

Bacterial Spectrum and Antibiotic Sensitivity in open Fractures of the Extremities

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ABSTRACT

Background: Open fractures account for around 3 - 4% of all fractures, and infection caused by deprivation of bone and soft tissue, as well as loss of skeletal stabilization, is a serious consequence, particularly in grade III open fractures.

Objective: To determine bacterial spectrum and antibiotic sensitivity in open fractures of the extremities

Methodology: The current study was descriptive cross sectional study carried out at the department of Orthopedic Surgery, Khyber Teaching Hospital Peshawar for duration of six months from July 2021 to January 2022. All the samples were sent to the hospital diagnostic lab for bacterial identification and antibiogram assay. Kirby- Bauer method was used for antibiogram assay. The data was analyzed by using IBM SPSS version 19.0.

Results: A total of 210 patients were included in our study. Male patients were 168(80%) and female were 42(20%). The major cause of fracture was traffic accident observed in 168 (80%) patients. Positive culture report was observed in 196 (93.33%) patients. Staphylococcus Aureus was most frequently observed in 115(54.76%) patients. High resistance against commonly used antibiotics was observed in our study. All the isolates were completely (100%) resistant to ampicillin. All the isolates were 100% sensitive to Amikacin except MRSA.

Conclusion: Our study observed positive culture of bacteria in most of the open fractures of the extremities. Gram positive bacteria were most common than gram negative. Antimicrobial resistance was observed in majority of the bacterial isolates against commonly used antibiotics.

Key words: Open fractures, Antibiotic sensitivity, Bacterial Culture, Extremities

INTRODUCTION

Open fractures are those that have a skin wound that enables communication with the environment¹. High-energy trauma is the most common cause². In an earlier research, it was shown that almost a fourth of patients with chronic osteomyelitis had antecedent trauma, with an open fracture accounting for 93 % cases³. Road traffic injury, falls from a height, firearms, assaults, injury by machine, and other factors are the most common causes of open fractures⁴. Open fractures account for around 3 - 4% of all fractures⁵, and infection caused by deprivation of bone and soft tissue, as well as loss of skeletal stabilization, is a serious consequence, particularly in grade III open fractures⁶.

Infection rates increase with increase of wound size and pollution linked with open fractures of the extremities⁷. Infection rates vary depending on the period of contact and the severity of the damage. If the period of exposure was shorter than 6 hours, the wound was deemed less polluted since the activity of bacteria multiplication began at the wound area and the mechanism of infection began in the wound⁸. Because of lack of optimal medical services and public knowledge in peri-urban settings, a delay in the treatment of open fractures prolongs the patient's exposure and, eventually, increases the infection incidence⁹.

Early administration of broad spectrum antibiotics is thought to prevent bacterial proliferation at contaminated sites, extending the golden time of open fracture care by a few hours, however the evidence is ambiguous^{10, 11}. Many variables influence antibiotic selection, including the cause of injury, injury location, degree of damage, microbial culture, and antibiogram assay^{12, 13}.

Penicillin, cephalosporin and aminoglycosides are the most usually prescribed antibiotics for the treatment of open fractures, either individually or in combination, however antimicrobial treatment should preferably be determined on a culture and sensitivity test^{14, 15}. The most frequent pathogens identified in open fractures are Pseudomonas, Staphylococcus, Enterobacter, Actinobacter and Klebsiella which are susceptible to quinolones and cephalosporin^{12, 16}. The Department of Orthopedic Surgery, Khyber Teaching Hospital, Peshawar, did not have an antibiogram for common pathogen of open extremities yet, and the choice of empiric antibiotics in open fractures is dependent on the individual

surgeon's preference and experience, as well as the patient's financial situation. There is also a scarcity of data on the antibiogram profile of pathogens associated with open fractures of the extremities. This study was therefore carried out to determine the frequency of micro organisms in open fractures of the extremities and their sensitivity pattern to the commonly used antibiotics. This research will aid in the development of local antibiograms for open extremity fractures, which will aid in the development of empiric antibiotic treatment recommendations.

