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Aerobic Bacteriological Profile and Antimicrobial Susceptibility Pattern of Surgical Site Infections: A Prospective Study at a Tertiary Care Hospital in Northern Odisha.

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Abstract
Background and Objectives: Surgical site infections (SSIs) are among the most frequently encountered healthcare-associated infections, significantly contributing to postoperative morbidity, mortality, and healthcare costs. With the escalating threat of antimicrobial resistance, continuous monitoring of local microbial flora is essential. This study aimed to determine the aerobic bacteriological profile and antimicrobial susceptibility patterns of SSIs at a tertiary care center in Northern Odisha. ***Material & Methods:*** A prospective, hospital-based cross-sectional study was conducted across the surgical departments of Fakir Mohan (FM) Medical College and Hospital, Balasore, Odisha, between January 2023 and January 2025. A total of 72 clinically suspected cases of SSI were enrolled. Pus swabs or aspirates were collected and processed for aerobic culture and antimicrobial susceptibility testing utilizing the Kirby-Bauer disc diffusion method in accordance with Clinical and Laboratory Standards Institute (CLSI) guidelines. ***Results:*** Out of 72 samples, 60 (83.33%) exhibited positive bacterial growth, yielding 65 aerobic bacterial isolates (inclusive of 5 polymicrobial infections). The highest incidence was noted in males (59.72%) and the 41–60 age group (43.06%). General Surgery accounted for the majority of cases (48.61%). Staphylococcus aureus was the most predominant isolate (40.00%), followed by Escherichia coli (23.08%), Pseudomonas aeruginosa (12.31%), and Klebsiella pneumoniae (10.77%). Methicillin-resistant S. aureus (MRSA) constituted 46.15% of the S. aureus isolates. All Gram-positive isolates demonstrated 100% sensitivity to Vancomycin and Linezolid. Gram-negative bacilli showed alarmingly high resistance to third-generation cephalosporins (65–80%) but retained high susceptibility to Carbapenems and Amikacin. ***Conclusion:*** Staphylococcus aureus remains the primary etiological agent for SSIs, alongside a significant burden of multidrug-resistant Gram-negative pathogens. Formulating institution-specific antibiotic policies and reinforcing strict infection control practices are imperative to combat the rising tide of antimicrobial resistance.

Keywords: Surgical Site Infection, Aerobic Bacteria, MRSA, Antimicrobial Resistance, Antibiogram, FM Medical College Balasore.

INTRODUCTION
Surgical site infections (SSIs) represent a major complication following surgical procedures, defined by the Centers for Disease Control and Prevention (CDC) as infections occurring within 30 days after surgery, or within 90 days if an implant is left in place [1]. Despite modern advancements in surgical techniques, operation theater sterilization, and the advent of prophylactic antimicrobials, SSIs continue to be the second most common healthcare-associated infection (HAI) globally [2]. In developing countries like India, the incidence of SSI is notably higher, exacerbating hospital stay durations, imposing economic burdens, and increasing patient morbidity [3].

The microbiology of SSIs is dynamic and varies extensively depending on the anatomical site of surgery, the surgical environment, and the geographical region. Infections are predominantly caused by endogenous flora from the patient's skin or hollow viscera, though exogenous contamination from surgical personnel and instruments also plays a critical role [4]. Recently, there has been a concerning paradigm shift in the bacteriological profile of SSIs, marked by the rapid emergence of multidrug-resistant (MDR) strains such as Methicillin-Resistant Staphylococcus aureus (MRSA), Extended-Spectrum

Beta-Lactamase (ESBL) producing Enterobacteriaceae, and Metallo-Beta-Lactamase (MBL) producing non-fermenters [5].

Fakir Mohan (FM) Medical College and Hospital, Balasore, is a pivotal tertiary care institution catering to a massive rural and semi-urban population in Northern Odisha. To ensure effective empirical antibiotic therapy and formulate robust antimicrobial stewardship programs, continuous surveillance of local pathogen epidemiology is required. Therefore, this prospective study was undertaken from 2023 to 2025 to meticulously evaluate the aerobic bacteriological profile and antibiogram of SSIs within this clinical setting.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted in the Department of Microbiology in collaboration with the Departments of General Surgery, Orthopedics, and Obstetrics & Gynecology (OBG) at FM Medical College and Hospital, Balasore. The study period extended from January 2023 to January 2025.

