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Bacteriology of Pyogenic Wound Infections in a Tertiary Care Hospital

Estibeiro Mendonca Anita Sandhya[1], Rodrigues Savio[2]
[1](Department of Microbiology, Goa Medical College, Bambolim, Goa, India)
[2](Department of Microbiology, Goa Medical College, Bambolim, Goa, India)
Corresponding Author: Estibeiro Mendonca Anita Sandhya

Abstract: *Diagnosis and treatment of wound infections is a challenge to Clinicians and the Microbiology Laboratory. The present study was undertaken to determine a clinico - bacteriological correlation of pyogenic wound infections. Cultural analysis was undertaken using solid and liquid culture media, All bacterial species isolated were subjected to antimicrobial susceptibility pattern. A total of 300 samples were processed and bacteria were isolated in 73.6% cases. Monomicrobial etiology was observed in 84.6% cases. The commonest bacteria isolated were Staphylococcus aureus (17.8%), followed by Acinetobacter baumanii and Pseudomonas aeruginosa (13.2% each). High resistance was observed to Amoxycillin (56.5%) in Gram Positive bacteria and to Cephalosporins (71.2%) among Gram Negative bacteria. Types of samples yielding bacterial growth were predominantly pus (35.3%) and slough (25.8%). Males accounted for 55.2% of the total culture positive cases. Older age group patients contributed to 37.6% of the total culture positive subjects. A large majority (93.2%) were indoor admitted patients. Patients under surgical care units were 55.7%, while 11.8% were from Burns Unit and 8.1% from Plastic Surgery. Analysis of wound microbiology is critical towards successful management. Knowledge of the antibiotic sensitivity pattern of the invading pathogens will guide the treating doctor in rational selection of antibiotics.*

Key words: *Wound, pus, culture, antimicrobial sensitivity pattern*

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I. Introduction

Skin is an important and crucial organ in the human body, which not only regulates fluid, electrolyte balance and temperature but also provides protection against external deleterious agents, principally, microorganisms. Disruption in the integrity of the skin epithelium results in wound formation.[1]

Wound provides a conducive environment for microbes to colonise, proliferate and cause infection. Bacteria present as commensals on the skin are capable of causing infection. An infected superficial wound may extend to the subcutaneous tissues and delay healing. The extent of wound infection is dependent on various host factors, including type, size and depth of the wound, level of blood perfusion and overall immunity of the patient. Severity of the wound is also determined by the infecting pathogens along with virulence factors expressed by them.[2]

Wounds can be infected by a large array of bacterial pathogens, both Gram Positive and Gram Negative. Notorious Gram Positive bacteria include Staphylococcus aureus, Streptococcus pyogenes and Enterococcus. Various Gram Negative bacteria associated with wound infections include members of the Enterobacteriaceae family and non fermenting Pseudomonas and Acinetobacter.

The emergence of multidrug resistance in bacteria has posed challenges in the management and control of wound infections, reducing treatment options and adding to the overall patient morbidity and mortality. A knowledge of wound bacteriology is crucial to the treating surgeon in optimal management and selection of appropriate antimicrobial therapy.

The present study was therefore undertaken to determine the bacterial etiology of wounds, both superficial and deep, the antibiogram pattern of the bacteria isolated and to obtain a clinico – bacteriological correlation.

II. Material And Methods

A total of 300 wound samples received for aerobic bacterial culture and sensitivity, from different wards/ units and Out Patient Departments, of Goa Medical College and Hospital, were included in the study.

All samples were subjected to primary gram staining, to look for pus cells and organisms. Specimens were inoculated on to Blood agar and MacConkey agar along with Glucose broth and incubated at 37^{o}C for 24 hours. After incubation, the culture plates were examined for bacterial growth and identified using standard microbiological techniques.[3] These included colony morphology, gram staining reaction and biochemical

parameters. The Glucose broth was subcultured on to solid media, if primary isolation did not yield bacterial growth. Antimicrobial susceptibility testing was performed on all isolates, by Kirby Bauer's disc diffusion method, as per CLSI guidelines.[4]

III. Results

Out of 300 pyogenic wound samples processed, a positive bacterial culture was obtained in 221 cases ie. 73.6%. Among the 221 culture positive samples, a single bacterial isolate was encountered in 187 (84.6%) cases, while polybacterial etiology was seen in 34 cases (15.4%).

Table No. 1 depicts the various bacterial isolates obtained in the study. Gram Positive bacteria accounted for 31.1% of the total (85 out of 273), while Gram Negative bacilli predominated ie. 68.9% (188 out of 273). Among the Gram Positive bacteria, Staphylococcus aureus predominated (57.6%), followed by Enterococcus (27.1%). Acinetobacter baumanii and Pseudomonas aeruginosa contributed to 19.1% each, of all Gram Negative bacilli, followed by Klebsiella pneumoniae (17.1%) and Escherichia coli (15.9%). Concomitant isolation of bacteria in polybacterial etiology cases is depicted in Table No. 2. Two organisms were isolated in 47.1% cases, while three organisms were encountered in 52.9% subjects.

