the frequency of infection in open fractures. While Weitz-Marshall and Bosse discovered infection rates ranging from 0% to 50%, Spencer et al. reported an overall incidence of infection in open fractures of around 10.4% [1].
It is easiest to think of the process for evaluating and treating open fractures as a collection of ideas that have developed throughout time, frequently in connection with improvements in the treatment of military troops during the war. These guidelines cover both preoperative care and after surgery[2].

Accurately diagnosing and recording the damage mechanism is the first step. With the start of the proper antibiotic medication and tetanus prophylaxis, the wound is appropriately covered, and the fracture is splinted. Usually, this is followed by an urgent surgical intervention that addresses soft tissue and bone treatment. The treatment of open fractures has progressed and now includes adjuncts such as the local fracture environment supplied with essential nutrients or antibiotics[3,4].

In one research, the culture reports showed that 27 (54%) cases were Gram-positive, with Staphylococcus aureus accounting for 32% of the cases and Streptococcus for 18%. Two cases involved MRSA and Staphylococcus epidermidis. Gram-negative organisms were found in twelve instances (24%), with E. coli being the most prevalent (12%). Six (12%) of the patients had mixed growth, one of which included *Enterobactor arogenosa* and MRSA. Ten percent (5 instances) show no growth[5].

Postoperative infection is the primary complication of open fracture wounds, which are contaminated wounds. The fracture's severity increases the risk of bacterial infection, communication of the broken bone fragments to the surrounding environment, patient co-morbidities, de-vascularized soft tissue, and treatment delay[6].

Surgeons find it challenging to repair open fractures because infection from contaminated wounds is a known consequence. For open fractures, preventive antibiotic medication is usually advised to prevent this consequence[7].

In another research, there were 15 (23.43%) incidences of infection out of 60 patients with 64 open fractures. Traffic accidents accounted for 48 (75%) of all injuries. Throughout the hospital stay, the flora in the wounds changed. The ultimate wound covering lasted an average of 5.66 days. From the last wound coverage period to an increase in trauma, the rate of infection rose[8].

This study aims to find the frequency of organisms from culture reports of open fractures of the extremities.

METHODOLOGY

This descriptive cross-sectional study was conducted at the Department of Orthopedics, Lady Reading Hospital, Peshawar, from August 2020 to February 2021. Using the WHO Sample Size Calculator, a total sample size of 173 was determined, accounting for 12.5 percent of *E. Coli* in open fractures with a 95% confidence interval, 5% significance level, and 5% margin of error. Consecutive non-probability sampling was used.

Patients with open fractures, defined as those with a duration of more than five days and any gender who presented with the fracture, were included in the study. Patients with potentially fatal head, abdominal, or chest injuries, mental illness, burns, systemic illnesses, or immune-compromised status were excluded, as were patients who later experienced trauma or showed signs of immediate amputation.

All patients who met the inclusion criteria and were hospitalized as emergency patients were included in the research after receiving clearance from the hospital's ethical committee. Written informed consent was obtained from all patients before the study implementation. After surface cleaning, wound swabs were obtained for sensitivity and culture. For a minimum of five days following surgical debridement, intravenous (IV) broad spectrum antibiotics were administered as injections of amoxicillin + clavulanic acid (1.2 g BD), amikacin (500 mg OD), and metronidazole (500 mg TDS). Wound debridement and irrigation with three liters of saline were performed.

If the wound allowed, primary wound closure was completed. If a wound was highly polluted, secondary wound closure was done. Wound dressings were applied every 48 hours when patient load caused a delay in wound closure or covering. Skin grafting or flap covering for wounds was done as soon as feasible for bigger deformities. Additionally, cast immobilization or external and internal fixation were performed. Analgesics and intravenous fluids were administered as needed.

Data analysis was done using SPSS version 22. Age and other numerical factors were determined as mean + SD. The study computed frequencies and percentages for categorical variables, including micro-organisms, gender, injury location, and open fracture grade.

RESULTS

A total of 173 patients presented with open fractures as per operational definition, having duration of fracture > 5 days.

The results were analyzed as follows: Age distribution among 173 patients was analyzed: 18-24 Years was 26 (15.03%) 25-32 Years was 34(19.7%) and 33-40 Years was 24(13.9%) 41-47 Years was 21(12.1%) 48-54 Years was 22(12.7%) 55-61 Years was 20(11.6%) and 62-67 Years was 26(15.03%). The mean age was 28.6±3. (**Table I**)

Gender Wise Distribution among 173 patients was analyzed as 92(53.2%) were male and 81(46.8%) were Female.

The distribution of compound fractures according to anatomic location among 173 Patients. (**Table II)** Micro-organism distribution among 173 patients was analyzed: 45(26%) and 36(20.8%) were *staphylococcus aureus* and *Streptococcus*, respectively. Staphylococcus epidermidis were 32 (18.5%). Pseudomonas aeruginosa were 34(19.7%), and E. coli were 26 (15.02%) (**Table III**).

