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EVALUATING THE MICROBIOLOGICAL PROFILE OF OSTEOMYELITIS AND ITS ANTIBIOTIC RESISTANCE PATTERN OF BACTERIAL ISOLATES WITH SPECIAL REFERENCE TO MDR STRAINS.

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ABSTRACT

INTRODUCTION: Osteomyelitis is an inflammatory process that affects bone caused by germs that spread contiguously, directly or hematogenously. It is a difficult to diagnose infectious disease with complex treatment options due to its heterogeneity, pathogenesis, clinical presentation, and management.

AIM AND OBJECTIVE: To study the microbiological profile of osteomyelitis and its antibiotic resistance pattern of bacterial isolates with special reference to MDR strains.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

MATERIAL AND METHODS: This was a Cross sectional study conducted in the Department of Microbiology and Department of Orthopedics at a Tertiary Care centre for a period of 12 months i.e, August 2023 to August 2024. A total of 200 samples from osteomyelitis cases were aerobically cultured and isolates from culture positives were identified by standard procedures. Antimicrobial susceptibility testing was done according to the CLSI guidelines. Staphylococcal isolates were screened for methicillin resistance and Gram negative bacilli were screened for MDR production.

RESULT: In the present study a total of 200 samples were screened out of which culture positive cases were 78% and culture negative observed were 22%. It was found that cases of Tibia (49%) were more affected than femur (33%) followed by Fibula. Trauma as the commonest predisposing factor was seen in 82 (41%) cases, followed by post-operative infections 48 (24%), orthopaedic implants 40 (20%) cases, /Diabetes mellitus 3 (1.5%) cases, Implant / Diabetes mellitus 21 (10.5%) cases and Post operative infection / Diabetes mellitus in 6 (3%) cases, Trauma / Diabetes mellitus 3 (1.5%) cases.

The *Staphylococcus aureus* was the most common isolate with 75 (48%) followed by *Escherichia coli* 35 (22.4%), *Klebsiella pneumoniae* with 10 (6.4%), *Pseudomonas aeruginosa* with 9 (5.7%), *Staphylococcus lugdenensis*, *CONS* with 8 (5.1%) respectively, *Proteus mirabilis* with 6 (3.5%) and least for *Acinetobacter baumanni* with 5 (3.2%). Out of 65 organisms isolated, most effective drug of GNB was *Colistin*, followed by Polymyxin B 100(%), *Tigycyclin*, *Meropenem*, *Imipenem*, and *Piperacillin/Tazobactum*, whereas in cases of GPC *Vancomycin*, *Teicoplanin*, *Linezolid* followed by *Gentamicin* and *Amikacin* was most effective.

CONCLUSION: Effective infection control procedures and antibiotic policies must be followed to limit the incidence of MDR strains.

KEYWORDS:- Osteomyelitis, MDR, MRSA, ESBL, Antibiotic Resistance

Introduction

Osteomyelitis is an inflammatory process that affects bone due to the contiguous infection, direct inoculation, or hematogenous spread of microorganisms [1] Current interest in this condition has increased due to recent changes in the epidemiology, pathogenesis, diagnosis, treatment, and prognosis of the disease [2,3]. However, it is not a single entitythis disease is differentiated

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according to the etiology, pathogenesis, and degree of bone involvement, as well as age and the immune condition of the patient [4,5].

However, it is not a single entity; this disease is differentiated according to the etiology, pathogenesis, and degree of bone involvement, as well as age and the immune condition of the patient [6]. The reported incidence has increased due to comorbidities such as diabetes mellitus, peripheral vascular disease, trauma and surgery [7]. After an open fracture, the incidence of osteomyelitis can range from 2% to 16% depending on the type of injury and the treatment administered [8,9]. It can involve different structures such as the bone marrow, cortex, periosteum, and parts of the surrounding soft tissues, or remain localized. Osteomyelitis mostly affects the growing ends of long bones and it is more common in the lower extremity at metaphysis of femur and proximal end of tibia.

