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Research Article

ORGANISMS CAUSING OSTEOMYELITIS AND ANTIMICROBIAL SUSCEPTIBILITY PATTERN AMONG PATIENTS SEEKING CARE ATA TERTIARY CARE ORTHOPEDIC CENTER

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ABSTRACT

Objective: The objective of this study was to study the organisms causing osteomyelitis and their antimicrobial susceptibility pattern from a tertiary care teaching hospital located in a region of Madhya Pradesh.

Methods: Fifty clinically diagnosed cases of osteomyelitis visiting the medical college and seeking care for the same in orthopedics department during the study period formed the study population. Pus samples were collected and sent to microbiology laboratory for culture and testing of their antimicrobial susceptibility as per the standard guidelines.

Results: Out of 50 water samples gathered, 25, 14, and 11 samples of water were gathered from municipal tap water, government hand pump, and water cooler separately. Close to half of the examples were viewed as inadmissible. *Escherichia coli* was viewed as answerable for 26% of tests while Pseudomonas in 1/5th of gathered examples. *Staphylococcus aureus*, 14 (87.5%) were found resistant to Penicillin-G. *Pseudomonas aeruginosa*, 14 (100%) were found resistant to ampicillin, whereas more than half cases were found be resistant to antibiotics, namely, ciprofloxacin, ofloxacin, and cephotaxime, respectively.

Conclusion: We observed changes in the patterns of isolated organisms and the establishment of higher levels of antibiotic resistance among bacterial isolates in osteomyelitis cases. It is imperative that monitoring be prioritized to track etiological changes and to adhere to a single health policy to stop the multidrug-resistant bacteria threat.

Keywords: Osteomyelitis, Antimicrobial susceptibility, Culture.

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INTRODUCTION

Bone and joint infections cause patients agonizing pain and confounding symptoms for both themselves and their doctors and surgeons [1]. The extent of bone inclusion, origin, pathophysiology, age, and patient condition all distinguish this infection from others. It may contain different structures, such as bone marrow, the cortex, the periosteum, and some of the nearby delicate tissues, or it may remain limited. A few factors, such as the patient's age, the location of the disease, the severity of the infecting organism, and the patient's resistance, affect the clinical appearance and typical course of osteomyelitis [2]. Osteomyelitis typically affects the growing ends of long bones, and it is more common in the lower portion at the femur's metaphysis and the proximal end of the tibia [3,4].

The introduction of microorganisms into the bone may occur during crack realignment, prosthetic implantation, or due to trauma. Blood from skin wounds and other enticing regions allows microorganisms to enter the metaphysis of bone. Increased microbial growth in the metaphysis can result in obstruction, edema, exudates, leukocytosis, necrosis, and abscess [5].

The key factor driving the development of drug resistance is thought to be the inappropriate, indiscriminate, and unneeded use of anti-microbials. To treat osteomyelitis, the right antibiotics must be administered along with the causative bacterium. Therefore, understanding the microbiological etiology of the different kinds of osteomyelitis in our region is crucial. The best results come from timely antibiotic therapy, before significant bone necrosis or destruction. The present study is planned to study the organisms causing osteomyelitis and their antimicrobial susceptibility pattern.

METHODS

This study was conducted executed by the department of orthopedics along with department of microbiology of a tertiary care teaching health center located at Madhya Pradesh.

Study design
This study was cross-sectional study.

Study period
This study was March 2021–September 2021.

Sampling technique
This study was purposive sampling.

Sample size
Fifty clinically diagnosed cases of osteomyelitis.

Inclusion criteria
The following criteria were included in the study:
1. Clinically diagnosed cases of osteomyelitis visiting the medical college and seeking care for the same
2. All the deep tissue and bone tissue received from osteomyelitis patients (Non-repetitive).

Exclusion criteria
The following criteria were excluded from the study:

Superficial wound infections and patients on antibiotic treatments.

Specimen collection

Pus samples were gathered after surgical debridement. The affected area with nearby skin was first cleaned with iodine solution. The superficial discharge of the sinus was removed and the material was then taken out aseptically in two separate swabs. One swab was utilized for microscopy and another one for isolation of aerobic bacteria. For anaerobic culture, specimen was collected in a syringe and added immediately to appropriate media and incubated anaerobically [6]. The culture isolates were identified by Gram stain morphology, colony characters and biochemical reactions [7]. Antibiotic sensitivities were done on Mueller–Hinton agar by Kirby–Bauer disk diffusion method as per CLSI guidelines [8].