MATERIALS AND METHODS

The current study was descriptive cross sectional study carried out at the department of Orthopedic Surgery, Khyber Teaching Hospital Peshawar. The study duration was six months from July 2021 to January 2022. The inclusion criteria for our study includes all the patients of either sex, having age ranged from 18-60 years with open fractures of extremities. Only patients presented within 24 hours of injury were considered for selection. The exclusion criterion for our study was all the polytrauma patients, head injury patients, patients with pathological fracture and patients with thoracic and abdominal injuries. Study approval was properly taken from the research and ethical committee. Study was explained in detail and informed consent was taken in written from all the participants. Stabilization and resuscitation of all patients were done according to advanced trauma life support (ATLS) protocol. All the data including age, gender, injury cause and injury duration was recorded. Levine technique was used for swab sampling¹⁷. All the samples were sent to the hospital diagnostic lab for bacterial identification and antibiogram assay. Kirby- Bauer method was used for antibiogram assay. The data was analyzed by using IBM SPSS version 19.0. For quantitative data like age, mean and standard deviation were calculated and for qualitative data like sex percentages were calculated.

RESULTS

A total of 210 patients were included in our study. Male patients were 168(80%) and female were 42(20%). (Figure 1) The mean age in our study was 36.12±6.12 years with minimum age of 28

and maximum age of 60 years. The major cause of fracture was traffic accident observed in 168 (80%) patients followed by gunshot in 17 (8.10%), fall in 13 (6.19%) and assault in 12 (5.71%). (Figure 2) The mean (SD) duration presentation to hospital was 10.11 (8.40) hours. Based on the site of injury, the most common injury was in tibia in 51 (24.29) patients followed by humerus, metacarpals, ankles, radius/ulna and femur in 42 (20%), 35 (16.67%), 30 (14.29%), 27 (12.86%) and 25 (11.90%) respectively. The most predominant type of fracture was Gustilo Anderson type IIIA in 84 (40%) patients. Positive culture report was observed in 196 (93.33%) patients while in 14(6.67%) patients microbial growth was not observed. Based on the type of bacteria isolates, Staphylococcus Aureus was most frequently observed in 115(54.76%) patients followed by Streptococcus in 34(16.19%) patients, E. Coli in 25(11.90%) patients, Pseudomonas in 22 (10.48%) and MRSA in 14 (6.67%) patients. (Figure 3)