Healthy intact bone is resistant to infection. The bone becomes susceptible to disease with the introduction of a large inoculum of bacteria, from trauma, ischemia, or the presence of foreign bodies because bone sites to which microorganisms can bind are exposed. Various microorganisms can reach to bone through blood and cause inflammation in bone tissue rarely soft tissue infection may lead to bone damage. Microorganism reach to the metaphysis of bone through blood flow from skin wound, upper respiratory tract infection, periodontitis and any other infectious region. Bone metaphysic is a region full of blood vessels and slow bloodstream which can spread the infection. Direct trauma to bone may cause osteomyelitis [10].

Various microorganisms can reach to bone through blood and cause inflammation in bone tissue rarely soft tissue infection may lead to bone damage. Microorganism reach to the metaphysis of bone through blood flow from skin wound, upper respiratory tract infection, periodontitis and any other infectious region. Bone metaphysic is a region full of blood vessels and slow bloodstream which can spread the infection. Direct trauma to bone may cause osteomyelitisalso [11-13].

Diagnosis of this condition mainly depends on strong clinical suspicion in non-healing ulcer especially in diabetic patient, radiological findings of translucency of bone with patchy sclerosis and adjacent periosteal bone reaction. MRI and blood culture along with deeper bone biopsy or culture and pus culture are mainstay in management protocol of these patients [12].

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

Certain bacteria such as *Staphylococcus aureus* adhere to the bone by expressing receptors, called adhesins, for some components of the bone matrix, including laminin, collagen, fibronectin, and bone sialoglycoprotein [14]. *S. aureus* expresses a collagen-binding adhesin, which permits its attachment to bone cartilage while the fibronectin-binding adhesin's role in attachment of bacteria to surgically implanted devices in bone was recently discovered [15,16]. Also interesting to note is that *S. aureus* can survive intracellularly after being internalized by cultured osteoblasts. Some bacteria create a protective biofilm coating around themselves and underlying surfaces [17]. This characteristic of some bacteria to adhere to the bone and surgically implanted devices following which they express phenotypic resistance to antibiotic therapy and their ability to survive intracellularly may explain the persistence of bone infections and high failure rates of shorter courses of antimicrobial treatment [18,19].

The bacteria most commonly causing chronic osteomyelitis are *Staphylococcus aureus ,Coagulase negative Staphylococcus,Pseudomonas spp., E. coli, Proteus spp.,Klebsiella spp., Enterococcus spp., Enterobacterspp.* and anaerobes like *Peptostreptococcusspp., Bacteroides spp., Clostridium spp.* And rarely *Salmonella spp.* and *Actinomycetes* [20, 21] *Staphylococcus aureus* constitutes 50% - 75% cases of chronic osteomyelitis. In most of the cases infection is mono microbial, infection with multiple organisms are usually seen in diabetes mellitus patients with ulcer in foot.[22].

Osteomyelitis is a persistent concern due to the rise of multidrug-resistant strains among the bacterial infections that cause it. Beta lactamases are the most rapidly emerging antibiotic resistance mechanism in the Enterobacteriaceae family, owing to the selective pressure generated by inappropriate use of third-generation cephalosporins, which are most commonly found in ICU settings [23]. The two most frequent beta lactamases are extended spectrum beta lactamases (ESBL) and AmpC enzymes. Carbapenems marked a significant advancement in the treatment of major bacterial infections caused by betalactam-resistant bacteria. [24] However, excessive and unneeded carbapenem use fostered the creation of carbapenem-resistant bacteria, which created the carbapenem hydrolysing enzyme Metallo Beta Lactamase (MBL), so named because they include a metal ion that acts as a cofactor for enzymatic activity [25]. Methicillin resistant *Staphylococcus aureus* (MRSA) is prevalent worldwide and are animportant cause of nosocomial infection, resulting in increased morbidity andmortality in the hospital settings worldwide [26-28].

