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Original Research Article

Bacterial Profile and Antibiogram of Post-Operative Wound Infections in a Tertiary Care Hospital, Chennai

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Abstract:
Introduction: Post-operative wound infections are the second most common nosocomial infections to be recorded and they represent a significant global public health concern. Significant morbidity and mortality as well as increased treatment costs and length of hospital stay are caused by postoperative wound infections.
Objectives: To assess the bacterial profile and their antimicrobial susceptibility pattern of postoperative wound infections.
Methods: Cross sectional study was conducted for a period of one year (January 2023 to January 2024) in the Department of Microbiology at ACS Medical College and Hospital, Chennai. The study included 182 pus and tissue samples from post-operative wound patients. Samples were processed and isolates were identified by Standard Microbiology guidelines. Antibiotic susceptibility testing (AST) was done by the Kirby- Bauer disc diffusion method and zone size was interpreted based on Clinical and Laboratory standard institute (CLSI) guidelines.
Results: Out of 182 isolates, 60.4% were from males. Among the 182 isolates, E. coli (19.2%) and Klebsiella pneumoniae (19.2%) were the most common pathogens followed by Staphylococcus aureus (18.1%), Pseudomonas aeruginosa (15.9%). The least organism isolated was Providencia species (1.6%). Monomicrobial growth was seen in 94% isolates. Out of 182 isolates, 37.3% were gram positive and 68.5% were gram negative isolates. The antibiotic to which gram negative bacteria reported maximum resistance was ceftazidime (56.7%) and the antibiotic that reported maximum sensitivity was cefepime (73.1%).The antibiotic to which gram positive bacteria reported maximum resistance was ciprofloxacin (50%) and the antibiotic that reported maximum sensitivity was vancomycin (69.3%).Among the Gram Negative Bacteria (GNB) organisms, majority of Extended Spectrum Beta Lactamases (ESBL) producers were Klebsiella pneumoniae (42.8%) and Amp-C producers were Pseudomonas aeruginosa (37%).
Conclusion: The incidence of post-operative wound infections will undoubtedly decline with rigorous adherence to infection and prevention control practices, maintenance of good hand hygiene and appropriate preoperative, intraoperative and postoperative patient care.
Keywords: Post-operative Wound Infection, Antibiotic Sensitivity Testing, Antimicrobial Resistance, Hospital Acquired Infection.

Introduction

Post-operative wound infections are frequent surgical complications with an incidence rate of 2-20%. They are one of the most common nosocomial infections [1] and are responsible for elevated hospital expenses, prolonged hospital stays, and increased rates of mortality and morbidity [2]. Exogenous and endogenous microorganisms that infiltrate the surgical site during procedure (primary infection) or afterwards (secondary infection) are typically the source of these illnesses[3].Factors like age, sex, diabetes, stress, nutrition, and oxygenation are just a few of the numerous variables that could slow down the wound healing process[4].Due to inadequate preoperative care, wound contamination, inappropriate antibiotic selection, or the impaired patient's immunity to fight off infection, bacteria can thrive in the surgery site and cause wound infections[5]. The selection of empirical therapy has become more challenging and expensive due to the advent of bacterial Antimicrobial resistance (AMR)[6]. With antibiotic resistance as a growing concern, a procedure for evaluating microorganisms for culture and sensitivity is critical to providing proper therapy and preventing further complications[7]. Methicillin Resistant Staphylococcus Aureus (MRSA), Coagulase negative staphylococcus species (CoNS), Vancomycin Resistant Enterococci (VRE), Escherichia coli (E.coli), Acinetobacter baumanii, and Pseudomonas aeruginosa are the multidrug resistance organisms that increase mortality and morbidity[8]. Post-operative wound infections mostly rely on Antibiotic Sensitivity Testing (AST) provided by clinical labs or epidemiological data from continuous hospital surveillance [9].

Materials and Methods:

Study Design: A cross-sectional study was conducted over a period of one year from January 2023 to January 2024 at ACS Medical College & Hospital, Chennai a tertiary care hospital, after obtaining approval from the Institutional Ethical Committee. (Approval number: 1099/2024)

Study Population: 182 clinical isolates from post-operative wound patients

Exclusion Criteria: Patients who have given repeated pus samples.

Study Sample: Pus or tissue samples collected from patients were subjected to microbiological processing in the laboratory.

