

ORIGINAL ARTICLE

Bacteriology of Wound Infections and the Antimicrobial Susceptibility Pattern among the Isolates

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Abstract

Objectives: To study the causative agents of wound infections and to report the susceptibility pattern of drugs among the isolates. **Materials & Methods:** A cross-sectional study was conducted in the department of microbiology at a tertiary care hospital at Government Medical College, Akola over a period of one year from January 2016 to December 2016. A total of 324 wound samples were collected and further processed according to the standard Microbiology guidelines. **Results:** Of the 324 samples, 201 were culture positive and rest (123) were culture negative. Out of 201 culture positive isolates, 103 were Gram positive and 98 were Gram negative. In Gram positive isolates, *Staphylococcus aureus* was predominant (91.26%) followed by *Enterococcus* species (6.7%) and *Streptococcus* species (1.9%). Vancomycin was found to be the most effective drug against Gram positive organisms. In Gram negative, *Escherichia coli* (34.69%) was predominant followed by *Klebsiella* (28.57%) and *Pseudomonas* species (15.30%). Imipenem was found to be the most effective drug against Gram negative organisms. **Conclusions:** The study showed increasing antibiotic resistance in Gram-positive and Gram-negative isolates which leads to the failure of treatment. Thus, this study will be of great help for the clinicians for prescribing the suitable antibiotics depending on the susceptibility pattern and thus, improves outcome.

Keywords: Wound infections, antibiotic resistance, bacterial infections

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Introduction

Skin being the largest organ in the human body plays an important role in the sustenance of life through water, electrolyte and temperature regulation¹. The primary function of intact skin is to control microbial populations that live on the skin surface and to prevent underlying tissue from becoming colonized and invaded by potential pathogens². Wound is defined as a breakdown in the protective function of the skin and loss of continuity of epithelium with or without loss of underlying connective tissue³. Wound can be infected by a variety of microorganisms ranging from bacteria to fungi and parasites as well as virus. The most common organisms are *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*,

Klebsiella spp and *Acinetobacter* spp. It is one of the most common hospital acquired infections and results in sepsis, limb loss, long hospital stays and higher costs¹. It remains an ongoing problem which although, cannot be completely eradicated but can be minimized by taking prompt control measures. Antibiotics, although, have been of great value in treatment and in prophylaxis to prevent infections, the timing of administration, choice of antimicrobial agent, durations of administration have clearly defined the value of antibiotics in reducing wound infections⁴. Advance in control of infection have not completely eradicated the problem of the wound infection because of development of drug resistance⁵. Hence, the present study was conducted to determine the bacteriological profile of wound infection and

their antimicrobial susceptibility pattern. This would help the clinicians in appropriate selection of antibiotics especially against hospital acquired infections.

Materials and Methods

It is a cross-sectional study which was carried out in the Department of Microbiology at tertiary care center, Akola, Maharashtra during the period of January 2016 to December 2016. A total of 324 samples from patients of wound infections were collected and were processed according to the standard laboratory guidelines. Two pus swabs were collected; one for the direct microscopy and the other for culture. The pus specimens were cultured onto the MacConkey agar and Blood agar plates and incubated overnight at 37°C. The culture plates were examined for bacterial growth and identified using standard microbiological techniques such as colony characteristics, staining reactions and biochemical properties. The antibiotic susceptibility test of all isolates was then performed by Kirby Bauer's disc diffusion method on Mueller Hinton agar using Clinical Laboratory Standard Institute (CLSI) guidelines⁶

Results

Table 1: Organism wise distribution of culture positive isolates

Organisms	Number	%
<i>Staphylococcus aureus</i>	94	91.26
<i>E.coli</i>	34	34.69
<i>Klebsiella sp.</i>	28	28.57
<i>Pseudomonas sp.</i>	15	15.30
<i>Proteus sp.</i>	10	10.20
<i>Enterococcus sp.</i>	7	6.7
<i>Citrobacter sp.</i>	5	5.10
<i>Acinetobacter sp.</i>	4	4.08
<i>Enterobacter sp.</i>	2	2.04
<i>Streptococcus sp.</i>	2	1.9

A total of 324 samples were collected from the patients of wound infections. Out of them 172 were males and 152 were females. Out of total 324 samples, 274 were indoor patients and 50 were outdoor patients whereas 102 of the OPD patients and 19 of the indoor patients had no growth in culture. Out of 201 culture positive isolates, 103 were Gram positive and 98 were

Gram negative. In Gram positive isolates, *Staphylococcus aureus* was predominant (91.26%) followed by *Enterococcus species* (6.7%) and *Streptococcus species* (1.9%). In Gram negative, *Escherichiacoli* (34.69%) was predominant followed by *Klebsiella* (28.57%) and *Pseudomonas species* (15.30%). This data is shown in the table no. 1. Vancomycin was found to be the most effective drug against Gram positive organisms and Penicillin was ineffective for them. Among the 65 *Staphylococcus isolates*, Linezolid and Amikacin showed highest sensitivity followed by Tetracycline (Table-2). Imipenem was found to be the most effective drug against Gram negative organisms and Ceftriaxone was found to be less sensitive against these organisms (Table-3). *Pseudomonas isolates* were mostly sensitive to Imipenem resistant to Cefepime (Table- 4).

