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Original Research Article

Study Is To Identify the Isolates Causing Surgical Site Infections and Its Anti-Microbial Susceptibility Pattern

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Abstract:

Background: Surgical site infections (SSIs) rank third among nosocomial infections and are linked to higher rates of morbidity, death, and medical expenses. Finding the isolates responsible for surgical site infections and their antimicrobial susceptibility pattern is the primary goal of this investigation.

Methods: For the study, a total of 50 surgical site infection cases were collected. The suspected samples underwent conventional microbiological processing techniques. The antibiotic susceptibility pattern was determined using the modified Kirby-Bauer's disc diffusion method. Using the Double Disk Synergy Test, the Enterobacteriaceae family isolates were first checked for the formation of ESBLs, in accordance with standards set forth by the Clinical and Laboratory Standards Institute (CLSI). As controls, reference strains of Klebsiella 700603, P. aeruginosa (ATCC-27853), S. aureus (ATCC 25923), and E. coli (ATCC 25922) were employed.

Result: Nineteen (38%), of the fifty samples, were culture-positive, and 23 organisms in all were isolated. The most frequently isolated organism was Pseudomonas aeruginosa 9 (39.13%), which was followed by Staphylococcus aureus 3 (13.04%) and Klebsiella spp. 5 (21.73%). Ipenem, meropenem, and piperacillin-tazobactam were the most effective antibiotics against the majority of the Gram-negative isolates. The sensitivity of gram-positive organisms to vancomycin, linezolid, and levofloxacin has been observed. 44.44% of the isolates from the Enterobacteriaceae family produced ESBLs.

Conclusion: In any hospital, the rate of infection is a reflection of the quality of care and treatment provided to patients. Thus, appropriate antibiotic policy and improved SSI stewardship are needed. It is advised to periodically examine the etiology and antibiotic susceptibility in both hospital and community settings.

Keywords: Surgical site infection, Bacteriological profile, Antibiotic susceptibility test, ESBL (Extended Spectrum Beta-Lactamase).

Introduction

A surgical site infection (SSI) is an infection that results from a surgical procedure and affects just the skin or subcutaneous tissue of the incision. It usually manifests at the site of the incision or within 30 days after the treatment.[1-3] SSI rates have been reported ranging from 2.5% to 41.9% worldwide. [1,2] According to recently released studies, the incidence of SSIs was 1.8.14% in Telangana, 4.11.6% in Western Rajasthan, and 3.38% in Karamsad. [5]

Surgical Site Infection (SSI) represents 14% to 16% of all nosocomial infections among hospitalized patients and is the third most commonly reported nosocomial infection. [4.2,6] The frequency of surgical site infections (SSI) varies between hospitals as well as among various research that are periodically published. [7] SSI remains a major cause of hospital-acquired infections and a major source of morbidity and mortality among hospitalized patients in developing countries, despite recent advancements in aseptic techniques, including operation theatre and surgical techniques, sterilization methods, and standard protocols of preoperative preparation and antibiotic prophylaxis. [2-4]

SSI development is complex in its risk. Emergency treatments, pre-morbid illnesses, age and gender extremes, impaired immune response, malnourishment, metabolic disorders, and wound classification are all included. [2] Rehospitalization rates, healthcare utilization, diagnostic and treatment resource usage, and hospital expenses all raise as a result of SSIs. [2,5] Compared to patients without SSIs, those who have them are twice as likely to die, five times more likely to be readmitted to the hospital, and sixty percent more likely to need to stay in an intensive care unit (ICU). [6] A new aspect to the management of SSI8 is the nosocomial infection caused by multidrug-resistant organisms such as Extended-spectrum beta-lactamase (ESBL)-producing Klebsiella, vancomycin-resistant Enterococcus (VRE), Pseudomonas aeruginosa, and Methicillin-Resistant Staphylococcus aureus (MRSA). It has increased the difficulty and expense of selecting empirical therapy. Because antimicrobial drugs are prescribed irrationally, the issue is severe in developing nations. [9]. Determining the organism's antibiotic susceptibility is the first step in treating it. [7]

According to research conducted by the World Health Organization (WHO) and others, up to 50% fewer SSIs can be caused by routine surveillance and providing surgeons with feedback on the incidence of SSIs and related factors.5. According to published research, 60% of SSIs can be avoided. [6] Hospital departments are able to monitor improper use of antibiotics and establish guidelines for their administration thanks to the regular research conducted on the antimicrobial susceptibility pattern of the organisms causing surgical site infections. Therefore, it is crucial to identify the microorganisms causing surgical site infections (SSIs) and investigate their antimicrobial susceptibility pattern.