Collection of pus from swab: Open wounds containing surface material were thoroughly cleaned and irrigated with sterile saline. About five times, the swab was gently rolled over the wound's surface, paying particular attention to any areas showing signs of pus or tissue. Two sterile cotton swabs were used for dry wounds, which were moistened with sterile saline. Swabs were transported to the lab for processing.

Microbiological Processing: All samples were transported to the laboratory and were processed for gram stain and culture was done on 5% sheep blood agar and MacConkey agar using Standard Microbiology techniques. Plates were incubated at 37°C for 24 hours. Identification of the isolates were done using Standard Microbiology techniques.

Antimicrobial susceptibility testing: The susceptibility test was performed on Mueller-Hinton agar (MHA) using the Kirby Bauer disk diffusion method, according to Clinical and Laboratory standards Institute (CLSI) M100-Ed33 2023 guidelines. The antibiotics (Himedia Laboratories Pvt Ltd) are ampicillin sulbactam (10/10µg), amikacin (30µg), cefepime (10µg), ceftriaxone (10µg), ceftazidime (30µg), ciprofloxacin (5µg), imipenem (10µg), meropenem (10µg), piperacillin tazobactam(75/100µg), gentamycin (30µg) were used for the GNB organisms and penicillin (10U), vancomycin (30µg), erythromycin(15µg), clindamycin(2µg), linezolid (30µg), cefoxitin (10µg) were used for the Gram Positive Cocci (GPC) organisms and diameter of the zone of inhibition was measured and interpreted using the CLSI M100 Ed33 2023 guidelines[13].

ESBL detection method: Gram negative bacilli having a reduced zone of inhibition against ceftazidime, cefotaxime and ceftriaxone were suspected of producing ESBLs hence confirmed by combination disk method.

Combination disk test: The antibiotics used in this test were ceftazidime (30µg), ceftazidime/ clavulanic acid (30/10µg). Four to five colonies with identical morphology were inoculated into 5 ml peptone water and incubated at 37°C for 4-6 hours until turbidity equalled that of the McFarland 0.5 standard ($1.5x10^8$ CFU/ml). The lawn culture was applied to MHA plates and disks were placed 50mm apart. The zone of inhibition was measured around the disk. A 5mm increase in zone of inhibition in a disk containing clavulanic acid than cephalosporin was an ESBL producer.

Amp-C β-lactamase enzyme detection Using Disk approximation test: Prepare 0.5 McFarland bacterial suspensions from an overnight blood agar plate. Inoculate surface of MHA plate using this suspension as per standard Disk diffusion method. Place a 30µg Ceftazidime disk at the centre of the plate and 20µg Amoxicillin clavulanate disk, 10µg Imipenem disk, 30µg Cefoxitin disk at a distance of 20mm from ceftazidime disk incubate overnight at 37°C. Examine the plate for any obvious blunting/ flattening of the zone of inhibition between Ceftazidime disk and inducing substrate (IMP, CX, AMC) if there is any blunting / flattening of the zone consider as positive for Amp-C producer.

Statistical Analysis: Using SPSS Software. P value < 0.05 is statistically significant.

Results

In the present study, total 182 isolates were obtained from post-operative wound patients. In the peak incidence of post-operative infection, majority of patients belonged to age group of 41-60 years (47%) followed by >60 years of age (27.5%) and then followed by 21-40 years of age (Table 1). Among 182 isolates, males (60.4%) were more commonly affected than females (39.6%) (Table 2). Many patients were admitted to the general surgery department (42.9%) (Table 3). Out of 182 clinical isolates, monomicrobial growth was seen in 171 isolates while 11 isolates showed polymicrobial growth (TABLE 4). Out of 182 isolates, 37.3%

were gram positive bacteria and 68.5% were gram negative bacteria (Table 5). Among the 182 isolates, Escherichia coli and Klebsiella pneumoniae (19.2%) was the most common pathogen followed by Staphylococcus aureus (18.1%), CoNS (15.9%), Pseudomonas aeruginosa (14.8%) respectively (Table 6). The antibiotic to which most gram negative bacteria reported maximum resistance was ceftazidime (56.7%) and that antibiotic reported maximum sensitivity was cefepime (73.1%) (Table 7). The antibiotic to which gram positive bacteria reported maximum resistance ciprofloxacin (50%). The antibiotic to which gram positive bacteria showed maximum sensitivity was vancomycin (68.3%) (Table 8). Amongst the Gram negative bacilli isolates 36 (28.8%) isolates were observed as ESBL producers, 22 (17.6%) isolates were observed as Amp-C producers. Among the beta-lactamase producing gram negative organisms, majority of ESBL producers were Klebsiella pneumoniae (42.8%) and E. coli (31.4%) isolates. A majority of pseudomonas aeruginosa (37%) and E.coli (17.1%) isolates were Amp-C producers (Table 9).

