Section: Microbiology

Original Research Article

BACTERIOLOGICAL SPECTRUM OF SURGICAL WOUND INFECTIONS

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Received : 31/05/2024
Received in revised form : 01/08/2024
Accepted : 16/08/2024

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DOI: 10.70034/ijmedph.2024.3.92

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2024; 14 (3); 511-514

ABSTRACT

Background: In spite of modern criteria of preoperative groundwork, antimicrobial prophylaxis, and operative procedure, postoperative/surgical site wound infections persist as a serious threat. So the aim of this study is Bacteriological Spectrum of Surgical Wound Infections.
Materials and Methods: This study was conducted in Department of Microbiology, Heritage Institute of Medical Sciences, Varanasi. The present study was carried out on the patients admitted in surgical wards. This study were included 200 cases. Out of 200, pus samples were 140 and wound swabs 60 were collected. The duration of study was 3 Years.
Results: This study included a total of 200 cases of surgical wound infections. Among them, 61% of cases involved patients under the age of 30, while the remaining 39% were from those aged 30 and above. Positive bacterial growth was observed in 42% of the cases, while the rest showed no growth. The most common organisms identified were Pseudomonas (33.4%), followed by Staphylococcus aureus (25%), Escherichia coli (15.4%), Proteus (8.4%), CONS (5.9%), Klebsiella spp. (4.7%), Acinetobacter baumannii complex (3.5%), Enterobacter (2.3%), and Citrobacter spp. (1.1%).
Conclusion: Gram negative pathogens are the most common cause of post-operative wound infections, with emergence of drug resistance against commonly used antimicrobial drugs.
Keywords: Surgical wounds, Bacterial spectrum, Antimicrobial Resistance.

INTRODUCTION

Infectious diseases are a major cause of illness and death.[1] When the body's primary defense mechanisms, such as the skin and mucous membranes, are compromised, microorganisms can invade and cause infections.[2] Wound infections, in particular, increase the risk of wound dehiscence and slow the healing process.[3] Traumatic injuries are the most common cause of wounds in hospitalized patients and can be classified as either accidental or intentionally induced. Hospital-acquired wounds, such as surgical incisions or those from intravenous devices, are intentionally induced, while non-intentionally induced wounds include conditions such as pressure ulcers.[4] Surgical interventions are the leading cause of wound infections in hospitals, specifically surgical site infections (SSI), which are classified into three types: superficial incisional SSI, deep incisional SSI, and organ-specific SSI.[5]

Developing countries have reported high rates of postoperative wound infections, significantly straining healthcare systems both health-wise and financially.[6-8] This has become a critical issue, highlighting the need for cost management systems.[9] There is an urgent requirement for surveillance programs to detect and diagnose SSIs, as well as to understand the antibiotic susceptibility patterns of the infecting organisms to minimize complications and morbidity.[10]

Timely and appropriate antibiotic treatment is currently the most effective way to prevent harm from bacterial infections. Laboratory isolation and susceptibility testing of organisms are crucial for diagnosing and selecting the appropriate antibiotics. However, the use and selection of antibiotics related to medical procedures and treatments can contribute to antimicrobial resistance, making the control of wound infections increasingly difficult due to widespread bacterial resistance to antibiotics.[10]

MATERIAL AND METHODS

Study Area: This study was conducted in Department of Microbiology, Heritage Institute of Medical Sciences, Varanasi.

Study Population: The present study was carried out on the patients admitted in surgical wards. This study were included 200 cases. Out of 200, pus samples were 140 and wound swabs 60 were collected.

Study Duration: The duration of study was 3 Years.

Data Collection: Specimens of pus and wound swabs were collected using sterile cotton swabs. Before sampling, the swabs were moistened with sterile saline and then applied to the wound surface in a "zig-zag" motion while being rotated between the fingers. The sample was taken from the entire wound area. The study included all patients from surgical wards with wound infections, regardless of age or gender. However, samples that were improperly labeled, stored for an extended period, or taken from non-surgical cases were excluded from the study.

Data Analysis: The data were analyzed by using Microsoft Excel.

RESULTS

This study included a total of 200 cases of surgical wound infections. Among them, 61% of cases involved patients under the age of 30, while the remaining 39% were from those aged 30 and above.