RESULTS

Out of 50 water samples gathered, 25, 14, and 11 examples of water were gathered from municipal tap water, government hand pump, and water cooler separately. Close to half of the examples were viewed as inadmissible. *Escherichia coli* was viewed as answerable for 26% of tests while Pseudomonas in a fifth of gathered examples (Table 1).

With respect to *Staphylococcus aureus*, 14 (87.5%) were found resistant to Penicillin-G, whereas 12 (75.0%) were observed resistant to three antibiotics, namely, ampicillin, ciprofloxacin, and cephalexin. In case of *Enterococcus faecalis*, 8 (88.9%) were found resistant to penicillin-G, whereas 7 (77.8%) were found resistant to three antibiotics, namely, ampicillin, gentamicin, and ceftazadime (Table 2).

In case of important aerobic Gram-negative bacterial isolates, *Pseudomonas aeruginosa*, 14 (100%) were found resistant to ampicillin, whereas more than half cases were found be resistant to antibiotics, namely, ciprofloxacin, ofloxacin, and cephotaxime, respectively. *Citrobacter freundii* was found resistant to ampicillin, amikacin, cephotaxime, and ceftazadime in all the cases tested (Table 3).

Table 1: Organisms isolated from cultures in osteomyelitis cases

Organisms	Number	Percentage
Gram-positive bacteria		
Staphylococcus aureus	16	25.0
Enterococcus faecalis	9	14.1
Streptococcus pyogenes	2	3.1
Staphylococcus epidermidis	2	3.1
Gram negative *bacteria*		
Pseudomonas aeruginosa	14	21.8
Acinetobacter baumannii	11	17.2
Klebsiella pneumoniae	4	6.2
Proteus mirabilis	3	4.7
Clostridium spp.	1	1.5
Citrobacter freundii	1	1.5
Morganella morganii	1	1.5

*More than one organism was isolated in 15 patients

DISCUSSION

This review's bacteriological testing of the water's quality is not to be seen as a technological intermediary, but rather as a way to collaborate with the community's stronger systems of health administration and health promotion. It is possible to trace a significant portion of humanity's frailty, particularly in developing countries, to the lack of protected and clean water. Positive health cannot exist without access to clean water. We expect water should be safeguarded since it is essential to our survival. In fact, even water that appears clear may not actually be safe or appropriate [9].

The potability of water is determined by a bacteriological analysis. According to Indian standards (BIS, 1981), no sample should contain *E. coli* in 100 mL and 95% of tests should be free of coliform organisms or not be recognizable in that state of mind in any two consecutive samples. The appropriate coliform concentration in water is 10 MPN/100 mL [10].

Since water is the primary anticipated source of infectious diseases, it is necessary that the water used for human consumption be free from pathogenic and substance specialists, delicious to drink, and suitable for domestic uses. The primary option for ensuring general well-being is water sanitization. The study report also revealed that water-borne illnesses regularly caused a few deaths, particularly among children. In fact, in non-industrial countries like India, access to pure water and disinfection offices continues to be a strict test even after more than 60 years of freedom [11].

Twenty five samples of water from public tap water, government hand pumps, and water coolers, respectively, were collected for this review. Nearly half of the samples were thought to be inappropriate. A quarter of tests were thought to be answerable for *E. coli*, while a fifth of the samples were thought to be answerable for *Pseudomonas*. In the event that a water test was conducted on municipal ordinary water, the MPN of coliform was determined to be extremely high (180), and in the case of water from a water cooler, it was 90, not adaptable, and no coliform was identified in the government hand pump supply for drinking.

In this review, we observed that *P. aeruginosa*, 14 (100%) were found resistant to ampicillin whereas more than half cases were found be resistant to antibiotics, namely, ciprofloxacin, ofloxacin, and cephotaxime, respectively. *C. freundii* was found resistant to ampicillin, amikacin, cephotaxime, and ceftazadime. Similar results were observed by Wadekar *et al.*; in their investigation, 67.0% of the cases had mono etiology, followed by 20% of polymicrobial development [12]. Although Gram-negative bone infections had greatly increased, *S. aureus* (43.0%), *P. aeruginosa* (10.0%), and *S. aureus* (10.0%) remained the most frequent causes of osteomyelitis, according to Kaur *et al.*, which is consistent with our data [13].