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

The clinical presentation of osteomyelitis depends on the etiology. Sometimes diagnosis in adults can be tricky, and it requires a high index of suspicion. A good history and physical is always the right place to start and are essential parts of the initial evaluation. Some patients are at high risk for osteomyelitis, and these include those with bacteremia, endocarditis, intravenous drug use, trauma, and open fractures. Also, patients with chronic poorly healing wounds in the setting of diabetes mellitus, peripheral vascular disease, peripheral neuropathy, or orthopedic hardware are at increased risk [14].

Prolonged antibiotic therapy is the cornerstone of treatment for osteomyelitis. Results of culture and sensitivity should guide antibiotic treatment if possible, but in the absence of this data, it is reasonable to start empiric antibiotics.

Therefore the present study was undertaken to study the Microbiological profile in clinically suspected cases of Osteomyelitis, its associated risk factors also the antimicrobial susceptibility pattern of the isolated strain in patients attending a tertiary care hospital.

MATERIAL AND METHODS

This was a Cross sectional observational study conducted in the Department of Microbiology and Department of Orthopedics at a Tertiary Care centre for a period of 12 months i.e, August 2023 to August 2024. The Samples from outpatients and inpatients admitted to the orthopedic ward suspected to have osteomyelitis was collected as the source of the sample for the study.

Inclusion Criteria

The study included clinically confirmed cases of osteomyelitis from all age groups and both sexes. Samples such as pus, pus swabs, bone sequestrum, and synovial fluid were obtained under aseptic conditions and processed for culture and sensitivity.

Exclusion Criteria

Patients with malignant and benign tumors, cysts, non-infected, non-unions, old trauma, and osteomyelitis patients on antibiotic therapy were excluded

Sample Collection: All clinical specimens received from orthopedic outpatient and inpatient department yielded growth on blood agar, chocolate agar and MacConkey agar culture

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

was collected and processed. The bacterial isolate was identified with standard bio-chemical tests . Antimicrobial susceptibility testing (AST) was done on Mueller Hinton agar (HiMedia Laboratories, India) by Kirby Bauer disk diffusion method using Clinical and Laboratory Standard Institute guidelines CLSI 2023 [29].

Collection of Sequestrum: Sequestrum obtained per-operatively was collected in a sterile container without fixative. Fragments of excised tissue removed during wound toilet or curetting from infected sinuses were also collected in a similar manner. They were homogenized in a tissue grinder with a little sterile broth and subsequently treated in the same way as exudates.

Collection of Swabs: The surface of the wound was cleaned well with sterile normal saline and swabs were taken from the depth of the sinus.

Collection of Pus: Pus was aspirated from the depth of the sinus or collected directly from cavities per operatively and transported to the laboratory in a small screw- capped bottle, syringe or a sealed capillary tube.

Antibiotic Susceptibility Test : The AST was performed by using the CLSI guidelines 2023 [29].

Antibiotics for Gram positive cocci -Amikacin(30 µg), Cefotaxime(30 µg), Erythromycin(15 µg), Gentamycin(10 µg), Linezolid(30 µg), Oxacillin(10 µg), Penicillin(10 µg), Tetracyclin(30 µg), Teicoplanin(30 µg), Vancomycin(30 µg),Azithromycin.

Antibiotics for Gram positive cocci -Ceftriaxone(30 µg), Ceftazidime(10 µg), Cefotaxime(30 µg), Aztreonem(30 µg), Gentamycin(10 µg),Amikacin (30 µg), Ofloxacin(µg), Levofloxacin(5 µg), Imipenem(10 µg), Meropenem(10 µg), Colistin(10 µg), Polymixin B, Piperacillin(100 µg), Piperacillin/Tazobactum(10/100 µg), Tigecyclin(15 µg).