Table no 1: Bacterial isolates encountered in the study

Organisms isolated	Number	Percentage
GRAM POSITIVE COCCI	85	31.1
Methicillin Sensitive Staphylococcus aureus	19	6.9
Methicillin Resistant Staphylococcus aureus	30	10.9
Coagulase Negative Staphylococci	13	4.8
Enterococcus	23	8.5
GRAM NEGATIVE BACILLI	188	68.9
Escherichia coli	30	10.9
Klebsiella pneumoniae	32	11.7
Citrobacter species	22	8.1
Enterobacter species	25	9.2
Proteus species	7	2.6
Acinetobacter baumanii	36	13.2
Pseudomonas aeruginosa	36	13.2
TOTAL	273	100

Table no 2: Concomitant isolation of bacteria in Polymicrobial etiology cases

Polybacterial Group	Number	Percentage
Two Gram Positive Cocci	1	2.9
Two Gram Negative Bacilli	9	26.5
One Gram Positive Coccus and One Gram Negative Bacillus	6	17.7
Three Gram Negative bacilli	3	8.8
One Gram Positive Coccus and Two Gram Negative Bacilli	15	44.1
Total	34	100

Antimicrobial sensitivity pattern of the bacteria can be observed in Table Nos. 3 and 4. A high resistance was observed to Amoxicillin (56.5%) in Gram positive bacteria and to Cephalosporins (71.2%) in Gram Negative bacteria.

Table no 3: Antimicrobial sensitivity pattern of Gram Positive Cocci (Percentage)

Antimicrobial	S. aureus	CONS	Enterococcus
Penicillin	20.4	23.1	30.4
Ampicillin	32.6	30.8	30.4
Azithromycin	63.2	61.5	-
Amoxycillin	40.8	46.2	-
Trimethoprim-Sulphamethoxazole	75.5	76.9	-
Chloramphenicol	63.2	61.5	-
Ciprofloxacin	63.2	61.5	60.8
Levofloxacin	63.2	69.2	65.2
Gentamicin	55.1	46.2	47.8
Rifampicin	87.7	-	-
Doxycycline	75.5	69.2	-
Tetracycine	-	-	65.2
Clindamycin	75.5	76.9	-
Linezolid	87.7	84.6	86.9
Cefoxitin	38.8	46.2	-
Vancomycin	100	100	100

Table no 4: Antimicrobial sensitivity pattern of Gram Negative Bacilli (Percentage)

Antimicrobial	Enterobacteriaceae	Pseudomonas	Acinetobacter
Ampicillin	20.6	-	-
Cefazolin	29.3	-	-
Gentamicin	52.6	55.5	27.8
Amikacin	73.2	69.4	41.7
Tobramycin	52.6	50.0	27.8
Amoxycillin Clavulanate	25.8	-	-
Ampicillin Sulbactam	34.4	-	27.8
Piperacillin Tazobactam	63.7	69.4	50.0
Cefuroxime	29.3	-	-
Cefepime	30.2	27.8	27.8
Ceftriaxone	30.2	-	27.8
Ceftazidime	30.2	27.8	27.8
Ciprofloxacin	63.7	50.0	30.2
Levofloxacin	-	50.0	-
Imipenem	73.2	69.4	52.6
Meropenem	73.2	69.4	52.6
Trimethoprim Sulphamethoxazole	52.6	-	41.7
Aztreonam	63.7	66.7	-
Colistin	-	80.6	77.8
Chloramphenicol	63.7	-	-
Doxycycline	-	-	30.2
Netilmycin	-	41.7	-

Predominant type of samples yielding positive cultures were pus (35.3%; n=78) and slough (25.8%; n=57), followed by swabs (17.6%; n=39) and aspirates (12.2%; n=27). Other samples yielding bacteria included tissue (4.1%; n=9), curetting and cystic fluid (1.8%; n=4, each) and cellulitic fluid (1.4%; n=3).

The male : female ratio among culture positive cases was 1.2:1, males being 55.2% of the total. Although no age was spared from wound infections, older age group individuals in the age bar, 51 years and above contributed to 37.6% of the total (Table No. 5).

