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BACTERIOLOGICAL PROFILE OF POST-OPERATIVE SURGICAL SITE INFECTION IN A TERTIARY CARE HOSPITAL IN NORTHERN INDIA

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ABSTRACT

Introduction: Surgical site infections are infections that occur after surgery in the body where the surgery took place. They can be superficial or serious, involving tissues under the skin, organs, or implanted material. Surgical site infections contribute to high mortality rates, morbidity, hospitalization length, and treatment costs. Symptoms may be seen as redness, delayed healing, fever, pain, tenderness, warmth, or swelling. Symptoms include pus production from superficial incisions, deep incisions, organ or space SSIs, and abscesses.

Methods: From August 2022 to August 2023 in this study. There were 65 pus samples from different surgical wards that were clinically suspected of having post-operative surgical site infections. The MacConkey agar and blood agar media were inoculated using a culture swab, and the medium was then incubated for 24 hours at 37°C. Using a normal microbiological approach, the bacteria from the positive culture were identified after incubation. Staphylococcus aureus strains were identified using the following methods: mannitol fermentation, catalase production test, slide and tube coagulase test, colony morphology, and gram's staining.Antimicrobial susceptibility testing was carried out using the Kirby-Bauer disc diffusion method on Mueller Hinton agar, in compliance with Clinical and Laboratory Standard Institute (CLSI) standards.

Results: The current investigation was carried out at Government Medical College Kannauj Following inoculation, a total of 65 samples obtained from clinically suspected post-operative surgical site were examined, 56 (86.15%) had bacterial growth, while 9 (13.85%), exhibited no growth at all following inoculation. In terms of age distribution, the highest rate of post-operative surgical site infection was 57.14%, or 32 out of 65 cases in the 30-40 Age group. This was followed by 19.64%, or 11 cases out of 65 in the 40–50 age group, and the lowest rate was 10.5%, or 7 cases out of 65 in the more than 60 age group.

Conclusion: The study carried out between August 2023 to August2024, identified 56 bacterial growth isolates from post-operative surgical site infection. Worldwide, there is a genuine danger of postoperative wound infections with all surgical procedures and medical treatments. It is one of the main causes of much higher rates of morbidity, death, unwarranted longer hospital stays, and increased medical expenses for surgical patients. Every hospital should conduct periodic surveillance of postoperative wound infections at regular intervals in order to evolve control strategies and lower the infection rate, as the control of post-operative complications is a crucial aspect of overall management.

Keywords: Extended spectrum beta lactamase, Methicillin resistant *staphylococcus aureus*, Antibiotic susceptibility, post-operative surgical site infection.

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INTRODUCTION

Surgical site infections are infections that occur after surgery in the body where the surgery took place.[1] They can be superficial or serious, involving tissues under the skin, organs, or implanted material. Surgical site infections contribute to high mortality rates, morbidity, hospitalization length, and treatment costs.[2]