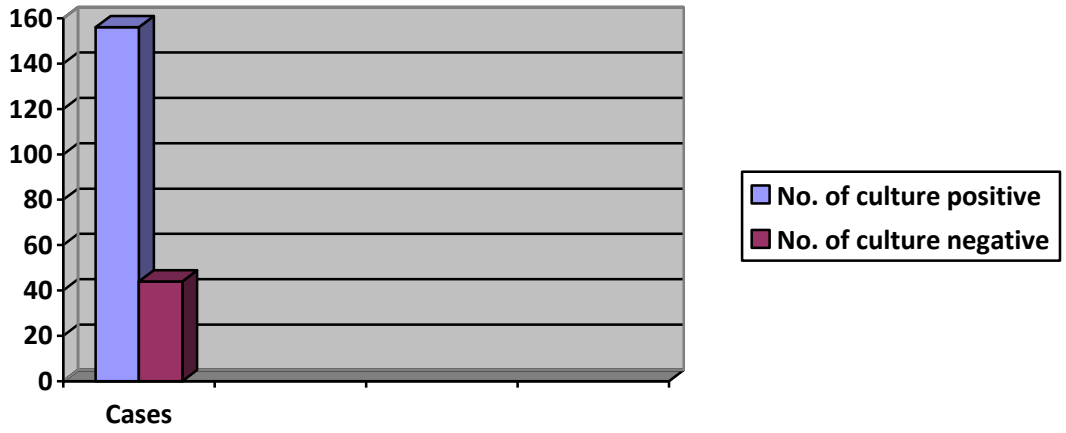
RESULTS

In the present study a total of 200 samples were screened out of which the Culture positive cases observed were 78% and Culture negative cases observed were 22%.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

No. of Culture Positive Cases	No. of Culture Negative Cases	Total
156 (78%)	44(22%)	200(100%)

Table no .1: Distribution of cases



Graph No. 1: Graphical Representation of distribution of case

Bone involved	No. of cases	Percentage (%)
Tibia	98	49%
Femur	66	33%

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

Fibula	10	5%
Ulna	6	3%
Radius	4	2%
Metacarpal	4	2%
Metatarsal	4	2%
Radius	4	2%
Calcaneus	4	2%
Total	200	

In the present study it was observed that out of the total 200 cases Tibia (49%) being more affected than femur (33%) followed by Fibula.

Table.no. 2: Showing bones involved in osteomyelitis

From the table no. 3 it was observed that trauma as the commonest predisposing factor seen in 82 (41%) cases, followed by post-operative infections 48 (24%), orthopaedic implants 40 (20%) cases, /Diabetes mellitus 3 (1.5%) cases, Implant / Diabetes mellitus 21 (10.5%) cases and Post operative infection / Diabetes mellitus in 6 (3%) cases, Trauma / Diabetes mellitus 3 (1.5%) cases.

Predisposing factor	No. of cases	Percentage (%)
Trauma	82	41%
Orthopaedic implants	40	20%
Post operative infection	48	24%
Implant / Diabetes mellitus	21	10.5%
Post operative infection / Diabetes mellitus	6	3%
Trauma / Diabetes mellitus	3	1.5%
Total	**200**	**100%**