Table no 5: Age and Sex distribution of culture positive cases

Age in years	Male		Female		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
0 – 10	7	53.8	6	46.2	13	5.9
11 – 20	17	56.7	13	43.3	30	13.6
21 – 30	15	55.6	12	44.4	27	12.2
31 – 40	18	56.3	14	43.7	32	14.4
41 – 50	19	52.8	17	47.2	36	16.3
51 – 60	21	55.3	17	44.7	38	17.2
> 60	25	55.6	20	44.4	45	20.4
Total	122	55.2	99	44.8	221	100

Among the culture positive subjects, a large majority ie. 93.2% were admitted in various wards of the hospital, while outdoor patients were only 6.8% of the total. Unit/Department wise distribution of culture positive cases can be seen in Table No. 6. Majority of patients were seen by the Surgery Department (55.7%), followed by Burns Unit (11.8%) and Plastic Surgery Unit (8.1%).

Table no 6: Unit/Department wise distribution of Culture Positive cases

Ward/Unit	Number	Percentage
Surgery	123	55.7
Burns	26	11.8
Plastic Surgery	18	8.1
Orthopaedic	9	4.1
ENT	10	4.5
Obstetric and Gynaecology	15	6.8
Medicine	4	1.8
Dermatology	12	5.4
Paediatric	4	1.8
Total	221	100

IV. Discussion

Pyogenic wound infections are common conditions, for which patients seek medical attention. These wound infections may extend from the skin and soft tissue, to involve deeper areas including muscle, bone and even internal organs. Pyogenic wound infections are often complicated by situations related to vascular and neurological problems, including poor arterial circulation and peripheral neuropathy. Proper management of such patients requires accuracy of cultural diagnosis and an understanding of the wound bacteriology.

In the present study, 300 pyogenic wounds were evaluated for their bacteriological profile. Bacterial culture positivity was seen in 73.6% cases. Hanumanthappa et al obtained positive cultures in 56% cases.[5] Polybacterial etiology was observed in 15.4% cases in the present study. Similar finding of 18.5% polybacteria was seen in the study of Azene and Beyene in 2011.[6] However, Hanumanthappa et al observed growth of two bacterial isolates in 3.2% cases.[5] In the present study, in polybacterial cases, not more than three organisms were isolated concomitantly. Hanumanthappa et al isolated not more than two bacteria together.[5] However, Jeffrey et al, in their study, encountered an average involvement of 5-6 organisms in their infective wounds.[7]

In the present study, Staphylococcus aureus was the most frequent pathogen to be isolated (17.8%). Similar finding was observed in the studies of Kensekar et al[8] and Hanumanthappa et al.[5] Barbos et al opine that nasal carriage is an important risk factor for infection. The authors observed that carriers were 2-9 times more likely to have their wounds infected by Staphylococcus.[9] Pseudomonas aeruginosa and Acinetobacter baumanii were isolated each, in 13.2% cases. This finding is similar to that of Musaddiq et al.[10] Collectively, enteric pathogens were isolated in 42.5% cases in the present study, as was also the case in the study of Musaddiq et al.[10]

Staphylococcus aureus isolates were resistant to Amoxycillin (59.2%) in the present study. MRSA occurrence was 61.2%. Similar finding was upheld by Hanumanthappa et al.[5] All strains of Staphylococcus aureus were sensitive to Vancomycin. These observations are an indication that empiric antibiotic treatment against MRSA is warranted. Choice of antibiotic needs to be guided by antibiogram pattern. Among Gram Negative isolates, most effective antibiotics were Meropenem, Amikacin, Quinolones and Colistin, least effective being the Cephalosporins. Resistance to Cephalosporins was also observed by Goswami et al.[11] Increased bacterial resistance has set in due to irrational, inappropriate and inadequate use of antimicrobial agents, often available off the counter.

Males predominated in the present study (55.2%). Similar finding of male predominance was observed by Verma et al.[12] This is probably related to outdoor engagements among males, with more chances of them being prone to accidents. Occurrence of wound infections gradually increased with age in the present study, probably related to a weakened immune response and presence of associated comorbid conditions.

Indoor patients predominated in the present study (93.2%). However no significant difference was found in the culture positive cases among inpatients and outpatients, in the study conducted by Shrestha et al.[13] Occurrence of wound infection is multifactorial. Important factors are chronicity and severity, due to which probably, patients require hospital admission. Majority of patients in the present study were from Surgical wards and OPDs (55.7%). Similar finding was observed by Shrestha et al, in their study.[13] It stands to reason that the General Surgeons are the appropriate choice for treatment of pyogenic wound infections.

V. Conclusion

Proper management of wound infections in patients requires careful sampling and processing, stringent antibiotic policy to guide appropriate selection of antibiotics, proper and dedicated care of the wounds and education on personal hygiene. It is imperative to have a baseline knowledge of the antibiogram pattern of the common bacteria in a locality, as it will guide the treating doctor, to select the most effective antibiotic, in case empiric treatment is an important and unavoidable option.

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