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Antibiotic Sensitivity Pattern of Aerobic Bacterial Isolates in Wound Infections in Navi Mumbai, India

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Wound infection is a breach in the integrity and protective function of the skin. Mostly bacteria (e.g. *Staphylococcus aureus*), certain viruses (e. g. *Herpes virus*) and fungi (e.g. *Candida albicans*) are responsible for wound infection. This study was conducted for isolation, identification and antibiotic sensitivity testing of aerobic bacterial strains from wound infection.
Methods: Total 216 pus samples were collected and immediately inoculated on Blood agar and MacConkey agar plates. Then the culture plates were placed in incubator at 37℃ for 24 hours. After incubation, all isolates were identified by using Gram staining and different biochemical tests. Antibiotic sensitivity test was performed on Mueller Hinton agar plate by Kirby Bauer Disc Diffusion method as per CLSI guidelines.
Results: Among 216 samples, 166 (76.8%) showed positive growth. Fifteen different bacterial species were isolated. The most commonly isolated organism was *Staphylococcus aureus* (26.7%) followed by *Pseudomonas sp.* (16.4%), *Escherichia coli* (11.9%), *Klebsiella sp.* (7.8%). Antibiotic sensitivity test showed that the most effective antibiotics for Gram positive bacteria were Linezolid (87.2%) and Ampicillin + Sulbactam (82.3%) whereas Cefotaxime (48%) was the least effective antibiotic. The most effective antibiotic for Gram negative isolates was Amikacin (72.3%) followed

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by Netilline (67.3%). Cefuroxime (21.9%) was the least effective antibiotic for Gram negative bacteria.
Conclusion: *Staphylococcus aureus* was the most frequently isolated bacteria in wound infection. Linezolid and Amikacin were the most effective antibiotics for Gram positive and Gram negative bacteria, respectively.

Keywords: Wound infection; Staphylococcus aureus; Escherichia coli; Pseudomonas sp.

1. INTRODUCTION

A wound is a breach in the skin and the exposure of subcutaneous tissue following loss of the skin integrity. It provides suitable environment for microbial colonization and proliferation [1]. Classical signs of inflammation were described by Celsus in the first century as calor, rubor, tumor and dolor (heat, redness, swelling and pain), a fifth sign fluor (discharge) was added to theses [2].

Wound infections are mainly of two types i.e. open wound and closed wound. Open wound is an injury of the skin caused by external damage, whereas closed wound is a infection to underlying tissues and skin remains intact [3].

Wound infections are one of the most common hospital acquired infections which account for morbidity and 70-80% mortality [4]. Such infections cause delayed healing, anxiety and discomfort for a patient, longer stay at hospital and add to cost of healthcare services significantly.

Wound infection can be caused by different microorganisms like Bacteria, Fungi and Viruses. The infecting microorganism may be aerobic (requires oxygen for the growth) or anaerobic (No oxygen requirement). Aerobic microorganism, frequently isolated from wound infections, are *Staphylococcus aureus*, Coagulase-Negative *Staphylococci* (CoNS), *Enterococcus sp., Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Enterobacter sp., Proteus mirabilis, Streptococcus sp. and Acinetobacter sp.*

Common wound infections are surgical site infections, Bite wound infections, Burn wound infections, Acute soft tissue infections, Diabetic foot ulcer infections, Leg and decubitus (pressure) ulcer infections [4,5]. Surgical site infections (SSI) are most important cause of morbidity and prolonged stay in hospital. SSI accounts for 12.3% of hospital acquired infections [6]. According to a report, surgical site infection rate in India to be between 4 to 30% [7]. The control of wound infections has become more challenging due to widespread bacterial resistance to antibiotics and to a greater incidence of infections caused by methicillin-resistant *Staphylococcus aureus* and polymicrobial flora. The knowledge of the causative agents of wound infection are therefore very helpful in proper antimicrobial therapy and on infection control measures in health care settings [1].

Hence this study investigates the bacteriology of patients' infected wounds in a tertiary care hospital in Navi Mumbai.

2. MATERIALS AND METHODS

This was a retrospective study of pus samples from all wounds over a period of one year. Total 216 samples were collected from patients visiting MGM Hospital Kamothe Navi Mumbai. Pus samples were collected with the help of 2 sterile disposable cotton swabs [8]. One swab was used for direct microscopy and other was inoculated on Blood agar and MacConkey agar media and incubated at 37°C for 24 hours. After incubation, Identification of bacteria from positive cultures was done with standard microbiological techniques which included Gram staining and biochemical tests like Catalase, Coagulase, Mannitol salt agar, Oxidase, Indole production, Methyl red, Citrate utilization, Triple sugar iron test etc. [9]. The antibiotic sensitivity testing was done as per CLSI guidelines by modified Kirby Bauer's disc diffusion method on Mueller Hinton agar using antibiotic discs of Hi media Laboratories Pvt. Limited, India [10].

