

# Frequency of Various Causative Bacterial Organisms and their Culture Sensitivity Pattern in Patients with Open Tibial Fracture

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## ABSTRACT

**Objective:** To determine the frequency of various causative bacterial organisms and their culture sensitivity pattern in patients with open tibial fracture.

**Subject and Methods:** This is cross sectional study conducted at Orthopedic Surgery, Liaquat University of Medical and Health Sciences, Jamshoro and SMBBMU Larkana from 14th October 2015 to 13<sup>th</sup> April 2016. Total of 150 patients having open tibial fracture with signs and symptoms of infections presenting within one week of fracture were included in this study. All this information was recorded through Proforma (attached).

**Results:** Out of 150 infected fractures, *S. aureus* was present in 40% cases, MRSA in 14%, Enterococcus in 4%, B-Staphylococcus in 4%, Pseudomonas aeruginosa in 8%, Acinetobacter in 4%, E.coli in 16% and Klebsiella in 10%. Regarding sensitivity analysis, Meronem, Piperacillin, Avelox, Linzolid were more than 80% sensitive to *S. Aureus*. MRSA Enterococcus Sp, B-Streptococcus. Ceftazidime, Gentamicin were more than 80% sensitive to *S. Aureus* and gentamicin also 83.3% sensitive to B-Streptococcus. Gentamicin was 83.3% sensitive to Enterococcus Sp as shown in table 2A. Meronem, Piperacillin were 80% to 96% sensitive to Pseudomonas aeruginosa, Acinetobacter, E. Coli and Klebsiella Species. Avelox was 83.3% sensitive to Pseudomonas aeruginosa. Ceftriaxone and Avelox were 87.5% and 100% sensitive to E. coli.

**Conclusion:** It is noted that infection rate is higher in open fracture mostly fracture at extremity of bones. More severe and exposure, more is infection rate noted.

**Key Words:** Open fracture, Bacterial organisms, Sensitivity pattern, Open tibial fracture

## INTRODUCTION

Open fracture is defined as fracture of bone in which bone is visible, due to removal of overlying tissues one.<sup>1</sup> As severity of injury and exposure time increases, infection rate rises ranging from 0.2% in Gustilo Anderson type I fractures to 20-25% for type IIIC, with an amputation rate more than 50%.<sup>1</sup> It is noted that when antibiotics are given at the time of arrival of patient in Accident and emergency department or at the time of wound irrigation, it will decrease infection rate and improves overall survival.<sup>2</sup> Previously it was thought that once irrigation of wound done as early as possible, it will reduce infection rate, but theory has been changed, now it is noted that irrigation solution of standard quality and pressure remain of same use.<sup>3</sup> Being a part of trauma management team its our prime duty to be aware of organisms involved in open wound, antibiotic susceptibility, there dose and duration to minimize risk of infection leading to sepsis, morbidity and mortality.<sup>4</sup> Various factors are responsible for improving action of antibiotic, like type and duration, type of fracture, mechanism of fracture, other associated injuries, associated pre-existing chronic diseases like diabetes and hypertension, degree of contamination, degree of soft tissue involvement, organism involved and its sensitivity and resistance pattern.<sup>1</sup> Combat-associated tibial fractures are predominantly associated with infections due to Gram negative organisms and they can be successfully treated.<sup>5</sup> One study reported that in 42 orthopedic infected fractures, *S. aureus* was present in 33% cases, MRSA in 12%, Enterococcus in 9%, Staphylococcus in 5%, Pseudomonas aeruginosa in 8%, Acinetobacter in 8%, Proteus in 5%, E.coli in 2%, Klebsiella in 9%, Citrobacter in 6% and *Candida krusei* in 2% cases.<sup>6</sup> One more study found that (n=66) Staphylococcus aureus was the commonest gram positive organism cultured (50%), 35% were MSSA and 15% were MRSA, followed by Enterococcus sp (11%) and  $\beta$ -Hemolytic Streptococcus (7%), Pseudomonas aeruginosa was in 11%, Enterobacter sp. (10%) and Pseudomonas aeruginosa was isolated in 5% of the specimen.<sup>7</sup> Rationale of this study is to find the causative bacterial organisms and their culture sensitivity pattern in patients presenting with infected open tibial fracture. Because in our local set up the trend of treatment by local

Doctors, Hakeems, Jarrahs and Potters is most common. They treat the open fractures with different unsterile solutions and pastes. Therefore chances of infection in open tibial fractures are very high. So I want to know the pattern of most common organisms and their sensitivity.

