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Original Research Article

ASSESSING THE BACTERIOLOGICAL PROFILE AND ANTIBIOTIC SUSCEPTIBILITY PATTERN OF SURGICAL SITE INFECTIONS IN A TERTIARY CARE HOSPITAL

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Abstract

Background: Despite advances in infection control and wound management, surgical site infection remains a serious and significant clinical challenge, especially in developing countries. **Materials and Methods:** A total of 210 cases of clinically diagnosed SSI from Jhalawar Medical College (Rajasthan) were studied in this study, regardless of preoperative antibiotic administration. Samples of pus from deep within the wound were processed as per conventional microbiology methods. Antimicrobial susceptibility was done by Kirby – Bauer disc diffusion method. **Result:** The study found that Staphylococcus aureus and Klebsiella pneumoniae were respectively the most common gram-positive and gram-negative bacterium isolated. Gram-positive bacteria were most sensitive to linezolid and vancomycin and least sensitive to ofloxacin. Gram-negative bacteria were most sensitive to Piperacillin-tazobactam, Cefoperazone-sulbactam, and Meropenem, and least sensitive to Co-trimoxazole and Amoxyclav. **Conclusion:** Understanding the causative agent of wound infections, especially surgical site infections, and the degree of resistance of these isolates to different antimicrobial classes in specific geographic areas will help to provide locally applicable data and guide empirical treatment.

INTRODUCTION

Surgical site infections allude to the "proliferation of pathogenic microorganisms at the site of surgical incision which may involve the skin and subcutaneous fat (superficial), Musculofascial layers (deep) in an organ/ cavity".[1] Surgical site infections occur within thirty days of the surgery; however, in cases where implants are used, the duration might also extend up to one year from the surgical procedure.[2,3] Such infections place a significant burden on the patients in terms of mortality, morbidity, and increased healthcare costs.

Undoubtedly, the "bacterial load'' of the surgical site can be significantly reduced by adopting aseptic precautions, antiseptic techniques, and antimicrobial prophylaxis. Still, to effectively treat the patients and to efficiently adopt precautionary & preventive measures, it is very essential for a surgeon or physician to understand the microbiology of SSIs. Furthermore, systemic application of prophylactic antimicrobials can be a potent preventive measure in the control of surgical site infections in many settings; however, overuse of antibiotics has led to the emergence of antibiotic-resistant strains and increased rates of SSIs.

Bacteria can acquire resistance to antibiotics through mutation or exchange of genetic material between similar or closely related species, reducing or eliminating the effectiveness of drugs, chemicals, or other agents that are supposed to treat or prevent infection. Decreased sensitivity or resistance of bacteria to antibiotics means that "they should not be used in patients".[4,5] Microbial resistance to antibiotics has serious consequences. Infections caused by resistant microorganisms do not respond to treatment, leading to a greater risk of long-term illness and death, longer hospital stays, and infections that exceed the number of infections entering the community.

Despite advances in infection control and wound management, surgical site infection remains "a serious and significant clinical challenge, especially in developing countries".[6] This is because SSIs are a major source of postoperative morbidity, accounting for about a quarter of all "nosocomial" infections.[7]

Knowledge of the pathogens responsible for infections in the surgical site and the degree of resistance of these isolates to different classes of antibiotics in specific geographic areas will help to obtain data applicable to local conditions and guide empiric treatment. In India, especially Rajasthan, according to various studies, the pattern of resistance increases from time to time due to the misuse of antibiotics by the public. Therefore, this study is important for understanding resistance patterns, and the results of this study will help clinicians prescribe appropriate antibiotics and help patients receive timely and appropriate treatment.

Objectives

This study attempts to find out the bacteriological characteristics of SSIs and to determine the antibiotic susceptibility patterns of pathogens.

MATERIALS AND METHODS

- This cross-sectional study of the bacteriological characteristics of SSIs and their respective patterns of antibiotic susceptibility was conducted in the microbiology department of a tertiary hospital located in Jhalawar (Rajasthan) over a period of six months, from October 2022 to March 2023.
- Materials for this study were obtained from 210 clinically diagnosed cases of SSIs, who developed signs and symptoms of postoperative wound infection, including complaints of pain at the surgical site, swelling, delayed healing or non-healing wounds. The study considered bacterial isolates and antimicrobial susceptibility patterns as study variables.
- All consecutive patient's sample received to the microbiology department with wound infection were included. However, patients treated with antibiotics within 15 days of data collection, or patients, in whom healthy skin was not incised, such as opening abscesses, infection of burn wounds, and surgeries performed in other specialties, were not included in this study.
- After a thorough cleaning of the infected surgical site, light pressure was applied to expel pus from deep within the wound. Pus was collected with two sterile cotton swabs and immediately delivered to the laboratory for further processing.
- Collected samples were processed as follows: direct microscopic examination with Gram stain, inoculation of samples to isolate aerobic & anaerobic organisms, identification tests to determine colony morphology, biochemical tests to characterize species and antibiotic susceptibility tests.