Patient Selection

A sample size of 72 patients (N=72) who developed clinical manifestations of SSI (such as purulent discharge, localized erythema, induration, or wound dehiscence) post-surgery were selected.

Inclusion Criteria

Patients of all ages and both genders who underwent elective or emergency surgeries and developed an SSI within 30 days post-operation.

Exclusion Criteria

Patients presenting with traumatic wounds infected prior to admission, stitch abscesses, burn wound infections, and those who did not consent to participate.

Sample Collection and Microbiological Processing

Under strict aseptic precautions, the infected surgical wound was cleansed with sterile normal saline to eliminate superficial colonizers. Two sterile cotton swabs were utilized to collect pus or exudate from the depths of the wound. In cases where closed fluid collections were present, sterile syringe aspiration was performed.

The first swab was utilized for direct microscopy via Gram staining to assess the presence of polymorphonuclear leukocytes and bacterial morphology. The second swab was directly inoculated onto 5% Sheep Blood Agar and MacConkey Agar plates. The cultures were incubated aerobically at 37°C for 24 to 48 hours.

Bacterial Identification and Antibiotic Susceptibility Testing

Isolated bacterial colonies were identified using standard microbiological techniques, encompassing colony morphology, Gram stain characteristics, and a comprehensive suite of biochemical tests (Catalase, Coagulase, Oxidase, Indole, Methyl Red, Voges-Proskauer, Citrate utilization, Urease, and Triple Sugar Iron agar) [6].

Antimicrobial susceptibility testing (AST) was executed using the modified Kirby-Bauer disc diffusion method on Mueller-Hinton Agar. The inhibition zones were measured and interpreted strictly according to the contemporary Clinical and Laboratory Standards Institute (CLSI) guidelines [7]. MRSA screening was performed using a Cefoxitin (30 µg) disc.

RESULTS

Demographic Profile

Out of the 72 clinically suspected cases of SSI, 43 were males (59.72%) and 29 were females (40.28%). The highest prevalence of SSI was observed in the age group of 41–60 years (43.06%), followed by the 21–40 years cohort (31.94%).

Table 1: Demographic Distribution of SSI Patients (N = 72)

Age Group (Years)	Male (n)	Female (n)	Total (n)	Percentage (%)
≤ 20	4	2	6	8.33%
21–40	14	9	23	31.94%
41–60	18	13	31	43.06%
> 60	7	5	12	16.67%
Total	**43**	**29**	**72**	**100.00%**

Departmental Distribution and Culture Positivity

Out of the 72 processed samples, 60 samples yielded positive aerobic bacterial growth, establishing a culture positivity rate of 83.33%. The General Surgery department accounted for the highest number of total SSI cases and positive cultures.

Table 2: Department-wise Distribution and Culture Positivity of SSI Cases (N = 72)

Department	Total Suspected Cases	Culture Positive	Culture Negative	Culture Positivity Rate (%)
General Surgery	35	30	5	85.71%
Orthopedics	22	18	4	81.82%
Obstetrics & Gynecology	15	12	3	80.00%
Total	**72**	**60**	**12**	**83.33%**

Aerobic Bacteriological Profile

From the 60 culture-positive samples, a total of 65 bacterial isolates were recovered, as 5 samples (8.33%) demonstrated polymicrobial growth. Gram-positive organisms accounted for 46.15% (n = 30) of the isolates, whereas Gram-negative bacilli constituted 53.85% (n = 35). Staphylococcus aureus was the single most dominant pathogen overall. Among the Gram-negative organisms, Escherichia coli and Pseudomonas aeruginosa were the most frequently isolated.