## MATERIAL AND METHODS

This is cross sectional study conducted at Department of Orthopedic Surgery, Liaquat University of Medical and Health Sciences, Jamshoro and SMBBMU Larkana for the period of one year from 14th October 2015 to 13<sup>th</sup> April 2016. 150 patients fulfilling inclusion and exclusion criteria, was enrolled for the study through emergency of Department of Orthopedic Surgery, Liaquat University of Medical and Health Sciences, Jamshoro and SMBBMU Larkana. Patients having age 20-60 years, of either gender with open tibial fracture with signs and symptoms of infections presenting within one week of fracture were included in study. Patients presenting after 7 days of fracture, taking antibiotics for infection before or after accident, patients with osteomalacia, degenerative bone disease, diabetic and open tibial fracture Gustilo type III C were excluded. After obtaining informed consent from parents, demographic data (name, age, sex, duration of accident and contact) was collected. Then the proper history (from the incidence seen to the arrival at tertiary hospital), full examination of patient and relevant investigation was taken, wound condition assessed. Samples were collected from nearby area of suspected open area near bone by using a sterile cotton swab and a sterile disposable syringe. Samples were immediately shifted to lab and were incubated at 37°C for 24 hours, in order to see bacterial cells. Grams and acid fast staining done, cultures were done and isolated for antimicrobial susceptibilities by the Kirby Bauer method. Once organism is seen then its sensitivity and resistance is checked The data was entered and analyzed through SPSS version 17. The main study variables include causative bacterial organisms and their sensitivities were presented by calculating frequency and percentage. The continuous variables like age, duration of fracture were presented as mean and standard deviation. Data was stratified for effect modifiers like age,

gender, duration of fracture, type of fracture, mode of injury, treatment before arrival at LUH. Chi-square test was applied to see the difference. P value less than or equal to 0.05 was taken as significant. All this information was recorded through Proforma (attached).

**RESULTS**

Total of 150 patients with open tibial fracture with signs and symptoms of infections presenting within one week of fracture were included in this study. The mean age of the patients was 32.98± 3.151 years. Frequency of various causative bacterial organisms in patients presenting with open tibial fracture is shown in figure 1. Out of 150 infected fractures, S. aureus was present in 40% cases, MRSA in 14%, Enterococcus in 4%, B-Staphylococcus in 4%, Pseudomonas aeruginosa in 8%, Acinetobacter in 4%, E.coli in 16% and Klebsiella in 10%.

Regarding sensitivity analysis is shown in table 1 and table 2. Stratification analysis was performed as observed that MRSA was significantly high in above 40 years of age while Acinetobacter and Klebsiella Species was high in below 40 years of age patients while S.Aureus, Enterococcus Sp, B-Streptococcus, Pseudomonas aeruginosa and E.Coli was not significant among different age groups as shown in table 3.

Figure 1: Frequency of Various Causative Bacterial Organisms in Patients Presenting with Open Tibial Fracture n=150