Material and Methods

This cross sectional study was conducted at Department of Microbiology, Radha Devi Jageshwari Memorial Medical College & Hospital, Turki, Muzaffarpur, Bihar, from May 2023 to October 2023. A proforma comprising the patients' name, age, sex, and medical history was used to collect data on a total of 50 patients who were above the age of 18. samples (wound and pus swabs) from post-operative patients in all clinical departments who experienced an infection within 30 days of the procedure. All SSI cases had their pus and wound swabs collected aseptically and promptly sent to the Microbiology section for analysis. In accordance with normal protocols, the laboratory samples were prepared for direct microscopy, aerobic/anaerobic culture, and sensitivity. To determine the morphological form of the bacteria present, Gram's staining was performed on the swabs used to create the smear. The samples were inoculated in two sets on the appropriate agar plates, such as Sabouraud's dextrose agar (SDA), Blood Agar (BA), MacConkey Agar (MA), and Nutrient Agar (NA).5 One set was incubated anaerobically for 18–24 hours at 37°C, whereas the other was incubated aerobically. Following incubation, several microorganisms from positive cultures were distinguished based on their morphological and biochemical traits. [10] For the antibiotic sensitivity pattern, the modified Kirby-Bauer's disc diffusion method was employed. Following the standards of the Clinical and Laboratory Standards Institute (CLSI), it was performed on Mueller Hinton agar using different antibiotics. [11] The Double Disk Synergy Test was used to determine if the isolates of Escherichia coli, Klebsiella, and Proteus that demonstrated resistance to ceftazidime and cefotaxime produced ESBLs. [11] A zone diameter increase of more than 5 mm was considered indicative of ESBL development when comparing the ceftazidime-clavulanic acid zone diameter to the ceftazidime disk zone diameter after 18 hours of incubation on Mueller-Hinton agar. As controls, [11] reference strains of Klebsiella 700603, P. aeruginosa (ATCC-27853), S. aureus (ATCC 25923), and E. coli (ATCC 25922) were examined.

Data were recorded and analyzed SPPS ver. 20 and MS Excel.

Result

Thirteen (38%) and thirty-one (62%) of the fifty samples that were accepted for culture and sensitivity in the microbiology laboratory shown growth. [Table 1]

Table 1: Infection detected in study population (n=50)

Infection	No. of samples	Percentage
Growth	19	38.0%
No growth	31	62.0%
Total	50	100.0%

The majority of the 19 cases who tested positive for culture, or 78.94% (15/19), were male, and 21.05% (4/19) were female. According to the data, there were more cases in the 48–58 year age range 6 (31.57%)) than in the 38–48 year age group 4 (21.05%). [Table 2]

Table 2: No. of patients and percentage infected in different age groups

Age groups in years	No. of samples	Percentage
18-28	3	15.80%
28-38	1	5.26%
38-48	4	21.5%
48-58	6	31.57%
58-68	3	15.80%
68-78	2	10.52%

Table 3: Distribution of organisms in different surgeries

	Fracture	Laparatomy	Lord plication	LSCS	Mastectomy	Hernioplasty	Amputation	Aphakia
No growth	6	4	4	5	2	7	2	1
Klebsiella	0	0	0	1	1	0	3	0
P.aureginosa	2	0	0	0	0	0	7	0
E.coli	1	0	0	0	0	0	1	0
S.aureus	0	0	0	0	0	0	0	0
Acinetobacter	1	0	0	0	0	0	0	0
Streptococcus	0	0	0	0	0	0	0	1
P.vulgari	0	0	0	0	0	0	0	0

The rate of surgical site infections varies depending on the type of surgery. Amputations had a higher infection rate than fracture operations. [Table 3] Diabetic foot was the most common surgical diagnosis made.