Despite advancements in surgical and wound management systems, wound infections remain the most recognized nosocomial infections, especially in patients undergoing surgery.[3] Past studies indicate that SSI incidence is worsening in developing countries compared to developed ones, and a study in low- and middle-income countries supports this increase in the burden globally.[4-6] Elective and emergent types of surgery have been performed globally, resulting in successful procedures,however, patients undergoing these surgeries are highly susceptible to SSI, highlighting the need for improved safety measures.[7-8] All surgeons deal with infection because surgical site infections (SSI) are postoperative wound infections caused by the impairment of the host's first line of defense against external microorganisms and the host's internal milieu.[9] Symptoms may be seen as redness, delayed healing, fever, pain, tenderness, warmth, or swelling. Symptoms include pus production from superficial incisions, deep incisions, organ or space SSIs, and abscesses. Sponge samples can be cultured to identify infection-causing germs. Abscesses are enclosed areas of pus and disintegrating tissue surrounded by inflammation, visible during surgery or X-ray studies. A reduction in SSIs during COVID-19, which includes adherence to hand hygiene, universal mask use, and social distancing strategies, shows that these SSIs can be decreased if we follow infection control practices.[10] According to Centers for Disease Control guidelines, a surgical site infection (SSI) is defined as an infection that appears within 30 days or, in rare cases, 90 days following surgery and accounted for 31% of all Healthcare Associated Infections (HAI), contributing 20% to postsurgical readmissions. These infections are recognized to be among the most frequent causes of infections.[11] In developing nations like India, where resources are limited and staff is constantly in short supply, the situation is worse.[12]Bacteria can be aerobic or anaerobic and may exist alone or in combination. Infections of wounds typically result in pus production, indicating the presence of "pyogenic" bacteria. According to many studies, Gram-negative pathogens are the most common cause of infection in surgical sites, although numerous bacterial pathogens cause infections in different locations.[5,6,13,14] The mostcommon organisms encountered in surgical site infections are *Staphylococcus aureus,* Coagulase-negative *Staphylococcus (CONS)*, *Pseudomonas, E. coli, Klebsiella, Enterobacter, Proteus, Acinetobacter, and Enterococcus*, among others.[15] The careful and reasonable use of antibiotics in post-operative wound infections targeted at the prevailing organisms in that community not only aids in the reduction of antibiotic-induced bacterial resistance but also lowers the overall cost of treatment in developing countries, including India.[3]Globally, the susceptibility testing methods, local epidemiology data, and location all influence the resistance patterns of bacteria linked with food safety incidents.

Further, treatment for SSIs is difficult and presents a challenge due to bacterial resistance [6] These pathogens show notable resistance to the studied medications' antibiograms.[16] Data on drug resistance mostly comes from high-income countries, but there are limited reportson the prevalence and incidence of resistant bacteria causing SSI, particularly in developing nations. [17,18]

MATERIALS AND METHOD: From August 2022 to August 2023 in this study. There were 65 pus samples from different surgical wards that were clinically suspected of having post-operative surgical site infections.

INCLUSION CRITERIA: All patients who were hospitalized to various surgical wards (general surgery, orthopedics, obstetrics, and gynecology) and who were older than eighteen and had exudates from their surgical site were included.

EXCLUSION CRITERIA: The study eliminated patients who were less than eighteen years old, had infected burn wounds, a stitch abscess, or an episiotomy wound infection.

METHODOLOGY: Using dry, sterile cotton swab sticks, the sample were taken from the depth of the wound while taking careful aseptic measures for bacteriological analysis. For the purpose of the direct smear analysis and the aerobic bacterial culture, two culture swabs were taken from each sample and submitted straight away to the lab for analysis. The MacConkey agar and blood agar media were inoculated using a culture swab, and the medium was then incubated for 24 hours at 37°C. Using a normal microbiological approach, the bacteria from the positive culture were identified after incubation. Staphylococcus aureus strains were identified using the following methods: mannitol fermentation, catalase production test, slide and tube coagulase test, colony morphology, and gram's staining. Antimicrobial susceptibility testing was carried out using the Kirby-Bauer disc diffusion method on Mueller Hinton agar, in compliance with Clinical and Laboratory StandardInstitute (CLSI) standards.Following CLSI recommendations, MRSA was detected using the Cefoxitin disc diffusion technique with a Cefoxitin disc 30 µg, and ESBL was detected using the Combined Disc Diffusion method with a disc containing Ceftazidime + Ceftazidime-Clavulanic acid and Cefotaxime + Cefotaxime-Clavulanic acid.

RESULT: The current investigation was carried out a Government Medical College Kannauj Following inoculation, A total of 65 samples obtained from clinically suspected post-operative surgical site were examined, 56 (86.15%) had bacterial growth, while 9 (13.85%), exhibited no growth at all following inoculation.