Table 1: Age wise distribution of Post-operative patients

Age category	No of isolates	Percentage (%)
≤ 20 years	9	4.9
21-40 years	38	20.9
41 – 60 years	85	46.7
>60 years	50	27.5
Total	182	100.0

Table 2: Gender wise distribution of post-operative patients

Gender	No of isolates	Percentage (%)
Male	110	60.4
Female	72	39.6
Total	182	100

Table 3: Ward wise distribution of post-operative patients

Ward	No of isolates	Percentage (%)
MSW	78	42.9
FSW	45	24.7
POW	23	12.6
MMW	15	8.2
FMW	5	2.7
OBG	5	2.7
ORTHO	4	2.2
PAEDIATRIC	3	1.6
DERM	2	1.1
ENT	2	1.1
Total	182	100

*****Note- Derm- dermatology, ENT- Ear Nose Throat, MSW- Male surgical Ward, FSW- Female surgical ward, MMW- Male medical ward, FMW- Female medical ward, OBG-Obstetrics & Gynaecology, POW- post operative ward.

Table 4: Shows number of isolates from clinical samples:

Organisms	No of isolates	Percentage (%)
Mono-microbial	171	94.0
Poly-microbial	11	6.0
Total	182	100

Table 5: Number of gram positive and gram negative bacteria:

Organism	No of isolates	Percentage (%)
Gram positive bacteria	68	37.3
Gram negative bacteria	125	68.5
Total	182	100

Table 6: Distribution of organisms causing post-operative wound infections:

Organisms	No of isolates	Percentage (%)
Gram positive organisms		
CoNS	29	15.9
Enterococcus faecalis	6	3.3
Staphylococcus aureus	33	18.1
TOTAL	68	37.3
Gram negative organisms		
Escherichia coli	35	19.2
Klebsiella pneumonia	35	19.2
Proteus species	14	7.7
Pseudomonas aeruginosa	27	14.8
Acinetobacter species	11	6.0
Providencia species	3	1.6
Total	125	68.5

*Note-Coagulase negative staphylococcus species

Table 7: Antibiotic sensitivity pattern in isolated Gram Negative isolates (n=125)

Antibiotics	Sensitive	Resistant
Piperacillin /Tazobactum(Pit) 100/10µg	37 (55.2%)	30 (44.8%)
Gentamycin (GEN) 10µg	47 (71.1%)	20 (29.9%)
Ciprofloxacin (CIP) 5µg	30 (44.8%)	37 (55.2%)
Imipenem (IMP) 10µg	38 (56.7%)	29 (43.3%)
Meropenem (MRP) 10µg	37 (55.2%)	30 (44.8%)
Ceftazidime (CAZ) 30µg	29 (43.3%)	38 (56.7%)
Cefepime (CPM)	49 (73.1%)	18 (26.9%)

Table 8: Antibiotic sensitivity pattern in isolated Gram Positive isolates (n=68)

Antibiotics	Sensitive	Resistant	P value
Cefoxitin(CX)30µg	68 (56.7%)	52 (43.3%)	0.145
Linezolid(LZ) 30µg	75 (62.5%)	45 (37.5%)	
Vancomycin(VAN) 30µg	82 (68.3%)	38 (31.7%)	
Ciprofloxacin(CIP) 5µg	60 (50%)	60 (50%)	
Cotrimoxazole(COT) 1.25/23.75µg	71 (59.2%)	49 (40.8%)	
Clindamycin(CD) 2µg	69 (57.5%)	51 (42.5%)	
Penicillin(P) 10U	68 (56.7%)	52 (43.3%)	

Table 9: Prevalence of ESBL and Amp-C isolates:

Organisms	ESBL positive	Amp-C positive
E. Coli (N=35)	11	6
Klebsiella Pneumonia (N=35)	15	4
Pseudomonas Aureginosa (N=27)	2	10
Proteus Species (N=14)	8	2
p-value	<0.001	0.071