3. RESULTS

Total 216 patients suffering from wound infection were included in this study, out of which 146 (68%) were male patients and 70 (32%) were female patients. Among 146 samples from male patients, 120 (72%) samples showed positive

growth and among 70 samples from female patients, 46 (28%) showed positive growth (Fig. 1).

Patients of all ages were having the wound infections but surprisingly age group of 21-30 years was more prone to the wound infection (Fig. 2).

Out of 216 samples tested, 166 (76.8%) samples showed aerobic bacterial growth with 243 bacterial isolates and 50 (22.2%) samples were sterile in aerobic conditions. Out of the243 bacterial isolates, 102 (41.9%) were Gram positive and 141 (58.1%) were Gram negative (Fig. 3). Among Gram positive isolates, *Staphylococcus aureus* 65 (26.7%) was the most frequently isolated species and *Pseudomonas sp.* 40 (18.5%) was the most frequently Gram negative isolate (Tables 1, 2).

3.1 Antibiotic Sensitivity Pattern

The sensitivity pattern showed that Linezolid (87.2%) and Ampicillin + Sulbactam (82.3%) were the most effective antibiotic for Gram positive bacteria whereas Cefotaxime (48%) was the least effective antibiotic. For Gram negative bacteria, Amikacin (72.3%) and Netilline (67.3%) were the most effective antibiotics whereas Cefuroxime (21.9%) was the least effective antibiotic. Staphylococcus aureus was highly sensitive to Vancomycin (100%) and Linezolid (89.2%) whereas least sensitive to Cefotaxime (47.6%). For Pseudomonas sp., Amikacin (90%)