Positive bacterial growth was observed in 42% of the cases, while the rest showed no growth. The most common organisms identified were Pseudomonas (33.4%), followed by Staphylococcus aureus (25%), Escherichia coli (15.4%), Proteus (8.4%), CONS (5.9%), Klebsiella spp. (4.7%), Acinetobacter baumannii complex (3.5%), Enterobacter (2.3%), and Citrobacter spp. (1.1%).

Staphylococcus aureus exhibited the highest resistance to Penicillin (90.4%), followed by Ciprofloxacin (80.9%), Azithromycin, and Teicoplanin. Pseudomonas species showed the greatest resistance to Ceftazidime (82.1%) and Meropenem, followed by Ampicillin. Escherichia coli was most resistant to Amoxicillin-Clavulanate (100%), followed by Piperacillin-Tazobactam (69.2%) and Ceftazidime. Klebsiella species showed resistance to Gentamicin (75%).

Enterobacter species exhibited 100% resistance to both Ampicillin and Aztreonam, while Acinetobacter species showed 100% resistance to Ampicillin, Amikacin, Piperacillin-Tazobactam, and Cotrimoxazole. Proteus species displayed 85.7% resistance to both Ceftazidime and Ampicillin.

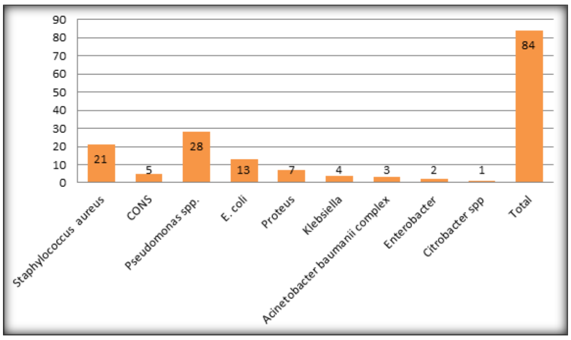

Figure 1: Distribution of cases according to isolates

Table 1: Distribution of cases according to gender

Gender	Number	Percentage
Male	100	50%
Female	100	50%
Total	200	100%

Table 2: Distribution of cases according to age group

Age Group	Number	Percentage
>30	78	39
<30	122	61
Total	200	100

Table 3: Distribution of cases according to culture growth

Culture	Number	Percentage
Positive growth	84	42
Negative growth	116	58
Total	200	100

Table 4: Distribution of cases according to bacteria

Isolates	Number	Percentage
Gram positive	25	29.7%
Gram negative	59	70.3%
Total	84	100%

Table 5

Isolates	Number	Percentage
Staphylococcus aureus	21	25%
CONS	5	5.9%
Pseudomonas spp.	28	33.4%
E. coli	13	15.4%
Proteus	7	8.4%
Klebsiella spp.	4	4.7%
Acinetobacter baumanii complex	3	3.5%
Enterobacter	2	2.3%
Citrobacter spp	1	1.1%
Total	84	100%

Table 6: Antibiotic resistant pattern of isolates

Antibiotics	Staphylococcus aureus (n=21)	CONS (n=5)	Pseudomonas spp. (n=28)	E. coli (n=13)	Klebsiella (n=4)	Citrobacter spp(n=1)	Enterobacter (n=2)	Proteus (n=7)	ACB complex(n=3)	Total (n=84)
Cefoxitin	7 (33.4)	2(40)	-	-	-	-	-	-	-	9
Amoxicillin-Clavulanate	20	3	22	13	2	1	1	2	1	65
Teicoplanin	14	4	-	-	-	-	-	-	-	18
Erythromycin	15	3	-	-	-	-	-	-	-	18
Clindamycin	17	4	-	-	-	-	-	-	-	21
Ceftazidime	-	-	23	11	2	1	1	6	0	44
Gentamicin	9	2	7	8	3	0	0	1	1	31
Ciprofloxacin	17	3	9	4	1	0	0	0	1	35
Aztreonam	-	-	17	5	3	1	2	2	2	32
Amikacin	-	-	3	2	0	0	0	1	3	9
Ofloxacin	-	-	12	6	1	0	0	0	2	21
Meropenem	-	-	22	6	1	1	1	1	2	34
Azithromycin	17	2	-	-	-	-	-	-	-	19
Ampicillin	5	3	21	8	2	1	2	6	3	51
Chloramphenicol	8	1	4	5	1	0	1	0	1	21
Penicillin	19	4	-	-	-	-	-	-	-	23
Doxycycline	12	1	3	0	1	0	0	0	0	17
Levofloxacin	11	1	9	1	1	1	1	1	2	28
Linezolid	1	0	-	-	-	-	-	-	-	1
Tobramycin	-	-	9	4	1	0	0	0	1	15
Tetracycline	6	2	5	8	1	1	1	2	2	28
Ampicillin-sulbactam	-	-	3	7	1	0	0	0	0	11
Piperacillin-Tazobactam	-	-	20	9	2	1	1	5	3	41
Cotrimoxazole	7	1	17	9	0	0	0	0	3	37