Discussion

In this study, maximum culture positivity of patients was in the age group of 41-60 (46.7%). The results were similar to study by Roopashree et al [4] (45.63%) and Negi et al[1] (51.8%) which concluded that maximum no of culture positivity was in the age group, 41 – 60 years. As age advances there is more chances of poor wound healing due to low immunity and presence of Co-morbid illness. In this study, 60.4% were male patients; the results were similar to a study by R.K.C et al [10], where 63.16% were from males. But in a study conducted by Wondimagegn M. et al [17] 67.3% were female patients. In our study, most samples were from the general surgery department (42.9%) followed by postoperative wards. The results were similar to a study by Roopashree S et al [4], who reported that (40.63%) and Bandy A et al[8] reported 54.6% that most samples were received from the general surgery department. Mengesha et al [9] reported 72.9% of samples were received from Orthopaedic ward. Out of 182 samples, 171(94%) samples were monomicrobial while 11(6%) samples were polymicrobial growth.

Similar result was reported by Vikrant Negi et al[1], 125(91.2%) samples were monomicrobial and 7(5.1%) were polymicrobial growth, M.S.S Pradeep et al[5] reported 56.07% were single isolates and 12.14% were multiple isolates. In contrast, Nandita pal et al [18] reported 23.3% as monomicrobial and 36.7% as polymicrobial. Of the 182 bacterial isolates, 68.8% were gram negative and 37.3% were Gram positive isolates. In a similar study conducted by Mahat et al [7] and Goswami et al [16]. Gram negative bacteria were found to be prevalent. But in a study done by Amrita Shriyan et al [3], Gram positive organisms were 63% which is in discordant results. In this study, the predominant organism isolated was E. coli (19.2%) which is similar to study conducted by Bandy A et al [8] & Pooja Singh Gangania et al [12] who reported E.coli (16.3%). In Amrita Shriyan et al [3] study, Staphylococcus aureus (63%) was the most common pathogen isolated. Similarly Vikrant Negi et al [1] reported the most common isolate was Staphylococcus aureus (50.4%).

In the present study, Gram negative isolates showed high susceptibility of Cefepime (73.1%), Gentamycin (71.1%), Imipenem (56.7%), Piperacillin/Tazobactam (55.2%), and Meropenem (55.2%). Similar results were showed by M.S.S Pradeep et al[5] who reported Gentamycin(64.9%), Imipenem(75.4%), Meropenem(71.9%), Piperacillin/Tazobactam (52.6%) were found to be sensitive antibiotics against gram negative bacilli. In this study, Gram negative isolates reported maximum resistance of Ceftazidime (56.7%), Ciprofloxacin (55.2%).

Similar results by Mahat P et al[7] and Negi et al[1] who reported 73.4% and 40.6% were resistance to ciprofloxacin. In contrast, Bandy A et al [8] who reported 90.4% were resistant to ampicillin. Gram positive organisms showed high susceptibility to Vancomycin (68.3%), linezolid (62.5%). Similar results were observed by Amrita Shriyan et al [3], Worku et al [11] which showed Vancomycin (100%) and Linezolid (100%) were found to be sensitive antibiotics in Gram positive isolates.

Gram positive isolates reported maximum resistance to ciprofloxacin (50%) which is similar to Roopashree et al [4] who reported 66.03% were resistant to ciprofloxacin. In contrast, Goswami et al [16] who reported 29.8% were resistant to Penicillin.In this study, most common ESBL producers were Klebsiella isolates 15(42.8%) which is similar to Amrita Shriyan et al[3] that reported as 5(75%) of Klebsiella isolates. In Roopashree S et al[4] E. coli 28(48.2%) were the common ESBL producers.

In this study, the most common Amp-C producers were Pseudomonas isolates 10 (37%). A Similar study by Roopashree S et al [4] showed the majority of Pseudomonas 15(30%) was Amp-C producers. The incidence of postoperative sepsis in any hospital is heavily influenced by the case material, hospital atmosphere, irrational use, and antibiotic availability.

Conclusion

Post-operative wound infections remain a significant issue for both patients and surgeons, even with contemporary aseptic techniques in place. Hospitals act as a reservoir for SSIs.

They contain pathogenic microorganisms and multi-drug resistant organisms. Studying the bacteriological and antibiotic susceptibility profile of Post-operative wound infections might help pick appropriate antibiotics, lowering morbidity, mortality, and the rate of post-operative wound Infections. To determine the prevalence of the same, all wound infections must be regularly monitored using Root Cause Analysis (RCA). To reduce the rates of wound infection, strict compliance with the hospital's antibiotic policy infection and prevention control methods and the appropriate use of antibiotics must be deemed mandatory.

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Limitations: The limitation of this study was that it was unable to perform gene study due to limited sources.

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