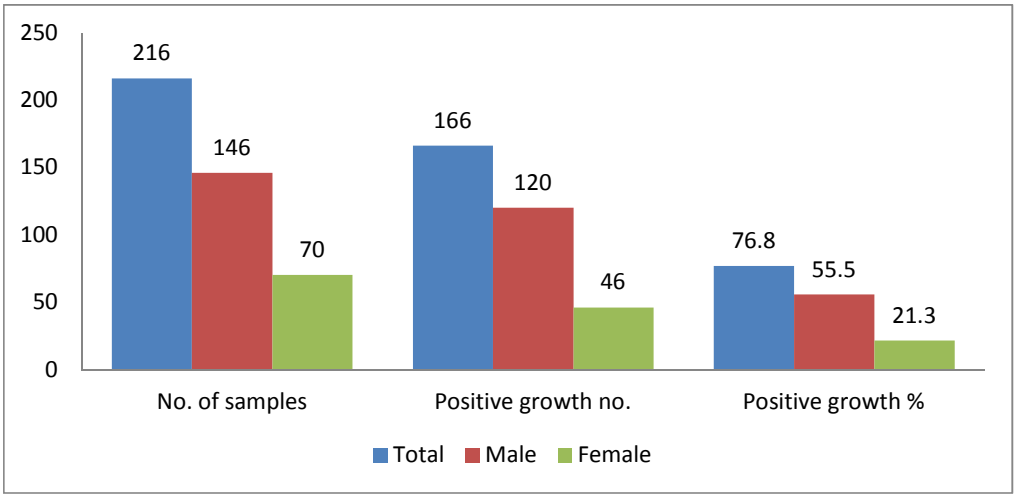

Fig. 1. Sex distribution

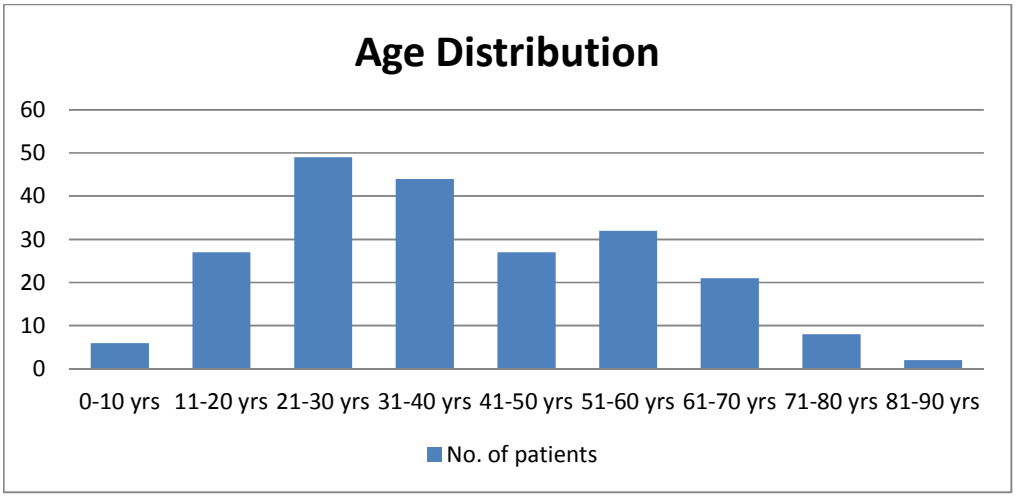

Fig. 2. Age distribution

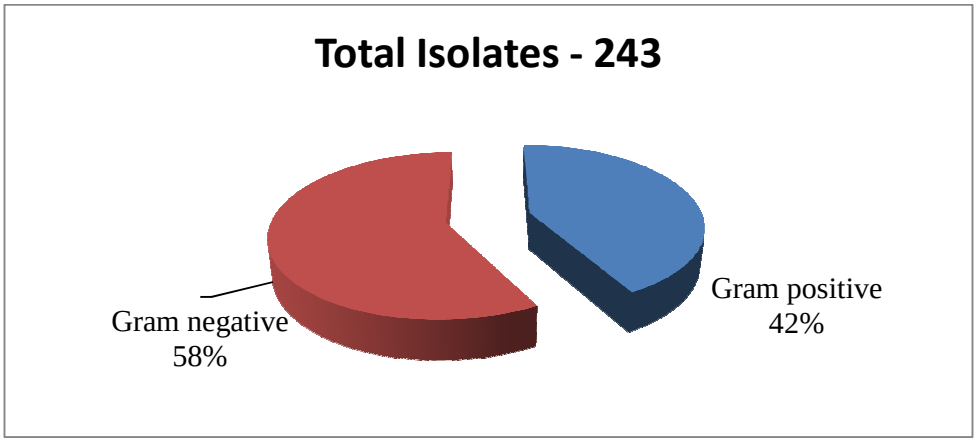

Fig. 3. Distribution of Gram positive and Gram negative organisms isolated from wounds

Table 1. Distribution of gram positive bacteria

Organisms	No. of isolates	% among total gram positive isolates (102)	% among total isolates (243)
Gram positive bacteria			
Staphylococcus aureus	65	63.7	26.7
CoNS	15	14.7	6.1
Streptococcus pyogenes	7	6.8	2.8
Streptococcus sp.	1	0.9	0.4
Enterococcus sp.	14	13.7	5.7
Total	102		

Table 2. Distribution of gram negative bacteria

Organisms	No. of isolates	% among total gram negative isolates (141)	% among total isolates (243)
Pseudomonas sp.	40	28.3	16.4
E. coli	29	20.5	11.9
Klebsiella sp.	19	13.4	7.8
Enterobacter sp.	13	9.2	5.3
Acinetobacter sp.	18	12.7	7.4
Proteus vulgaris	6	4.2	2.4
Proteus mirabilis	6	4.2	2.4
Citrobacterfreundii	5	3.5	2.05
Citrobacter diversus	1	0.7	0.4
GNNF	4	2.8	1.6
Total	141		

was the most effective antibiotic and for *E. coli,* the most effective antibiotic was Gentamycin (82.7%) followed by Amikacin (79.3%) and Netilline (79.3%).

3.2 Additional Antibiotic Sensitivity Pattern

Some bacterial strains (40 strains, out of which 11 were Gram positive and 29 Gram negative), highly resistant to primary antibiotics, were further tested for additional antibiotics (Figs. 4, 5).

4. DISCUSSION

In this study, total 216 patients, suffering from different wound infections, were included. The incidence of wound infection was more common in males than in females. A similar study conducted in three hospitals (Federal Medical Centre, Owerri, Imo State University Teaching Hospital, Orlu and General Hospital, Okigwe) by Ohalete et al also showed the same result that the males (59.3%) were more prone to wound infection than females (40.7%) [11].

Out of 216 cases, the highest number of cases 59 (27.3%) were from fracture. It might be due to the location of Hospital which is very close to Mumbai-Pune highway, where lot of trauma cases are registered every day in the Hospital.

The commonest age group with wound infections was 21-30 years which may be because it is a most active age group and so more prone to accidents. Out of total 216 patients, 49 (22.6%) patients were in the age group of 21-30 years. According to Mohammed et al from Kano, Nigeria, the highest 392 (82.5%) positive samples were collected from adult patients above the age of 13 years [12].