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

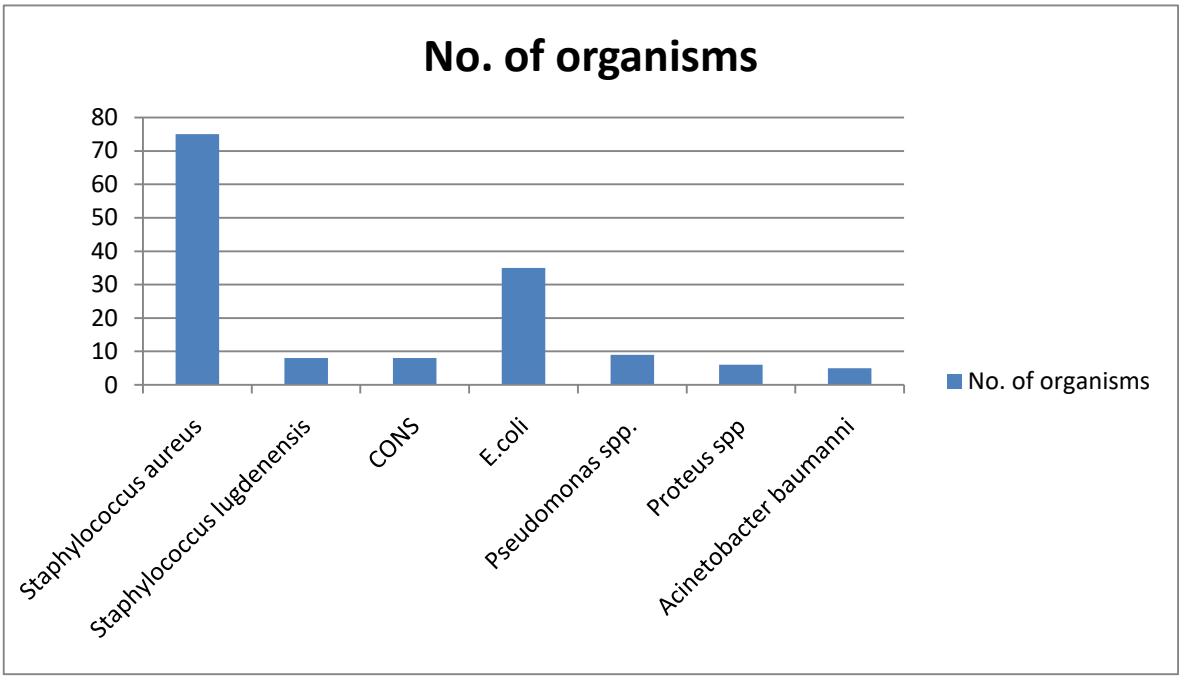
Table no. 3: Showing predisposing factors for osteomyelitis

In the present study it was observed that *Staphylococcus aureus* was the most common isolate with 75 (48%) followed by *Escherichia coli* 35 (22.4%), *Klebsiella pneumoniae* with 10 (6.4%), *Pseudomonas aeruginosa* with 9 (5.7%), *Staphylococcus lugdenensis*, *CONS* with 8 (5.1%) respectively, *Proteus mirabilis* with 6 (3.5%) and least for *Acinetobacter baumanni* with 5 (3.2%).

Organisms	**No. of organisms**	**Percentage (%)**
Staphylococcus aureus	**75**	**48%**
Staphylococcus lugdenensis	**8**	**5.1%**
CONS	**8**	**5.1%**
Escherichia coli	**35**	**22.4%**
Klebsiella pneumoniae	**10**	**6.4%**
Pseudomonas aeruginosa	**9**	**5.7%**
Proteus mirabilis	**6**	**3.8%**
Acinetobacter baumanni	**5**	**3.2%**
Total	**156**	**100%**

Table no.4: Showing various organisms isolated

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024



Graph no. 2: Showing various organisms isolated

In the current study it was found that out of 65 organisms isolated, most effective drug of GNB was *Colistin*, followed by Polymyxin B 100(%), *Tigycyclin*, *Meropenem*, *Imipenem*, and *Piperacillin/Tazobactum*.