Distribution of compound fractures according to Gustilo classification was analyzed as Grade 1 comprised 31, Grade II consisted of 48, Grade III comprised 80, Grade IIIB comprised 8, and Grade IIIC consisted of 6. The association of micro-organisms and gustilo classification is shown in (**Table IV**).

Table I: Age-wise distribution of sample size (n=173)

Age ranges	Frequency	Percent
18-24	26	15.03
25-32	34	19.7
33-40	24	13.9
41-47	21	12.1
48-54	22	12.7
55-61	20	11.6
62 -67	26	15.03
Total	173	100

Table II: Distribution of compound fractures according to anatomic location (n=173)

Site	Frequency	Percentage
Femur	32	18.5
Tibia	58	33.5
Ankle	25	14.6
Radius and Ulna	16	92.5
Humerous	11	63.6
Radius	13	7.5
Ulna	8	4.6
Fibula	4	2.3
Patella	3	1.7
Calcaneus	1	0.05
Pelvis	2	1.2

Table III: Micro-organism distribution (n=173)

Micro-organism	Frequency	Percent
Staphylococcus aureus	45	26
Streptococcus	36	20.8
Staphylococcus epidermidis	32	18.5
E Coli	26	15.02
Pseudomonas aeruginosa	34	19.7
Total	173	100%

Table No IV: Association between Micro-organism and Gustilo classification (n=173)

Micro-organisms	Gustilo classification					Total
	Grade 1	Grade 2	Grade 3			
			a	b	c	
Staphylococcus aureus	9	15	19	1	1	45
Streptococcus	6	11	17	1	1	36
Staphylococcus epidermidis	5	8	15	2	2	32
E Coli	6	4	14	2	0	26
Pseudomonas aeruginosa	5	10	15	2	2	34
Total	31	48	80	8	6	173

DISCUSSION

A total of 173 patients were included in our study. Male patients were 53.2%, and females were 46.8%. This finding agrees with the previous study, which documented more males than females[9]; this may be explained by the fact that men have traditionally dominated several occupations in Pakistan, including building, operating machinery, and transportation.

For various reasons, surgical debridement cannot usually be completed in the first six hours. Sometimes the surgery is done at the wrong time by overworked and exhausted anesthetists and surgeons.[10, 11] A waiting period of six to twenty-four hours before beginning surgical treatment for complex fractures can help with preoperative planning of the fractures that require final treatment, better identification of the extent of related injuries, and therefore, appropriate clinical stabilization. There is currently no scientific evidence in the literature suggesting that delaying surgical debridement affects the risk of infection.

According to Gustilo and Anderson's categorization[11,12], observational studies have demonstrated a correlation between infection and severe fractures, particularly those affecting leg bones. This investigation confirmed these findings. Notably, four infections were found in less significant fractures (Grade I and II), although no infections were found in those who underwent surgery six hours later; this indicates that the severity of injuries should always be considered and that time was not the only determining factor. Thus, we advise that more serious fractures should be operated on immediately.

Our attention was drawn to the high infection rate in ankle fractures; out of 18 fractures, 27.7% developed infection; this is a significant percentage compared to leg bone fractures, where 16.9% of the 65 fractures acquired infection. Further studies are necessary to determine the exact reason for this discovery, given this group was not studied in isolation[13].

There hasn't been much evidence in research to link infection to postponed surgical debridement[13,14]. Similar studies have not shown a correlation between the infection rate, the amount of time needed for surgical debridement, and IV antibiotics[15–19]. There is a chance of a type II error in this study because of the small sample size. Still, there is no statistically significant correlation between the infection incidence and the debridement time. After all fractures, 40.4% had surgery within 6 hours after the trauma; however, the causes of this delay in surgical debridement were not the focus of this investigation.

The research shows significant variation in the infection rates for complex fractures. In a nationwide investigation, Muller et al.[20] discovered acute infectious consequences in 20.5% of the fractures. Comparable infection rates were also seen in other foreign investigations[21-23], with an overall frequency of 13.24%.

We think a multicenter randomized trial would be required to more accurately analyze the relationship between the time and the occurrence of infection; however, this kind of analysis is hampered by ethical considerations. Other factors that affect the risk of infection should not be overlooked. These include patient-related factors (such as diabetes, smoking, and other co-morbidities), fracture type (including lesion location and severity), and surgical technique (including the surgeon's experience and the degree of aggressive debridement of devitalized tissues).

CONCLUSION

This study concludes that Gram-positive and Gram-negative bacteria are involved in infections of open fractures of extremities. Gram-positive bacteria were more frequent than Gram-negative. The results highlight the need for regular microbiological examination of open fracture injuries.

Ethical permission: Lady Reading Hospital, Medical Teaching Institute, Peshawar, Pakistan, IRB letter No. 475/LRH/MTI.
Conflict of Interest: No conflicts of interest, as stated by authors.
Financial Disclosure / Grant Approval: No funding agency was involved in this research.
Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Zaman R:	Literature search, data collection, manuscript writing, final approval
Deeba F:	Data analysis, final approval
Roghani AS:	Data interpretation, drafting
Roghani FS:	Data analysis, final approval
Inam M:	Study design, concept, questionnaire design, final approval

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