Most common isolate in wound infections was *Staphylococcus aureus* (26.7%) followed by *Pseudomonas sp*. (16.4%) and *E. coli* (11.9%). A similar study conducted in Tertiary Hospital in Benin City, Nigeria by Christopher Aye Egbe et al and in Nigeria by Akinjogunla OJ, et al. supported the result, as *Staphylococcus aureus* (37.8%) was the most commonly isolated bacteria followed by *Pseudomonas sp.* (27%) and *E. coli* (14.9%) [13,14]. In vitro sensitivity testing of this study showed that Linezolid was the most effective antibiotic against Gram positive bacteria and Amikacin for Gram negative bacteria.

These data are similar with those reported by a study carried out in Trivandrum, India by Asha Konipparambil Pappu et al. which showed that Linezolid and Vancomycin were the most efficient antibiotics for Gram positive bacteria and Amikacin was most effective antibiotic for Gram negative bacteria [15].

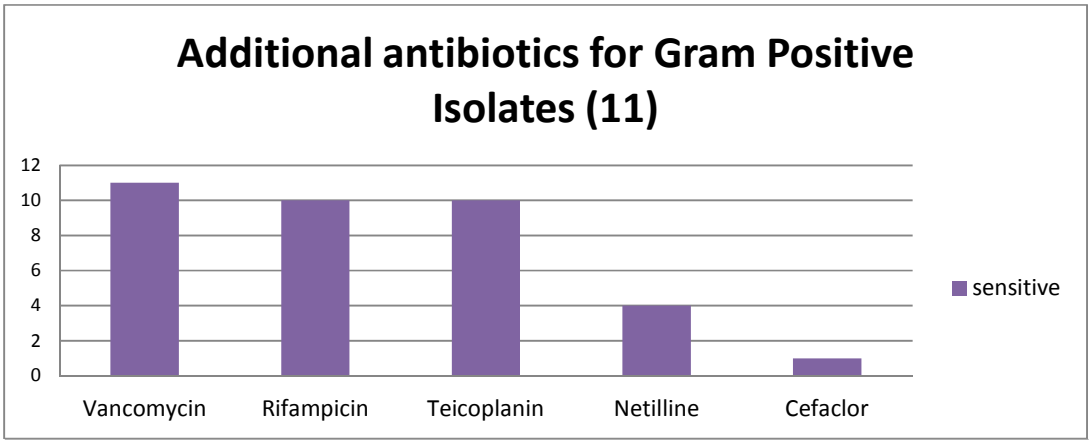

Fig. 4. Sensitivity of Gram positive isolates to higher antibiotics

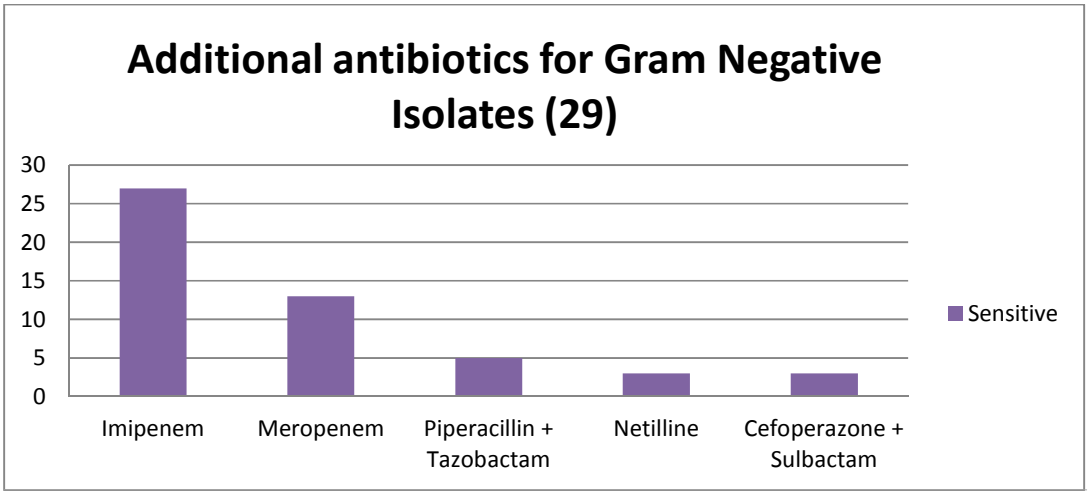

Fig. 5. Sensitivity of Gram negative isolates to higher antibiotics

For *Staphylococcus aureus*, the most effective antibiotic was Linezolid whereas least effective was Cefotaxime. This result was supported by Anbumani N et al who also reported that Vancomycin was most effective antibiotic for *S. aureus* [16].

5. CONCLUSION

The most common isolate in wound infection was *Staphylococcus aureus* followed by Gram negative fermentative and non-fermentative bacilli and *Enterococcus sp.* Linezolid and Ampicillin + Sulbactam were the most effective antibiotics for Gram positive, while Amikacin and Netilline for the Gram negative bacterial strain.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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