Antibiotics	***E.Coli (35)***	***Klebsiellaspp.(10)***	***Pseudomonas spp.(9)***	***Proteus spp.(6)***	***Acinetobacter spp.(5)***
Amoxyclav	4(11%)	0(0%)	0(0%)	3(50%)	0(0%)
Gentamicin	22(62.8%)	5(50%)	5(55%)	4(66%)	2(40%)
Amikacin	26(74%)	5(50%%)	5(55%)	4(66%)	2(40%)
Ciprofloxacin	7(20%)	0(0%)	1(11%)	1(16%)	0(0%)
Cotrimoxazole	7(20%)	0(0%)	0(0%)	4(66%)	0(0%)
Cefoxitin	9(25%)	0(0%)	0(0%)	4(66%)	0(0%)
Piperacillin	12(34.2%)	0(0%)	5(55%)	6(100%)	0(0%)
Piperacillin/	11(31%)	0(0%)	9(100%)	6(100%)	0(0%)

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

Tazobactum					
Ceftazidime	5(45.4%)	0(0%)	5(55%)	3(50%)	0(0%)
Aztreonem	12 (34.2%)	2(20%)	5(55%)	3(50%)	0(0%)
Ceftriaxone	4(11%)	0(0%)	5(55%)	3(50%)	0(0%)
Cefotaxime	4(11%)	0(0%)	1(11%)	3(50%)	0(0%)
Cefepime	8 (22.8%)	0(0%)	0(0%)	3(50%)	0(0%)
Meropenem	35 (100%)	10(100%)	5(55%)	4(66%)	5(100%)
Imipenem	35 (100%)	10(100%)	5(55%)	4(66%)	5(100%)
Colistin	35 (100%)	10(100%)	8(88%)	6(100%)	5(100%)
Polymyxin B	35 (100%)	10(100%)	8(88%)	6(100%)	5(100%)
Tigecycline	35 (100%)	9(90%)	0(0%)	3(50%)	5(100%)

Table no.5: Antibiotic Sensitivity Pattern of GNB

Organisms	**No. of isolates**	**ESBL producers No. (%)**
E.coli	35	16(45.7%)
Klebsiella spp.	10	7(70%)
Acinatobacter spp.	5	5(100%)
Pseudomonas spp.	9	2(22%)
Proteus spp.	6	2(33%)
Total	65	32(30%)

Table no. 6: Showing Extended Spectrum β Lactamases (ESBL) producers

Organism	**No. of isolates**	**MBL producers No. (%)**
E.coli	35	0(0%)
Klebsiella spp.	10	0(0%)

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

Acinatobacter spp.	5	0(0%)
Pseudomonas spp.	9	5(55%)
Proteus spp.	6	2(33%)
Total	65	7(10.7%)

Table no.7: ShowingMetallo β Lactamases (MBL producers)

Out of 91 organisms isolated, most effective drug of GPC was *Vancomycin*, *Teicoplanin*, *Linezolid* followed by *Gentamicin* and *Amikacin.*

Antibiotics	***S.aureus* *(75)***	***S.lugdenensis* *(8)***	**CONS (8)**
Penicillin	0(0%)	0(0%)	0(0%)
Ampicillin	2(2.6%)	0(0%)	0(0%)
Gentamicin	71(94.6%)	8(100%)	8(100%)
Amikacin	69(92%)	0(0%)	8(100%)
Ciprofloxacin	15(20%)	0(0%)	0(0%)
Erythromycin	38(50.6%)	0(0%)	2(25%)
Clindamycin	38(50.6%)	0(0%)	2(25%)
Cotrimoxazole	30(40%)	2(25%)	0(0%)
Oxacillin	32(42.6%)	0(0%)	2(25%)
Cefoxitin	32(42.6%)	0(0%)	2(25%)
Linezolid	71(94.6%)	8(100%)	8(100%)
Vancomycin	75(100%)	8(100%)	8(100%)
Teicoplanin	75(100%)	8(100%)	8(100%)

Table no .8: Antibiotic sensitivity pattern of Gram positive isolates:-

Type of organisms	**No. (%)**

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

Methicillin Sensitive Staphylococcus aureus (MSSA)	43(57.3%)
Methicillin Resistant Staphylococcus aureus (MRSA)	32(42.6%)
Total (%)	**75(100%)**

Table no. 9: Showing *Methicillin Resistant Staphylococcus aureus* (MRSA) isolated