Table 1: Distribution of bacterial growth

Total Samples	Bacterial Growth	No growth
65	56 (86.15%)	9 (13.85%)

Graph No: 1Graph of bacterial growth

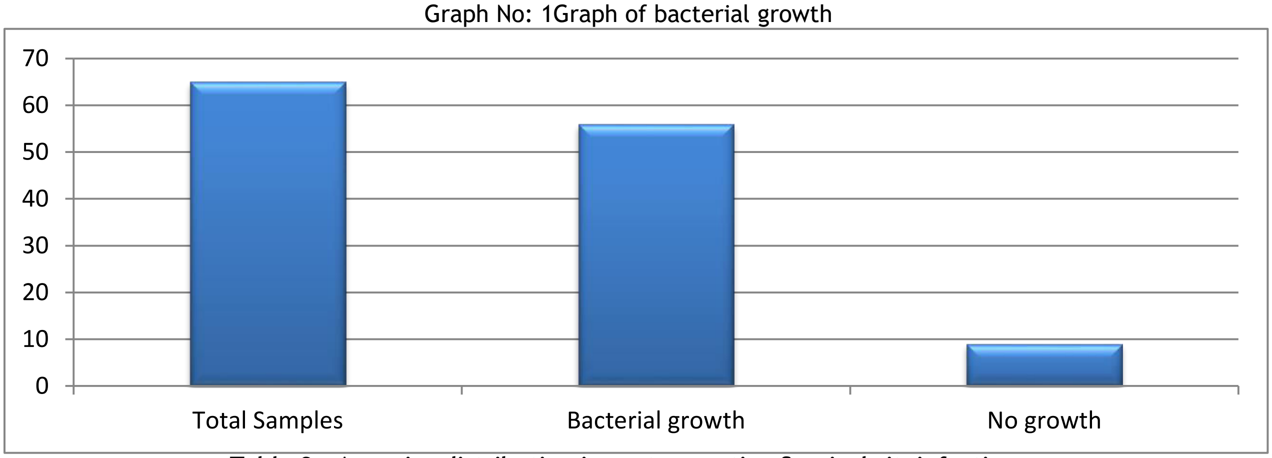
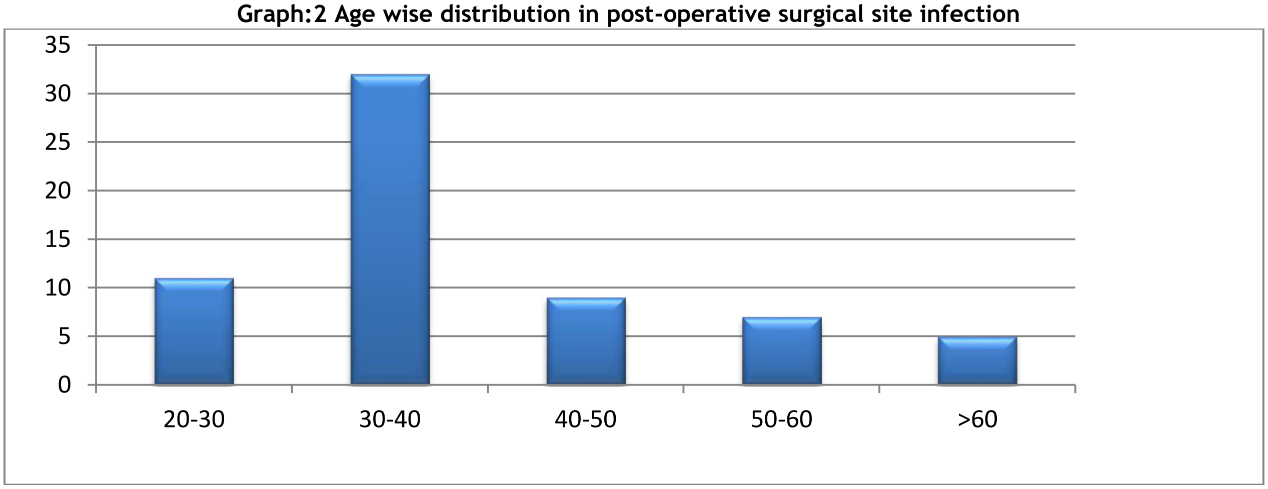