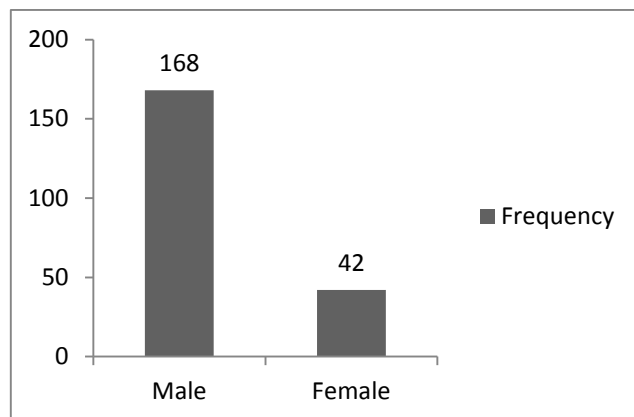


Figure 1: Gender wise distribution of patients

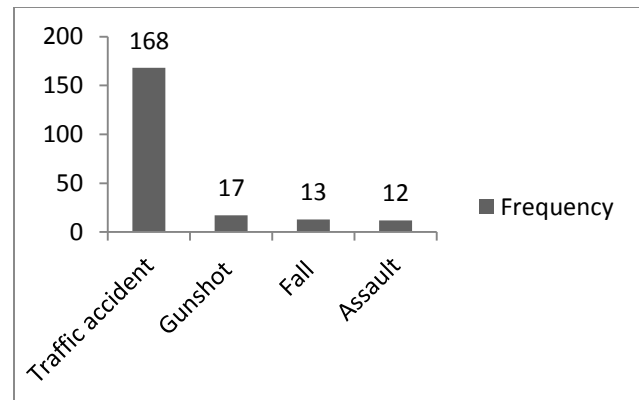


Figure 2: Distribution of patients based on cause of injury

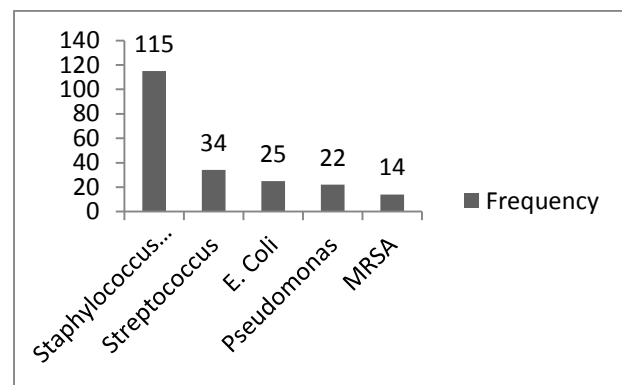


Figure 3: Frequency of types of isolates

Table 1: Antibiogram profile of all the isolates

Antibiotics used	Antimicrobial activity	S. aureus	Streptococcus	E. Coli	Pseudomonas	MRSA
Co-amoxiclav	Resistance	85%	87%	100%	100%	100%
	Sensitive	15%	13%	00%	00%	00%
Cefuroxime	Resistance	75%	73%	80%	90%	100%
	Sensitive	25%	27%	20%	10%	00%
Ceftriaxone	Resistance	50%	60%	40%	40%	100%
	Sensitive	50%	40%	60%	60%	00%
Ciprofloxacin	Resistance	50%	60%	30%	40%	100%
	Sensitive	50%	40%	70%	60%	00%
Vancomycin	Resistance	-	-	-	-	00%
	Sensitive	-	-	-	-	100%
Gentamycin	Resistance	60%	65%	30%	40%	100%
	Sensitive	40%	35%	70%	60%	00%
Meropenem	Resistance	00%	00%	30%	00%	100%
	Sensitive	100%	100%	70%	100%	00%
Amikacin	Resistance	00%	00%	00%	00%	100%
	Sensitive	100%	100%	100%	100%	00%
Ampicillin	Resistance	100%	100%	100%	100%	100%
	Sensitive	00%	00%	00%	00%	00%
Linezolid	Resistance	00%	00%	-	-	00%
	Sensitive	100%	100%	-	-	100%

High resistance against commonly used antibiotics was observed in our study. All the isolates were completely (100%) resistant to ampicillin. S.aureus shows 85% and 75% resistance to Co-amoxiclav and Cefuroxime respectively while highest sensitivity was shown by linezolid (100%), meropenem (100%) and Amikacin (100%). Streptococcus shows highest resistance to Co-amoxiclav (87%) and Cefuroxime (73%) while 100% sensitivity was shown to linezolid, meropenem and Amikacin. Highest resistance was shown by E.coli to Co-amoxiclav (100%) followed by Cefuroxime (80%). Seventy percent of E.coli isolates were sensitive to ciprofloxacin and gentamycin. All the isolates were 100% sensitive to Amikacin except MRSA. Pseudomonas was 100% resistance to Co-amoxiclav followed by Cefuroxime (90%).

Meropenem and Amikacin were 100% sensitive against pseudomonas. All the MRSA isolates were 100% resistant to all the antibiotics except vancomycin and Linezolid. (Table 1)

DISCUSSION

The development of novel antimicrobial agent has slowed in recent years¹⁸. Furthermore, the severity and scope of traumatic injury are becoming increasingly difficult. To improve a fracture surgeon's skill, they must have up-to-date knowledge about current infecting pathogens and their resistance patterns. Therefore the current study was carried out to assess the antimicrobial activity against commonly isolated pathogens from open fractures of the extremities.