Antibiotics	**MRSA (32)**	**MSSA(43)**
Penicillin	0(0%)	0(0%)
Ampicillin	0(0%)	2(4.6%)
Gentamicin	30(93.7%)	40(93%)
Amikacin	28(87.5%)	40(93%)
Ciprofloxacin	8(25%)	8(18.6%)
Erythromycin	16(50%)	20(46.5%)
Clindamycin	16(50%)	20(46.5%)
Cotrimoxazole	16(50%)	18 (41.8%)
Oxacillin	**0(0%)**	**43(100%)**
Cefoxitin	**0(%)**	**43(100%)**
Linezolid	31(96.8%)	43(100%)
Vancomycin	32(100%)	43(100%)
Teicoplanin	32(100%)	43(100%)

Table no. 10: Antibiotic sensitivity pattern of MRSA, MSSA

DISCUSSION

Osteomyelitis is an inflammatory process that affects the bone due to the contiguous infection, direct inoculation, or hematogenous spread of microorganisms. It is an infectious disease that is difficult to diagnose, and treatment is complex because of its heterogeneity, pathophysiology, clinical presentation, and management. In the present study an attempt was made to know the microbiological profile of osteomyelitis and their antibiotic sensitivity pattern. In the present study

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

the results for culture positive was observed to be 78% and 22% were culture negative. This study was parallel to the study performed by the other authors where the culture positive results was found to be 86% and 89% whereas culture negative was observed to be 14% and 8% respectively [30] [31]. There was the another study performed by Ruchi V.Shah et al [32] and Razia Khatoon et al in the year 2017 [33] which were also in correlation to the present study where the culture positive reported was 96% and 105% and the culture negative observed was 54% and 20%. In the study by B. Padmini (2021) reported the rate of culture positive to be 87% and the culture negative was observed to be 13% [34].

In the present study it was observed that trauma was recorded as 41% which was the highest followed by Post operative infection with 24%, Orthopaedic implants with 20%, Implant / Diabetes mellitus with 10.5%, Post operative infection / Diabetes mellitus with 3% and least for Trauma / Diabetes mellitus found to be 1.5%. This study was similar to the study conducted by the other research investigator where G.Suguneswari et al [35] observed trauma with 53%. There were other studies which were in support to the current study by Mita D Wadekar et al[30], Anupam Singh et al [31], Ruchi V.Shah et al[32], and Razia Khatoon et al [33] where the most common predisposing factor observed was trauma with 44%, 38%, 76%, 57% respectively followed by orthopaedic implants and post operative infections. The least was recorded for diabetes with 17%, 12%, 13%, 4% respectively.

In the current study it was observed that tibia was most commonly affected which was in accordance to the studies by other research investigator.

Bone involved	G.Suguneswari et al [34]	Mita D Wadekar et al [30]	Razia Khatoon et al [33]	Present study

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

Tibia	58	23	55	**49**
Femur	31	48	51	**33**
Fibula	-	1	01	**5**
Ulna	2	4	02	**3**
Radius	1	3	02	**2**
Metacarpal	2	4	03	**2**
Metatarsal	1	3	05	**2**
Humerus	3	9	03	**2**
Calcaneus	2	-	03	**2**
Malleolli	-	3	-	-
Patella	-	2	-	-

Table no.11: Comparison of different bones affected in osteomyelitis with other workers studies

In the present study it was observed that *Staphylococcus aureus* was most commonly found with 48% followed by *Escherichia coli*with 22.4%, *Klebsiella pneumoniae.*with 6.4%, *Pseudomonas aeruginosa* with 5.7% *Staphylococcus lugdenensis* and *CONS* with 5.1%, *Proteus mirabilis.*with 3.8% and least with *Acinetobacter baumanni* with 3.2%. This study was in support with the study performed by the other research investigator where MitaD Wadekar et al [30] observed *S.aureus* as the most common isolate. There was another study by Anupam Singh et al [31], Ruchi V.Shah et al [32], Razia Khatoon et al [33]and G.Suguneswari et al[35] which were in support to the present study where *S aureus* observed was found to be 53%, 60%, 34% and 53% respectively.