Table 2: Age wise distribution in post-operative Surgical siteinfections

Age Groups (years)	No. of post-operative surgical site infection	Percentage (%)
20-30	11	(19.64%)
30-40	32	(57.14%)
40-50	9	(16.07%)
50-60	7	(12.5%)
>60	6	(10.71%)

In terms of age distribution, the highest rate of post-operative surgical site infection was 57.14%, or 32 out of 56 cases in the 30-40 age group. This was followed by 19.64%, or 11 cases out of 56 in the 40-50 age group, and the lowest rate was 12.5%, or 7 cases out of 56 in the 50-60 age group.

Graph:2 Age wise distribution in post-operative surgical site infection



In addition, of the 65 samples, 34came from females and 31from males. This represents the gender distribution. Of them, 27 out of 34 (79.41%) of the femalesand 29 out of 31 (93.54%) of the men tested positive for culture.Out of 65 isolates, 48.21% (27 isolates) were Gram-positive, whereas 51.78% (29 isolates) were Gram-negative.

Table:3. Sex distribution in surgical site infections following surgery.

Sex	No. of total samples	Positive culture samples
Males	31	29 (93.54%)
Females	34	27(79.41%)

*Staphylococcus aureus*24 (42.85%) was the most often occurring isolate among gram-positive cocci, followed by E. Coli 11 (19.64%), *Klebsiellapneumoniae* 6 (10.71%), *coagulase negative staphylococcus (CONS)* 5 (8.92%),*Klebsiellaoxytoca* 3(5.35%),*Pseudomonas spp.* 4 (7.14%), and *Acinetobacterspp* 2 (3.57%) which was the least common.

Table: 4. Total isolates bacteria

Gram positive bacteria	Gram negative bacteria
Staphylococcus aureus 24 (42.85%)	*E. coli* 11(19.64%)
*(cons)*5 (8.92%)	*Klebsiella pneumoniae* 7 (12.5%)
	*Klebsiella oxytoca*3 (5.35%)
	*Pseudomonas aeruginosa*4 (7.14%)
	*Acinetobacter spp.*2 (3.57%)
Total - 29 (51.78%)	Total – 27 (48.21%)

According to the cefoxitin disc diffusion method, 24 out of the 29-staphylococcus*aureus* (82.75%) in the study were MRSA, while the other *staphylococcus aureus*were*methicillin-sensitivestaphylococcus aureus* (MSSA)(Figure:2)

Figure:2 MRSA ASTplate

8 of the 27 gram-negative isolates were discovered to be ESBL producers by the double disc diffusion technique using ceftazidime and ceftazidime-clavulanic acid as well as cefotaxime and cefotaxime-clavulanic acid. They included 4 out of 11(19.64%) E. Coli and 3 out of 7 (12.5%) Klebsiella that were discovered to be ESBL producers; 2 out of 4(7.14%)*pseudomonades* were revealed to be ESBL producers.

Table 4: ESBL Procedure Isolates.

Organisms	No. of total isolates	ESBL Producers	Percentage %
E.coli	11	4	23.21%
Klebsiella	7	3	16.01%
Pseudomonas	4	2	7.14%
Total	22	11	46.36%