In this study, it was seen that in case of important aerobic Gram-negative bacterial isolates like, *P. aeruginosa*, 14 (100%) were found

Table 2: Pattern of resistance shown by aerobic Gram-positive bacterial isolates

Antibiotic	*Staphylococcus aureus*	*Enterococcus faecalis*	*Streptococcus pyogenes*	*Staphylococcus epidermidis*
Penicillin-G	14 (87.5)	8 (88.9)	1 (50.0)	1 (50.0)
Ampicillin	12 (75.0)	7 (77.8)	1 (50.0)	1 (50.0)
Linezolid	9 (56.2)	5 (55.6)	-	1 (50.0)
Clindamycin	6 (37.5)	4 (44.4)	-	-
Gentamicin	11 (68.7)	7 (77.8)	-	-
Ciprofloxacin	12 (75.0)	6 (66.7)	-	-
Ofloxacin	9 (56.2)	6 (66.7)	-	-
Sparfloxacin	8 (50.0)	5 (55.6)	-	-
Cefotaxime	9 (56.2)	6 (66.7)	-	-
Ceftazadime	9 (56.2)	7 (77.8)	-	-
Cephalexin	12 (75.0)	5 (55.6)	-	1 (50.0)
Methicillin	7 (43.7)	-	-	-
Amikacin	6 (37.5)	3 (33.3)	-	-
Netilmycin	6 (37.5)	3 (33.3)	-	-

Table 3: Pattern of resistance shown by important aerobic Gram-negative bacterial isolates

Antibiotic	*Pseudomonas aeruginosa*	*Acinetobacter baumannii*	*Klebsiella pneumoniae*	*Proteus mirabilis*	*Citrobacter freundii*	*Morganella morganii*
Ampicillin	14 (100)	5 (45.4)	3 (75.0)	2 (66.7)	1 (100)	1 (100)
Amikacin	6 (42.8)	4 (36.3)	3 (75.0)	1 (33.3)	1 (100)	1 (100)
Ofloxacin	7 (50.0)	5 (45.4)	3 (75.0)	1 (33.3)	-	1 (100)
Ciprofloxacin	8 (57.1)	4 (36.3)	2 (50.0)	1 (33.3)	-	-
Cephotaxime	7 (50.0)	3 (27.2)	2 (50.0)	1 (33.3)	1 (100)	1 (100)
Ceftazadime	6 (42.8)	3 (27.2)	1 (25.0)	2 (66.7)	1 (100)	1 (100)
Cefoperazone+Sulbactam	5 (35.7)	2 (18.1)	1 (25.0)	1 (33.3)	-	-
Piperacillin	6 (42.8)	2 (18.1)	1 (25.0)	1 (33.3)	-	1 (100)
Piperacillin+Tazobactam	4 (28.6)	2 (18.1)	2 (50.0)	1 (33.3)	-	-
Imipenem	6 (42.8)	2 (18.1)	1 (25.0)	1 (33.3)	-	-
Meropenem	5 (35.7)	2 (18.1)	2 (50.0)	1 (33.3)	-	-

resistant to ampicillin, whereas more than half cases were found be resistant to antibiotics, namely, ciprofloxacin, ofloxacin and cephotaxime, respectively. *C. freundii* was found resistant to ampicillin, amikacin, cephotaxime, and ceftazadime. Sheehy *et al*. observed in her study that methicillin resistance was present in 50% of the *S. aureus*, showing methicillin-resistant *S. aureus*. All MRSA strains, however, exhibited 100% sensitivity to vancomycin, 59% sensitivity to clindamycin, 47% sensitivity to linezolid, and 51% sensitivity to netilmycin. The results of the previous studies and the present study make it abundantly clear that MRSA strains are becoming alarming due to their increased resistance to antibiotics such as amikacin, netilmicin, and to a lesser extent, vancomycin, and linezolid, which gives clinicians fewer options for choosing the right medication to treat chronic osteomyelitis [14].

This study has several advantages. We evaluated the bacteriological composition of drinking water from several dynamic water sources, which is a crucial focus study. Microbial science organizations and experts in the subject have not conducted a thorough investigation of this viewpoint. There are also some limitations on the review. Some would argue that the results might not matter to the general audience. In view of the fact that these findings are dependent on a single site study from Madhya Pradesh, I agree. There should be more multicentric evaluations.

CONCLUSION

The review featured unsafe nature of water sources in the study region with respect to drinking water which is not good for utilization of water. Reconnaissance of water sources and normal bacteriological evaluation of all water hotspots for drinking is suggested on regular basis. Furthermore, in the current investigation, we have observed changes in the patterns of isolated organisms and the establishment of higher levels of antibiotic resistance among bacterial isolates in osteomyelitis cases. It is imperative that monitoring be prioritized to track etiological changes and to adhere to a single health policy to stop the multidrug-resistant bacteria threat.

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AUTHORS' CONTRIBUTION

All the authors have contributed equally.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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