Table 4: Isolated Microbes

Bacteria	No. of samples	Percentage
Gram-negative	19	82.61%
Gram-positive	4	17.39%
Total	23	100.0%

Of the 19 culture-positive samples, 4(21.05%) produced mixed infections, and 15(78.95%) produced pure bacterial isolates. 23 organisms in all were isolated from 19 samples that tested positive for culture.

Four (17.39%) and nineteen (82.61%) of the 23 organisms identified from culture-positive pus samples were Gram-positive bacteria. [Table 4]

Table 5: Bacteriological profile of infected samples

Bacteriological Profile	No. of samples	Percentage
Klebsiella spp.	5	21.73%
Pseudomonas aeruginosa	9	39.13%
Escherichia coli	2	8.7%
S. aureus	3	13.04%
Streptococcus	1	4.35%
P. vulgaris	2	8.7%
Acinetobacter spp.	1	4.35%

The bacteriological profile of the infected samples is displayed in Table 5. Staphylococcus aureus 3 (13.04%) and Streptococcus 1 (4.35%) were the most prevalent organisms among the isolates of Gram-positive cocci. Pseudomonas aeruginosa 9 (39.13%) was the most prevalent Gram-negative bacterium, followed by Klebsiella 5 (21.73%), Escherichia coli 2 (8.7%), Proteus vulgaris 2 (8.7%), and Acinetobacter species 1 (4.35%), which was the least isolated.

Table 6: Antibiotic sensitivity pattern of Enterobacteriaceae (n = 9)

	Enterobacteriaceae		
Microbes	**Klebsiella (5)**	**Proteus (2)**	**Escherichia coli (2)**
Drugs	**Sensitivity %**	**Sensitivity %**	**Sensitivity %**
Ampicillin	0	0	0
Amoxicillin/clavulanic acid	0	0	0
Piperacillin/Tazobactam	40	100	50
Cefazolin	20	0	0
Cefaclor	20	0	0
Cefoperazone	40	50	50
Cefotaxime	40	50	50
Ceftriaxone	40	50	50
Ceftazidime	40	50	50
Cefepime	40	50	50
Imipenem	80	100	100
Meropenem	80	100	100
Amikacin	60	50	50
Gentamycin	60	50	50
Cefaclor	60	50	50
Levofloxacin	40	50	100
Ciprofloxacin	40	50	100
Ofloxacin	40	50	100
Cotrimoxazole	40	100	50

It was found that Klebsiella was 60% responsive to amikacin, gentamycin, and kanamycin, and 80% sensitive to imipenem and meropenem.

The study found that the sample exhibited 40% sensitivity to piperacillin/Tazobactam, 20% sensitivity to Cefazolin and Cefaclor, 0% sensitivity to Ampicillin, and 40% sensitivity to Cefepime, Levofloxacin, Ciprofloxacin, Ofloxacin, and Ceftazidime. [Table 6] It was discovered that Proteus was 50% sensitive to Cefoperazone, Cefotaxime, Ceftriaxone, Ceftazidime, Cefepime, amikacin, Gentamycin, Cefaclor, Levofloxacin, Ciprofloxacin, and Ofloxacin, and 100% sensitive to Piperacillin/Tazobactam, Imipenem, Meropenem, and Cotrimoxazole. Cefazolin, cefaclor, ampicillin, and amoxicillin/clavulanate showed zero percent sensitivity to Proteus and E. coli. [Table 6]

It was discovered that E. Coli was completely resistant to ampicillin, cefazolin, and cefaclor, and that it was only 50% resistant to piperacillin/Tazobactam, amikacin, gentamycin, and ofloxacin. [Table 6]

Table 7: Antibiotic sensitivity pattern of Non-fermenters (n=10)