RESULTS

Out of the total 210 cases, 139 aerobic and 8 anaerobic cases were isolated. Among the 139 aerobic isolates, 42 (28.6%) Gram-positive and 97 (66.0%) Gram-negative microorganisms were isolated. Similarly, among the 8 anaerobic isolates, 1 (0.7%) gram-positive and 7 (4.8%) gram-negative microorganisms were isolated.[Table1],

Table 1: Aerobic & Anaerobic Bacterial Isolates

Aerobic Isolates			Anaerobic Isolates			Total Isolates (%)
Gram Positive	Gram Negative	Total (%)	Gram Positive	Gram Negative	Total (%)	
42 (28.6)	97 (66.0)	139 (94.6)	1 (0.7)	7 (4.8)	8 (5.4)	147 (100.0)

Table 2: Aerobic Gram-Negative Organisms

Gram Negative Organisms	Count	Percent
Klebsiella pneumoniae	32	32.7
Escherichia coli	26	26.5
Pseudomonas aeruginosa	23	24.5
Proteus mirabilis	10	10.2
Klebsiella oxytoca	3	3.1
Acinetobacter baumannii	1	1.0
Citrobacter freundii	2	2.0
Total	97	100.0

Table 3: Aerobic Gram-Positive Organisms

Gram Positive Organisms	Count	Percent
Staphylococcus aureus	35	85.4
Staphylococcus epidermidis	6	12.2
Enterococcus faecalis	1	2.4
Total	42	100.0

Table 4: Anaerobic Culture-Positive Organisms

Culture Positive Organisms	Count	Percent
Anaerobic Bacilli	5	62.5
Anaerobic Cocci	3	37.5
Total	8	100.0

Table 5: Sensitivity Pattern of Gram-negative Organisms

Antibiotics	Gram-negative Organisms						
	Klebsiella pneumoniae (32)	Escherichia coli (26)	Pseudomonas aeruginosa (24)	Proteus mirabilis (10)	Klebsiella oxytoca (3)	Acinetobacter baumannii (1)	Citrobacter freundii (2)
Amikacin	25 (78.1)	26 (100)	17 (70.8)	7 (70)	3 (100)	---	2 (100)
Cefotaxime	9 (28.1)	16 (61.5)	4 (16.7)	5 (50)	2 (66.7)	---	2 (100)
Ciprofloxacin	20 (62.5)	19 (73.1)	19 (79.2)	6 (60)	2 (66.7)	1 (100)	2 (100)
Ofloxacin	15 (46.9)	14 (53.8)	10 (41.7)	5 (50)	2 (66.7)	---	2 (100)
Gentamicin	19 (59.4)	24 (92.3)	14 (58.3)	7 (70)	2 (66.7)	---	2 (100)
Cotrimoxazole	7 (21.9)	3 (11.5)	2 (8.3)	3 (30)	1 (33.3)	---	2 (100)
Piperacillin Tazobactam	32 (100)	26 (100)	24 (100)	10 (100)	3 (100)	1 (100)	2 (100)
Amoxyclav	8 (25)	4 (15.4)	20 (83.3)	2 (20)	1 (33.3)	---	1 (50)
Cefoperazone Sulbactam	32 (100)	26 (100)	24 (100)	10 (100)	3 (100)	1 (100)	2 (100)
Tobramycin	---	---	19 (79.2)	---	---	---	---
Ceftazidime	25 (78.1)	19 (73.1)	22 (91.7)	7 (70)	3 (100)	1 (100)	1 (50)
Meropenem	32 (100)	26 (100)	23 (95.8)	10 (100)	3 (100)	1 (100)	2 (100)

Table 6: Sensitivity Pattern of Gram-positive Organisms

Antibiotics	Gram-positive Organisms		
	Staphylococcus aureus (35)	Staphylococcus epidermidis (5)	Enterococcus faecalis (1)
Ampicillin	5 (14.3)	1 (20)	---
Gentamicin	4 (11.4)	2 (40)	---
Cotrimoxazole	18 (51.4)	3 (60)	1 (100)
Ofloxacin	4 (11.4)	2 (40)	---
Doxycycline	27 (77.1)	4 (80)	1 (100)
Erythromycin	31 (88.6)	4 (80)	1 (100)
Linezolid	35 (100)	5 (100)	1 (100)
Vancomycin	35 (100)	5 (100)	1 (100)
Amoxyclav	15 (42.9)	3 (60)	---
Cefotaxime	12 (34.3)	1 (20)	---
Ciprofloxacin	18 (51.4)	2 (40)	---

DISCUSSION

Out of the 139 isolated aerobic organisms, 97 (70.2%) were Gram-negative organisms. [Table 2] In a study by Naik & Deshpande[8], out of 300 samples, 216 (72%) were found to be positive. Culture-negative bacterial isolates may be due to prior antibiotic treatment or the presence of fastidious organisms that do not grow on conventional nutrient media. Among the isolated gram-negative microorganisms, Klebsiella pneumoniae was more common (n=32; 32.7%), followed by Escherichia coli (n=26, 26.5%) and Pseudomonas aeruginosa (n=23, 24.5%).