It was observed that in case of GPC Vancomycin, Linezolid,Teicoplanin were 100% sensitive whereas the sensitivity to Meropenem,Imipenem Colistin ,Polymysin B was also found to be 100% effective. This study was in support to the study performed by the other research investigator where in case of GPC 100% sensitivity was found for Vancomycin, Linezolid,Teicoplanin and for GNB Piperacillin /tazobactum& Ceftazidime, Amikacin, Imipenem with 100%. [30], [32], [33]

Antibiotic sensitivity was carried out for 200 isolates by Kirby-Bauer disc diffusion method. Of

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

Gram positive isolates, were 100% sensitive to Vancomycin to Linezolid and Teicoplanin. Among Gram negative isolates 100% sensitive to Meropenem, Imipenem and Polymixin B and Colistin.Similar sensitivity was reported by Razia Khatoon et al [33] (2017).

In the current study Methicillin Resistant *Staphylococcus aureus* **(**MRSA) isolated was observed to be 42.6% which was in accordance with the study by Razia Khatoon et al [33]. There were another study also performed by the other author where the rate of MRSA isolated was observed to be 52% [31] and the study by B. Padmini (2021) also supported our study where the rate of MRSA was observed to be 66% [34]. There was a study by G.Suguneswari et al [35] which was in contrast with the current study where the MRSA isolates was observed to be 23%.

S.No	**STUDY**	**MDRO**
1.	B. Padmini [24]	66%
2.	Anupam Singh [31]	MRSA 52%
3.	Razia Khatoon et al [33]	MRSA(43.1%),ESBL(51.6%) AmpC (24.2%),MBL(14.5%)
4	**Present Study**	**MRSA(42.6%), ESBL(30%),MBL(10.7)%**

Table no.12: Prevalance of MDRO in different studies

Osteomyelitis, an infection related to bone and bone marrow, is very diverse in its pathophysiology and clinical presentation; hence, it is considered one of the most difficult-to-treat infections [36] . The incidence of the devastating disease osteomyelitis is estimated to be 21.8 cases per 100,000 person-years, though the actual picture is difficult to predict [37]. As per published reports, nearly one in 675 hospital admissions/year or approximately 50,000 osteomyelitis cases occur annually in the United States [7]. The disease is said to be more common in young children and older adults, although no age group is spared. Inappropriate use of antibiotics and multidrug resistance has raised the morbidity and mortality rate in chronic osteomyelitis [38,39]. The emerging multidrug-resistant strain is a major concern for the treatment. Identification of causative isolates and using a judicious selection of antibiotics will help the clinician in starting the empirical

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

treatment accordingly would limit the multidrug resistance strains in the hospital as well as the community [40,41].

CONCLUSION

Osteomyelitis is a heterogeneous disease with a vivid presentation, which can lead to devastating complications if left untreated. Even if the clinical diagnosis of osteomyelitis is obvious, the microbiological workup for etiological diagnosis of cases of osteomyelitis is still not a routine practice in many hospitals, which needs to be improved. Therefore, adequate infection control measures and antibiotic policies must be followed to limit the incidence of MDR strains. Antibiotic susceptibility patterns assist clinicians in selecting appropriate medications, resulting in successful treatment and preventing the emergence and spread of drug resistant isolates. It will go a long way towards assisting the clinician in determining the treatment plan for these patients. The data gathered by these investigations will also be useful in developing hospital antibiotic policies.

Declarations:

Conflicts of interest: There is not any conflict of interest associated with this study

Consent to participate: There is consent to participate.

Consent for publication: There is consent for the publication of this paper.

Author's contributions: Author equally contributed the work.

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ISSN: 0975-3583,0976-2833 VOL15, ISSUE 11, 2024

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