Microbes	**Pseudomonas (9)**	**Acinetobacter (1)**
Drugs	**Sensitivity%**	**Sensitivity%**
Piperacillin	11	0
Piperacillin/Tazobactam	78	100
Ceftazidime	22	100
Cefepime	33	100
Aztreonam	33	-
Imipenem	78	100
Meropenem	78	100
Amikacin	11	100
Gentamycin	11	100
Ciprofloxacin	33	100
Ofloxacin	33	100
Levofloxacin	33	100
Gatifloxacin	33	-
Polymyxin-B	100	-
Cefotaxime	-	100

It was found that two strains of Klebsiella, one strain of Escherichia coli, and one strain of Proteus were Extended Spectrum Beta-Lactamase (ESBL) producers (44.44%), meaning that they were susceptible to imipenem and meropenem but resistant to first, second, and third generation cephalosporins and monobactams. The majority of these isolates that produced ESBLs came from amputation patients. Pseudomonas exhibited 100% sensitivity to Polymyxin-B among non-fermenters, while 78% of non-fermenters were sensitive to piperacillin/Tazobactam, Imipenem, and Meropenem. It displayed a 33% sensitivity to Cefepime, Aztreonam, Ciprofloxacin, Ofloxacin, Levofloxacin, and Gatifloxacin; Ceftazidime showed a 22% sensitivity, while Piperacillin, Amikacin, and Gentamycin showed an 11% sensitivity. With the exception of piperacillin, which was resistant, Acinetobacter was 100% sensitive to piperacillin/Tazobactam, Ceftazidime, Cefepime, Imipenem, Meropenem, Amikacin; Gentamycin; Ciprofloxacin, Ofloxacin, Levofloxacin, and Cefotaxime. [Table 7]

Table 8: Antibiotic sensitivity pattern of Gram positive cocci (n = 4)

Microbes	**Staphylococcus (3)**	**Streptococci (1)**
Drugs	**Sensitivity %**	**Sensitivity %**
Rifampin	100	100
PenicillinG	0	100
Ampicillin	0	-
Amoxicillin/clavulanicacid	0	-
Amikacin	67	-
Gentamycin	67	-
Kanamycin	67	-
Azithromycin	67	0
Clarithromycin	67	0
Erythromycin	67	0
Tetracycline	100	100
Levofloxacin	100	100

Ciprofloxacin	100	100
Moxifloxacin	100	100
Clindamycin	100	0
Trimethoprim	100	100
Linezolid	100	100
Vancomycin	100	100

Sixty-seven percent of the Gram-positive isolates of S. aureus were sensitive to Amikacin, Gentamycin, Kanamycin, Azithromycin, Clarithromycin, and Erythromycin, while the remaining isolates were 100% susceptible to Rifampin, Tetracycline, Levofloxacin, Ciprofloxacin, Moxifloxacin, Clindamycin, Trimethoprim, and Vancomycin. All Staphylococcus strains were susceptible to oxacillin and cefoxitin but resistant to ampicillin and penicillin. Methicillin-Sensitive Staphylococcus aureus (MSSA) was the strains that were so isolated. [Table 8]

Streptococci were resistant to azithromycin, clarithromycin, erythromycin, and clindamycin, but susceptible to Rifampin, Penicillin G, Tetracycline, Levofloxacin, Ciprofloxacin, Moxifloxacin, Trimethoprim, Linezolid, and Vancomycin. [Table 8]

Discussion

Fifty patients undergoing various surgical procedures were included in the current study. Thirteen (38%) of the fifty instances had a positive culture, while thirty-one (62%) had no growth at all. This study and another by Anirudh S. et al., where the infection rate was 32 percent, are comparable.[7]. Contrary to our findings, a small number of other researchers have discovered a very high frequency of culture-positive cases in their investigations.[12]

Compared to other countries, India has a substantially higher infection rate in hospitals (2.8% in the USA and 2-5% in European countries). [1,9] It's possible that the extremely different working circumstances found in industrialized nations account for the low infection rate in these nations. [7] Some authors have reported higher rates, which could be explained by the fact that their research included emergency procedures as well as contaminated and unclean wound types. [7]