Table-2: Sensitivity pattern (Gram +ve) isolates

Drugs	Sensitivity	Resistant
Ciprofloxacin	45	55
Erythromycin	25	60
Clindamycin	40	36
Linezolid	98	2
Tetracycline	97	3
Teicoplanin	97	3
Vancomycin	100	0
Amikacin	98	2
Cefoxitin	35	65
Cotrimoxazole	95	5
Penicillin	1	99

Table-3: Sensitivity pattern of (Gram-ve) isolates

Drugs	Sensitivity	Resistant
Ciprofloxacin	34	28
Ceftriaxone	10	23
Ceftazidime	13	59
Gentamycin	42	14
Amikacin	51	12
Imipenem	68	11
PiperacillinTazobactam	36	27
Colistin	4	0

Discussion

In our study, out of the 324 samples, 201(62.03%) showed bacterial growth which is correlating with study carried out by by

Shrestha et al at (60.20%)¹. Studies like Neelima et al⁷, Rai et al;⁸, Ananthi et al;⁹ and reported it to be 59%, 58% and 59.59% respectively which is lower than our study. Other studies by Sultana et al¹⁰ and Roy et al;¹¹ reported it to be 83.65% and 92% respectively which is higher than our study. Maximum numbers of patients were included in the age group 15-40, which is correlating with studies like Azene et al;¹².

Table 4: Sensitivity pattern of the *Pseudomonas* isolates

Drugs	Sensitivity	Resistant
Imipenem	14	1
Amikacin	13	4
Gentamycin	10	4
PiperacillinTazobactam	10	5
Ciprofloxacin	10	5
Cefotaxime	2	2
Ceftazidime	5	10
Ampicillin	12	3
Aztreonam	10	3
Cefepime	1	15
Piperacillin	12	2
Tobramycin	11	1

Our study showed male preponderance (62.3%) which may be due to higher involvement of them in physical outdoor works for earning livelihood as compared to females and more chances of injuries during these activities.³ This percentage was less than the study carried out by Mahat et al;¹³ (78.18%) and Shrestha et al¹ (73.56%). Another study by Bankar et al;¹⁴ and Sharma et al (46%)¹⁵ reported it to be 59.53% and 46% respectively which is less than our study. Study by Mullet et al;¹⁶ showed female preponderance which is not correlating with our study. In our study, *Staphylococcus aureus* was found to be the predominant pathogen which is similar to the study carried out by Chaudhary et al¹⁷ and Sangwan et al;¹⁸. It was followed by *Escherichia coli*, *Klebsiella* and *Pseudomonas* similar to the study carried out by Mordi et al¹⁹ and Bhatt et al²⁰. Whereas the study by Reddy et al²¹ and Trojan et al²² showed *E. coli* to be the predominant pathogen and a study by Pondei et al²³ reported *Pseudomonas* to be the predominant pathogen. *Staphylococcus aureus* is the most commonly reported pathogen because it is a major cause of soft tissue infection in hospitalized patients. It may be due

to contamination of the surgical instruments which originates from the environment. *Staphylococcus aureus* is a common bacterium on surfaces, and hence when the disruption of natural skin barrier occurs, it will easily find their way into wounds and will cause infection. In hospital the sources of *Staphylococcus aureus* may be the inanimate objects, health care workers, and other patients. Further, due to presence of the *S. aureus* as normal flora of human body, the endogenous infections are also possible.⁸ The nasal carriage of *Staphylococcus aureus* is the main risk factor for it to be the most important pathogen for wound infection since carriers are two to nine times more likely to acquire *Staphylococcus aureus* wound infection than noncarriers¹. *Staphylococcus aureus* colonize the human skin, nails and nares and disseminate via physical contact and aerosols. *Staphylococcal* invasion is generally caused due to breaches in local defense mechanism, like skin cuts or hair follicle trauma, which manifests as abscess formation and severe inflammation of surrounding tissues.¹⁵

Our study shows Vancomycin to be the most sensitive drug among the gram positive isolates which is correlating with study by Bessa L et al²⁴. Penicillin to be least effective similar to Giddiet et al;²⁵ Vancomycin is a unique glycopeptides and acts by inhibiting the second stage of cell wall synthesis of susceptible bacteria. It alters cell wall permeability and target D-alanine side chain²⁶. It selectively inhibits ribonucleic acid synthesis and acts by binding irreversibly to the terminal d-alanyl-d-alanine of bacterial cell wall precursors²⁷. The resistance of the gram positive isolates to Penicillin is due to the production of penicillinase which hydrolyses the β -lactam ring and inactivates the antibiotic and produce resistance¹³.

Conclusion

Wound infections are one of the most common hospital acquired infection causing significant morbidity and mortality. Results obtained from the study will help the policy makers in infection control measures and also it will prevent drug resistance in hospitals as well as in the community. Although complete eradication of wound infection is not possible however, adopting the preventive measures, hand hygiene

practices, proper care of wounds the incidence of wound infections can be minimized. Our study concludes the importance of aggressive debridement, medullary fixation with nails wound closure and immediate antibiotic therapy. Medullary fixation not only stabilizes the bone but also minimizes the infection, hospital stay, postoperative pain, and facilitates early ambulation. It is further maintains limb length, minimizes angular deformities and promotes mobilization of joints. Primary / early skin cover not only covers the soft tissue and bone but also protects from secondary infection and improves vascular bed so that early union is facilitated. Based on our results, we recommend primary medullary fixation of open fractures of long bones along with early soft tissue cover following wound debridement and early antibiotic therapy.

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