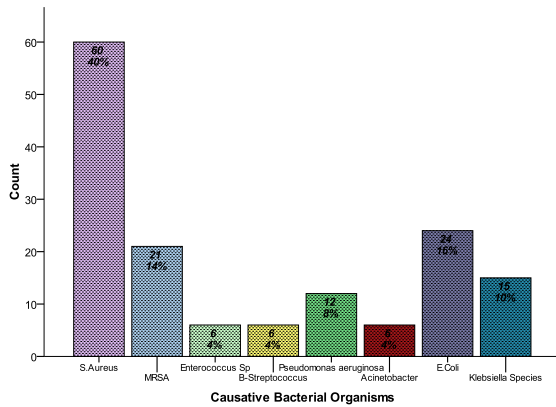


Table 1: Sensitivity pattern in patients presenting with open tibial fracture

Antibiotic	S .Aureus n=60	MRSA n=21	Enterococcus Sp n=6	B-Streptococcus n=6
Ampicillin	25(41.7%)	NT	3(50%)	3(50%)
Aztreonam	36(60%)	NT	4(66.7%)	4(66.7%)
Ceftriazone	43(71.7%)	NT	4(66.7%)	4(66.7%)
Meronom	58(96.7%)	19(90%)	5(83.3%)	5(83.3%)
Piperacillin	57(95%)	18(85.7%)	5(83.3%)	5(83.3%)
Avelox	57(95%)	17(81%)	5(83.3%)	5(83.3%)
Ceftazidime	58(96.7%)	12(57.1%)	4(66.7%)	5(83.3%)
Co Trimoxazole	18(30%)	NT	NT	NT
Gentamicin	48(80%)	NT	5(83.3%)	4(66.7%)
Ofloxacin	45(75%)	NT	3(50%)	3(50%)
Linulid	59(98.3%)	20(95.2%)	5(83.3%)	5(83.3%)

NT = Not tested

Table 2: Sensitivity pattern in patients presenting with open tibial fracture

Antibiotic	Pseudomonas aeruginosa n=12	Acinetobacter n=6	E.Coli n=24	Klebsiella Species n=15
Ampicillin	NT	NT	15(62.5%)	NT
Aztreonam	NT	NT	16(66.7%)	NT
Ceftriazone	NT	NT	21(87.5%)	NT
Meronom	11(91.7%)	5(83.3%)	23(95.8%)	12(80%)
Piperacillin	11(91.7%)	5(83.3%)	22(91.7%)	12(80%)
Avelox	10(83.3%)	NT	24(100%)	NT
Ceftazidime	NT	NT	17(70.8%)	NT
Ofloxacin	NT	NT	17(70.8%)	NT
Linulid	NT	NT	NT	10(66.7%)

NT=Not Tested

Table 3: Frequency of various causative bacterial organisms in patients presenting with open tibial fracture with respect to age groups

Bacterial Organisms	Age Groups (Years)			P-Value
	22 to 30 n=60	31 to 40 n=75	>40 n=15	
S.Aureus	24(40%)	27(36%)	9(60%)	0.22
MRSA	3(5%)	12(16%)	6(40%)	0.002
Enterococcus Sp	3(5%)	3(4%)	0(0%)	0.67
B-Streptococcus	3(5%)	3(4%)	0(0%)	0.67
Pseudomonas aeruginosa	6(10%)	6(8%)	0(0%)	0.44
Acinetobacter	0(0%)	6(8%)	0(0%)	0.04
E.Coli	9(15%)	15(20%)	0(0%)	0.15
Klebsiella Species	12(20%)	3(4%)	0(0%)	0.003

**DISCUSSION**

Wound infection is major burden, involving not only orthopedic surgeon, but also to all members involved in management of patient during trauma. Once not treated properly, it will increase the cost burden, hospital stay and morbidity. Injudicious use of antibiotics has leads to increased risk of resistance.

Open fracture is defined as fracture of bone in which bone is visible, due to removal of overlying tissues one. As severity of injury and exposure time increases, infection rate rises ranging from 0.2% in Gustilo Anderson type I fractures to 20-25% for type IIIC, with an amputation rate more than 50%. Volkmann in 1878 reported 38.5% of mortality and Bilroth results shows 36 death and 28 amputations in 96 fractures.

Result of our study are comparable to other studies like in our study group 74% were male, while in Moore et al 78.85% and Naeemullah 80%. Age group were also comparable in both studies, in our study most of patients were 20-40 years with average 32.98, while in Moore et al and Naeemullah the average age was 30 years.