In our study, the incidence of SSI was higher in males (78.94%, 15/19) than in females (21.05%, 4/19). This could be because men who engage in outdoor activities are more likely to experience trauma. A similar pattern was seen in Dr. Ashok Kumar's study, with 25.6% of men and 17.6% of women. According to the study, men were more likely to experience SSI. [13]

The age group of 48–58 years had the highest number of cases (31.57%), followed by 38–48 years (21.05%), which is consistent with the findings of other studies. [1,4,13] Growing older is associated with an increased risk of malnourishment, certain chronic illnesses, and a decline in the body's immune function, all of which increase the risk of SSI. [4,7,13] Similar to the current study, Shah et al. [1] and Brian Mawalla [9] observed a greater rate of infection in patients with diabetes mellitus. The analysis of the relationship between the kind of surgery and infection rate showed that, in contrast to previous research where laparotomy was the most prevalent procedure, the highest post-operative infection rate was identified in amputation surgery (22%) and fracture surgeries (12%). [9]

The current study 21.05% poly-microbial pathogen rate was similar to that of a study conducted by Lopiso Dessalegn et al. (20.1%). [12] but more than 11.6% were found in Dr. Mahesh Sharma's investigation. [5] Pseudomonas was the most often isolated organism, according to the microbiological profile of wound infection, which is consistent with other investigations. [4,14] Although some investigations show the opposite [5,7,12] which discovered that the most prevalent isolated bacterium was E. coli. Among gram-positive cocci, S. aureus was the most common causal agent, which was supported by additional research. [4,9,14]

In our study, the Enterobacteriaceae family members showed high susceptibility to imipenem and meropenem, then to amikacin, gentamycin, and kanamycin. This is in line with earlier studies. [14]

The percentage of Extended Spectrum Beta-Lactamase (ESBL) produced by two strains of Klebsiella, one strain of E. coli, and one strain of Proteus (44.44%) was shown to be comparable with previous investigations.[7,9] In line with previous research, our study found that Polymyxin-B and piperacillin-tazobactam were the most effective antibiotics for non-fermenters. [14]

Similar to a study by Aniruddha S. et al., S. aureus in Gram-positive bacteria was not susceptible to ampicillin or penicillin at all. [7] However, it exhibited 100% sensitivity to oxacillin and cefoxitin. As a result, the isolated strains were Methicillin-Sensitive Staphylococcus aureus (MSSA), which was different from other research that identified Methicillin-Resistant

Staphylococcus aureus (MRSA) but similar to the study by Aniruddha S. [7.9, 14] Additionally, their sensitivity to vancomycin and linezolid was comparable to that of previous investigations. [12,14] On the other hand, gentamycin was found to be the most effective antibiotic in another investigation. [7]

When used for serious bacterial infections, poor medication can complicate treatment and raise morbidity and mortality, which can have disastrous effects. While gram-positive isolates were responsive to vancomycin and clindamycin, the majority of gram-negative isolates were sensitive to meropenem. This difference in antibiotic sensitivity may be explained by the fact that these drugs are more expensive and therefore less frequently utilized in hospitals. [9]

The necessity for quick action to ensure efficient infection prevention and prudent use of antimicrobial agents to reduce infection rate and emergence of drug resistance is justified by the high isolation rate of bacteria and rising drug resistance to routinely used antibiotics. When empiric therapy of a surgical site infection is not avoidable, imipenem and meropenem are the best options since they work well against the majority of isolates of Enterobacteriaceae and non-fermenters. Vancomycin, Linezolid, and Levofloxacin were susceptible to Gram-positive cocci. Practically every isolate in our institute was successfully combatted with piperacillin-tazobactam.

Conclusion

One major complications of modern surgery is surgical site infection. It is among the major factors contributing to death and morbidity after surgery. Any hospital's infection rate is an indicator of the quality of care provided to patients and the standard of care. Antimicrobial resistance in hospital-acquired infections and, eventually, the rate of SSI in underdeveloped nations can be significantly decreased with appropriate antibiotic policies and improved SSI stewardship. It is advised to periodically check the antimicrobial susceptibility and etiology in both community and hospital settings.

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