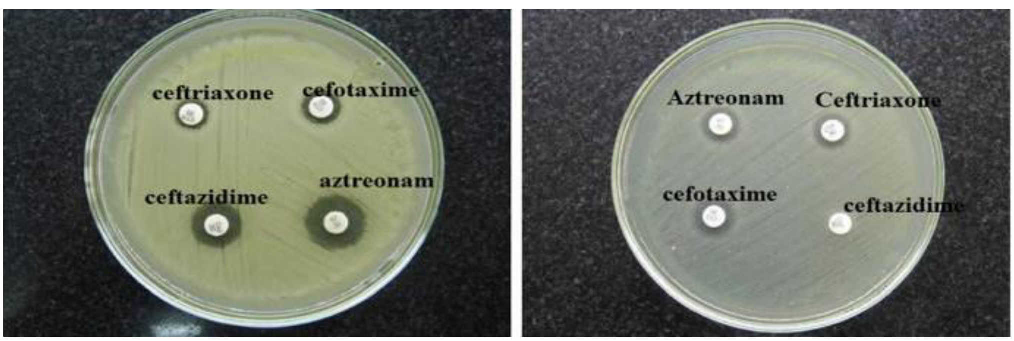


Figure:3 Confirmatory ESBL test

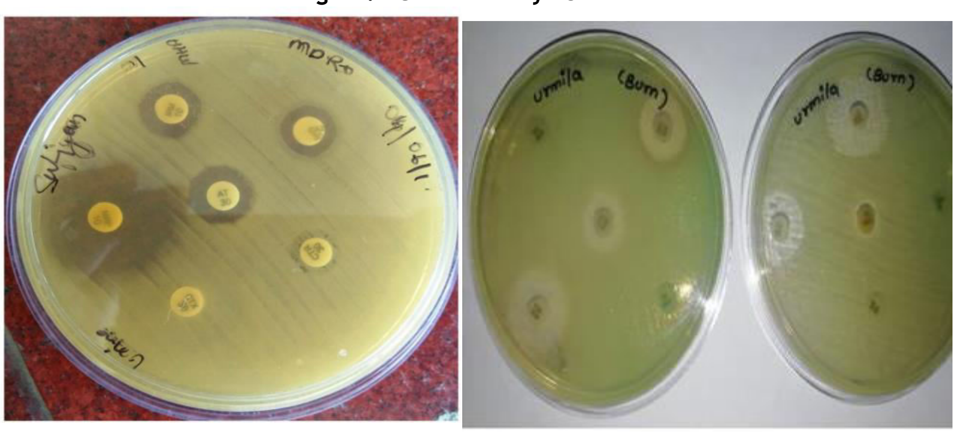


Figure 4: ASTof E. *coli*(ESBL) and *Pseudomonas auruginosa*on muller hinton agar

Testing for antibiotic sensitivity using the *Kirby Bauer disc diffusion method*

The antibiotic susceptibility pattern of the isolated organism, discovered using the Kirby Bauer disc diffusion method, revealed that among gram negative bacteria, both E. Coli and Klebsiella were susceptible to primarily Aztreonam, Linezolid, or Cefoxitine, while staphylococcus aureus (both coagulase positive and negative) was susceptible to Doxycycline, Clindamycin, and Linezolid. The distinct pattern of antibiotic susceptibility exhibited by isolates classified as gram positive and gram negative.

Table 5: Antibiotic susceptibility pattern of Gram-positive bacteria

Antibiotics	*Staphylococcus aureus (24)*	*Coagulase negative staphylococcus aureus* (5)
Amikacin	12 (50 %)	3 (60%)
Gentamycin	10 (41.6%)	3 (60%)
Tobramycin	16 (66.6%)	3 (60%)
Vancomycin	24 (100%)	5 (100%)
Linezolid	24 (100 %)	5 (100%)
Tetracycline	10 (41.6%)	4 (75 %)
Oxacillin	12 (50%)	3 (60 %)
Cefoxitin	18 (75 %)	4 (80 %)
Clindamycin	12 (50%)	4 (80 %)
Erythromycin	20 (83.3%)	3 (60 %)