A total of 210 patients were included in our study. Male patients were 80% and female were 20%. This finding is in line with the previous study who reported more males in their study as compared to female¹⁹. This might be attributed to the fact that some activities, including transportation, equipment operation, and construction labor, have historically been dominated by males in Pakistan. In our study, the major cause of fracture was traffic accident observed in 80% patients followed by gunshot in 8.10%, fall in 6.19% and assault in 5.71%. These findings are in accordance with another study who reported traffic accident as the main cause of injuries²⁰. This might be due to more traffic and people are not following traffic rules and regulation. Based on the site of injury, the most common injury was in tibia in 24.29 patients followed by humerus, metacarpals, ankles, radius/ulna and femur in 20%, 16.67%, 14.29%, 12.86% and 11.90% respectively in our study. The most predominant type of fracture was Gustilo Anderson type IIIA in 40% patients. A previous study also reported comparable results²¹. In our study, positive cultures were observed in 93.33% patients while in 6.67% patients microbial growth was not observed. Based on the type of bacteria isolates, *Staphylococcus Aureus* was most frequently observed in 54.76% patients followed by *Streptococcus* in 16.19% patients, *E. Coli* in 11.90% patients, *Pseudomonas* in 10.48% and MRSA in 6.67% patients. In contrary to our study, a previous study done by Faisham et al. reported positive culture in only 39.3% patients while growth was not reported in 60.7% patients. In his study *Staphylococcus aureus* was reported in 38.4% while *E. coli* and *pseudomonas* were reported in 7.6% patients²². Another study carried out by Sitati et al reported positive culture in 52.2% patients. *Staphylococcus aureus*, *Pseudomonas* and *Klebsiella* were observed in 22%, 11.7% and 10.4% respectively²³. In accordance with our study, another study reported positive culture in open fractures of 78.7% patients while *Staphylococcus aureus*, *Pseudomonas*, *E. coli* and streptococci were observed in 52.8%, 17.1%, 32.5% and 26% patients respectively²⁴. High resistance against commonly used antibiotics was observed in our study. All the isolates were completely (100%) resistant to ampicillin. In line with our findings, other studies also reported high resistance to ampicillin^{25, 26}.

S.aureus shows 85% and 75% resistance to Co-amoxiclav and Cefuroxime respectively while highest sensitivity was shown by linezolid (100%), meropenem (100%) and Amikacin (100%). *Streptococcus* shows highest resistance to Co-amoxiclav (87%) and Cefuroxime (73%) while 100% sensitivity was shown to linezolid, meropenem and Amikacin. Comparable results were reported by a previous study²⁶. Highest resistance was shown by *E.coli* to Co-amoxiclav (100%) followed by Cefuroxime (80%). Seventy percent of *E.coli* isolates were sensitive to ciprofloxacin and gentamycin. All the isolates were 100% sensitive to Amikacin except MRSA. *Pseudomonas* was 100% resistance to Co-amoxiclav followed by Cefuroxime (90%). In accordance with our findings another study reported comparable results²¹. A previous study piloted by Ojo et al reported that most of the isolates were resistant to Ofloxacin, Augmentin, Cloxacillin, Oxidillin, Ceftriaxone and Cefuroxime²⁷. There were just a few drawbacks in our research work. Our research was descriptive in nature. We were not able record individuals who had a positive culture for the development of a future wound infection and the isolation of the same or different microorganisms in the second culture.

CONCLUSION

Our study observed positive culture of bacteria in most of the open fractures of the extremities. Gram positive bacteria were most common than gram negative. Antimicrobial resistance was observed in majority of the bacterial isolates against commonly used antibiotics. The results highlight the need of regular microbiological examination of open fracture injuries and antimicrobial resistance profile monitoring for prophylactic and therapeutic antimicrobials usage.

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