DISCUSSION

Antimicrobial agents are often used empirically to manage infections, with these empirical treatments based on the susceptibility patterns of pathogens isolated at a specific institution over time.[11] Post-surgical wound infections are a serious complication that leads to significant postoperative morbidity and mortality, accounting for one-third of nosocomial infections in patients. In our study, we observed the bacterial spectrum in pus and wound swabs from surgical site infections, isolating pathogens in 42% of the 200 samples, indicating a high incidence of post-surgical wound infections.

A study by Abdulall et al,[12] in India reported a 79% infection rate among post-surgical wound samples, while Hanumanthappa P et al,[13] found a comparatively high surgical wound infection rate of 64%, which may be attributed to poor hygiene and improper sterilization techniques in the hospital. Among the isolates in our study, 70.2% were Gram-negative bacteria and 29.7% were Gram-positive. Staphylococcus aureus accounted for 25% of the isolates, and Pseudomonas spp. for 33.4%. Hanumanthappa P et al,[13] similarly found that, out of 149 isolates from 96 culture-positive cases, 71.8% were Gram-negative bacilli, and 28.2% were Gram-positive cocci, with Staphylococcus aureus at 16.1% and Pseudomonas species at 18.1%. Ravichitra K et al,[14] also demonstrated that Gram-positive cocci, particularly Staphylococcus aureus, were common bacterial pathogens in pus samples. Khullar S et al,[15] reported E. coli in 32 of 111 cases, Pseudomonas aeruginosa in 18, and Staphylococcus aureus in 17 cases.

Our study reported Methicillin-resistant Staphylococcus aureus (MRSA) in 33.4% and methicillin-resistant coagulase-negative Staphylococci (MR-CONS) in 40% of the total isolates. Hussain et al. (16) reported 24.0% MRSA in wound samples, and the high rate of MRSA in our study is a concerning indicator of hospital-acquired infections. Reducing these infections in healthcare centers can be achieved by conducting regular microbiological surveillance of different hospital wards, which will help in developing more effective antibiotic policies and infection control practices.[17] The widespread use of antibiotics exerts selective pressure that drives the development of antibiotic resistance. As resistance emerges to "first-line" antibiotics, there is an increase in the use of new, broader-spectrum, and more expensive antibiotics, which in turn leads to resistance to these new drugs.[18]

In our study, Staphylococcus aureus showed 90.4% resistance to Penicillin, followed by 80.9% resistance to both Ciprofloxacin and Azithromycin. However, 66.7% of Staphylococcus aureus isolates were sensitive to Teicoplanin. Similarly, Saeed M et al. reported high sensitivity and specificity of Teicoplanin against Staphylococcus aureus. Khullar S et al,[19] conducted a study on antibiotic susceptibility patterns in postoperative wounds and found that Augmentin was less effective against almost all clinical isolates. Hanumanthappa P et al,[11] also reported that most Staphylococcus aureus strains, including MRSA, were sensitive to Teicoplanin but resistant to Augmentin.

Hanumanthappa P et al,[11] found that all Gram-negative isolates were sensitive to Imipenem, with 75.7% sensitivity to Amikacin. Our study indicated that nearly all Gram-negative isolates were resistant to Augmentin (77.3%). Randrianirina F et al,[20] mentioned that resistance frequencies were high, particularly in Enterobacteriaceae, with susceptibility to Ceftazidime reported at 81.8% for E. coli, 60.9% for Klebsiella spp., and 52.5% for Enterobacter species. The high resistance among Enterobacteriaceae and moderate resistance of Staphylococcus aureus to Augmentin (84.4%) in other studies contrasts with the findings of the present study.

CONCLUSION

The rising incidence of post-surgical wound infections is a concerning trend. It has been observed that among the infected patients, the most common pathogens were Staphylococcus aureus, Pseudomonas species, and E. coli, all of which have shown increasing levels of drug resistance.

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