[Table 3] out of the 139 aerobic organisms were isolated, 42 (29.8%) were Gram-positive organisms. Among them, Staphylococcus aureus was more common (n=35; 85.4%).

[Table 4] out of the 8 culture-positive cases, 5 (62.5%) were ‘‘anaerobic bacilli” and 3 (37.5%) were “anaerobic cocci”. Research by Naik & Deshpande[8], Chia et al. [9], and Jido & Garba[10] also reported similar findings.

[Table 5] summarizes the “sensitivity pattern’’ of gram-negative organisms. It shows that, in the 98 isolates, almost all gram-negative bacilli were 100% sensitive to Piperacillin/ Tazobactam, Cefoperazone Sulbactam, and Meropenem. Klebsiella pneumonia isolates showed sensitivity of 59-78% for Amikacin, Gentamicin, Ceftazidime, and Ciprofloxacin. Sensitivity to Ofloxacin, Cefotaxime, Cotrimoxazole, and Amoxyclav were relatively minimal. Of the 26 Escherichia coli isolates, all showed sensitivity of 100% to Amikacin and Gentamicin apart from Piperacillin/ Tazobactam, Cefoperazone Sulbactam, and Meropenem. 53-73% sensitivity was seen in ciprofloxacin, cefotaxime, and ofloxacin. They were almost resistant to Amoxyclav and cotrimoxazole. Among the 24 Pseudomonas aeruginosa isolates, 70-92% sensitivity to Tobramycin, Ciprofloxacin, Amikacin, and Ceftazidime were seen. Sensitivity to Gentamicin were around 58% and they were least sensitive to Cotrimoxazole and Cefotaxime. Out of 10 isolates of Proteus mirabilis, 50-70% sensitivity was seen in Gentamicin, Amikacin, Ceftazidime, Ciprofloxacin, Ofloxacin, and Cefotaxime. Out of 3 Klebsiella oxytoca isolates, 100% sensitivity was seen in Amikacin, ceftazidime, Piperacillin/Tazobactam, Cefoperazone Sulbactam, and Meropenem. Sensitivity to Gentamicin, Cefotaxime, Ofloxacin, and Ciprofloxacin was 66.7%, whereas sensitivity to Cotrimoxazole and amoxiclav was around 33.3%. Apart from Piperacillin/ Tazobactam, Cefoperazone Sulbactam, and Meropenem, Acinetobacter baumannii was sensitive to Ceftazidime and Ciprofloxacin and showed very low sensitivity to all other antibiotics. Out of 2 Citrobacter freundii isolated, 50% sensitivity was for Amoxyclav and Ceftazidime. Both isolates were ‘‘100% sensitive” to Cefotaxime, Ciprofloxacin, Cotrimoxazole, Ofloxacin, Piperacillin/Tazobactam, Amikacin, Gentamicin, Cefoperazone Sulbactam, and Meropenem.

As summarized in [Table 6] in the 41 gram-positive isolates, all the gram-positive bacilli showed "100% sensitivity'' to Linezolid and Vancomycin. Out of 41 isolates, 35 were Staphylococcus aureus and showed 70-90% sensitivity to Erythromycin and Doxycycline; 42-52% sensitivity was for Ciprofloxacin, Cotrimoxazole, and Amoxyclav; and least sensitivity to Cefotaxime, Ampicillin, Gentamicin, and Ofloxacin was also encountered. Of 5 Staphylococcus epidermidis isolates, 60-80% were sensitive to Doxycycline, Erythromycin, Cotrimoxazole, and Amoxyclav. Ampicillin, Gentamicin, Ofloxacin, Ciprofloxacin, and Cefotaxime showed 20-40% sensitivity. The only isolate of Enterococcus faecalis was 100% sensitive to Cotrimoxazole, Doxycycline, and Erythromycin apart from Linezolid and Vancomycin as already mentioned above. These findings are supported by the studies of Bhalla et al and Thakur & Kujur.[11,12]

CONCLUSION

This study attempts to provide in-depth knowledge of surgical site infections at Jhalawar Medical College and Hospital by observing the bacteriological profile of the organisms causing surgical site infections and their antibiotic susceptibility patterns. Among the positive culture cases, Staphylococcus aureus was the most common Gram-positive organism isolated, and Klebsiella pneumoniae was the most common Gram-negative organism isolated. Most Gram-positive organisms were susceptible to Linezolid and Vancomycin, and most Gram-negative organisms were susceptible to Piperacillin, tazobactam, and Cefoperazone sulbactam. The study suggests a strong need to adapt existing antibiotic policies at the national and institutional level to ''limit the wastage of antibiotics and the emergence of resistant strains"[12]. Appropriate infection control measures and antibiotic policies must be implemented and monitored to prevent the emergence of antibiotic-resistant strains, a new global problem of enormous proportions.

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