Our study results are also comparable to Naeemullah and Muller studies in relationship to mechanism of injury, in our study group most common mechanism of injury is 46% of patients with road traffic accidents, 36% fall from height and 18%. While Naeemullah study 46% with road traffic accidents, 28% fire arm injuries, and 10% with occupational and bomb blast injuries and in Muller 38.4% Road traffic accidents 5.3% occupational accidents, fall and trampling.

Our study results were also compared with other studies regarding type of fracture, our results shows 4% type I fracture, 14% type II fractures, 34% type IIIA and 48% type IIIB. While Naeemullah study shows 3.7% type I fracture, 44.2% type II and 50% type III. Gustilo results shows 38% type I, 36% of type II and 25% of type III.

Combat-associated tibial fractures are predominantly associated with infections due to Gram negative organisms, and these infections are generally successfully treated. One study reported that in 42 orthopedic infected fractures, S. aureus was present in 33% cases, MRSA in 12%, Enterococcus in 9%, Staphylococcus in 5%, Pseudomonas aeruginosa in 8%, Acinetobacter in 8%, Proteus in 5%, E.coli in 2%, Klebsiella in 9%, Citrobacter in 6% and Candida krusei in 2% cases.

In our study we found Staph aureus as most common pathogen ranging upto 40%, not only in our study but worldwide same results are noted. One study conducted at National Orthopaedic Hospital Lagos by Onche his results suggest 71.4% while another study conducted at Zaria, North Central Nigeria, Mbamali his results shows staph aureus in 60% of patients.

Oguachuba results were totally different to our study, his results shows Proteus in 42% second most common Staph aureus as 25, while in rest of patients E. coli was noted.

Results of Dash et al study were also comparable to our study, in his study same organism found most common 27%, followed by Pseudomonas 12%, Klebsiella 11%, Acinetobacter 9.76%, Citrobacter 5%, Proteus 4% and E. coli 2%.

In this study MRSA in 14%, Enterococcus in 4%, B-Staphylococcus in 4%, Pseudomonas aeruginosa in 8%, Acinetobacter in 4%, E.coli in 16% and Klebsiella in 10%. One more study found that (n=66) Staphylococcus aureus was the

commonest gram positive organism cultured (50%), 35% were MSSA and 15% were MRSA, followed by *Enterococcus* sp (11%) and  $\beta$ -Hemolytic *Streptococcus* (7%), *Pseudomonas aeruginosa* was in 11%, *Enterobacter* sp. (10%) and *Pseudomonas aeruginosa* was isolated in 5% of the specimens. It is also noted that *Staph aureus* was mostly sensitive to cloxacillin and clindamycin 95% and 100% respectively. Vancomycin, clindamycin and chloramphenicol possess sensitivity upto 100% against MRSA. *Pseudomonas* was resistant to most of cephalosporin's.<sup>7</sup>

In this study regarding sensitivity analysis, Meronem, Piperacillin, Avelox, Linzulin were more than 80% sensitive to *S. Aureus*. MRSA. *Enterococcus* Sp, *B-Streptococcus*. Cefazidime, Gentamicin were more than 80% sensitive to *S. Aureus* and gentamicin also 83.3% sensitive to *B-Streptococcus*. When our results compared to Naeemullah et al study<sup>[1]</sup> 75% sensitivity to cephalosporin's, 70% beta lactamase inhibitors and 54% to Aminoglycosides, but results were different with Gram-negative rods showing more than 80% sensitivity to Aminoglycosides and 66% to Quinolones. These results can be compared to Muller<sup>16</sup> that shows 60% sensitivity to cephalosporin's for Gram positive bacteria.

## CONCLUSION

It is noted that infection rate is higher in open fracture mostly fracture at extremity of bones. More severe and exposure, more is infection rate noted. Most common causative bacterial organisms is *S. aureus*. Antibiotics are given empirically at the time of trauma, so this study is basically based to see burden of antibiotics resistance and its sensitivity.

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