Table No 6: Antibiotic Susceptibility pattern of Gram-negative bacteria

Antibiotics	*E. coli*(11)	*Klebsiella pneumonia*(7)	*Klebsiella oxytoca*(3)	*Pseudomonas* aeruginosa (4)	*Acinetobacter spp.* (2)
Amikacin	5 (71.4%)	5 (71.4%)	2 (66.6%)	3 (75%)	2 (100%)
Gentamicin	7 (63.6%)	4 (57.1%)	2 (66.6%)	1 (25%)	1 (50%)
Tobramycin	7 (63.6%)	5 (71.4%)	2 (66.6%)	3 (75%)	1 (50%)
Tetracycline	5 (45.4%)	0 (0%)	0 (0%)	1 (25%)	0 (0%)
Imipenem	11 (100 %)	6 (85.7%)	2 (66.6%)	4 (100%)	1 (50%)
Meropenem	11 (100 %)	4 (57.1%)	2 (66.6%)	4 (100%)	1 (50%)
Aztreonam	6 (54.5%)	3 (42.8%)	1 (33.3%)	3 (75%)	1 (50%)
Polymyxin	11 (100 %)	7 (100 %)	3 (100 %)	4 (100 %)	2 (100 %)
Colistin	11 (100 %)	7 (100 %)	3 (100 %)	4 (100 %)	2 (100 %)
Tigecycline	11 (100 %)	7 (100 %)	3 (100 %)	4 (100 %)	1 50 %)
Cefotaxime	5 (45.4%)	4 (57.14%)	1 (33.3%)	3 (75%)	1 (50%)
Cefoxitin	5 (45.4%)	4 (57.14%)	1 (33.3%)	0 (0%)	1 (50%)

Ceftriaxone	**3 (27.2%)**	**3 (42.8%)**	**1 (33.3%)**	**0 (0%)**	**1 (50%)**
Piperacillin Tazobactam	**11 (100 %)**	**7 (100 %)**	**3 (100 %)**	**4 (100%)**	**2 (100%)**

DISCUSSION

One of the most significant causes of morbidity is still post-operative surgical site infection, which is also one of the most frequent nosocomial infections in patients after surgery. The goal of the current investigation is to identify the different bacterial flora and their antibacterial susceptibility pattern that cause surgical site infections. The rate of surgical site infection varies widely between hospitals and around the world.Within this study, 86.15% (56 out of 65) ofclinically suspected infected patients from various surgical departments had positive growing pus culture results.*Staphylococcusaureus* was the most prevalent isolate in this investigation, accounting for 42.85% of the total population of 56 sample isolates. This was followed by *E. coli* (19.64 %), *Klebsiellapneumonia* (12.5%),*Klebsiellaoxycota*(5.35%), *Caugulase -ve staphylococcus aureus* (8.92%),*Acinetobactor* (3.57%),*Pseudomonas* (7.14%), and other commonly found bacteria.These discoveries corroborated those made by Krishnan et al., who found that *Pseudomonas, E. coli, Klebsiella, CONS, , Acinetobacter, ,* and providential species were the most frequently isolated species, after *S. Aureus.*Similar observations that Staph. aureus was the most frequently occurring strain, followed by *E. coli, CONS, Pseudomonas, Klebsiella, Proteus, Enterococcus, Acinetobacter*, and *Citrobacter* were noted in a research conducted by B Ananthi et al.Out of 108 female patients 8(7.4%) patient developed surgical site infection ,while out of 115 male patients 1(0.86%)patients developed surgical site infections study performed by ayushjain et.al. In our study out of 34 female patients 27 (93.54%)developed SSI,while out of 31 male patients 29(79.41%) developed SSI.We discovered 86.15% culture positive in the research samples that were obtained from individuals who had surgical site infections. It is significantly greater than Khyati Jain et.al.

CONCLUSION

The study carried out between August 2023 toAugust2024, identified 56 bacterial growth isolates from post-operative surgical site infection.Worldwide, there is a genuine danger of postoperative wound infections with all surgical procedures and medical treatments. It is one of the main causes of much higher rates of morbidity, death, unwarranted longer hospital stays, and increased medical expenses for surgical patients. Every hospital should conduct periodic surveillance of postoperative wound infections at regular intervals in order to evolve control strategies and lower the infection rate, as the control of post-operative complications is a crucial aspect of overall management. Aside from lowering antibiotic-induced bacterial resistance, prudent and reasonable use of antibiotics in post-operative wound infections directed against the dominant organisms in that community also helps to lower overall treatment costs in developingnations like India.

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