Table 3: Distribution of Aerobic Bacterial Isolates (N = 65)

Organism Isolated	Frequency (n)	Percentage (%)
Gram-Positive Isolates	**30**	**46.15%**
Staphylococcus aureus	26	40.00%
Coagulase-negative Staphylococci (CONS)	4	6.15%
Gram-Negative Isolates	**35**	**53.85%**
Escherichia coli	15	23.08%
Pseudomonas aeruginosa	8	12.31%
Klebsiella pneumoniae	7	10.77%
Acinetobacter spp.	3	4.61%
Proteus mirabilis	2	3.08%
Total Isolates	**65**	**100.00%**

Antimicrobial Susceptibility Patterns

Gram-Positive Isolates

Among the 26 S. aureus isolates, 12 (46.15%) were identified as MRSA. The Gram-positive isolates displayed complete sensitivity (100%) to reserve drugs such as Vancomycin and Linezolid. High resistance was noted against Penicillin and Erythromycin.

Table 4: Antimicrobial Susceptibility Pattern of Gram-Positive Isolates (n = 30)

Antibiotic	S. aureus (n = 26) - Sensitive (%)	CONS (n = 4) - Sensitive (%)
Penicillin	2 (7.69%)	1 (25.00%)
Cefoxitin (MRSA Screen)	14 (53.85%)	3 (75.00%)
Erythromycin	8 (30.77%)	2 (50.00%)
Clindamycin	16 (61.54%)	3 (75.00%)
Ciprofloxacin	10 (38.46%)	2 (50.00%)
Amikacin	18 (69.23%)	3 (75.00%)
Linezolid	26 (100.00%)	4 (100.00%)
Vancomycin	26 (100.00%)	4 (100.00%)

Gram-Negative Isolates

The Gram-negative Enterobacteriaceae and non-fermenters exhibited profound resistance to conventional beta-lactams and third-generation cephalosporins (Ceftriaxone, Cefotaxime). Carbapenems (Meropenem/Imipenem) and Aminoglycosides (Amikacin) remained the most effective therapeutic agents.

Table 5: Antimicrobial Susceptibility Pattern of Major Gram-Negative Isolates (n = 30)*

Antibiotic	E. coli (n = 15) - Sensitive (%)	P. aeruginosa (n = 8) - Sensitive (%)	K. pneumoniae (n = 7) - Sensitive (%)
Ampicillin	1 (6.67%)	Not Tested	0 (0.00%)
Amoxicillin-Clavulanic Acid	4 (26.67%)	Not Tested	2 (28.57%)
Ceftriaxone	4 (26.67%)	2 (25.00%)	2 (28.57%)
Ciprofloxacin	5 (33.33%)	3 (37.50%)	3 (42.86%)
Piperacillin-Tazobactam	11 (73.33%)	6 (75.00%)	5 (71.43%)
Amikacin	12 (80.00%)	5 (62.50%)	5 (71.43%)
Meropenem	13 (86.67%)	6 (75.00%)	6 (85.71%)
Imipenem	13 (86.67%)	6 (75.00%)	5 (71.43%)

* Note: Acinetobacter* spp. (n = 3) and Proteus mirabilis (n = 2) are excluded from this table for brevity, though they exhibited similar resistance profiles with 100% sensitivity to Polymyxin B/Colistin.*

DISCUSSION

Surgical site infections represent a pervasive challenge that compromises surgical success and patient safety. The present study documented a high culture positivity rate of 83.33% among clinically suspected SSI cases at FM Medical College and Hospital. This aligns closely with other contemporary Indian studies, such as Anusha et al. [8] and Negi et al. [9], which reported culture positivity rates ranging from 80% to 88%. The sterile cultures in 16.67% of cases might be attributed to the widespread preoperative use of empirical broad-spectrum antibiotics, infections driven by strict anaerobes not cultured in this protocol, or non-infectious postoperative inflammatory responses.

A distinct male predominance (59.72%) was observed, consistent with multiple national reports [10, 11]. This demographic trend is frequently linked to a higher volume of emergency trauma surgeries and outdoor occupational hazards among males. The maximum incidence of SSI was in the 41–60 years age bracket, likely reflecting the higher prevalence of associated comorbidities—such as diabetes mellitus and hypertension—which impair cellular immunity and wound healing [12].

Our bacteriological analysis identified Staphylococcus aureus (40.00%) as the most dominant standalone pathogen. Given its status as a ubiquitous skin commensal, S. aureus easily infiltrates incisions during the intraoperative or immediate postoperative phase [13]. Alarmingly, 46.15% of the S. aureus isolates were identified as MRSA. This high regional MRSA burden echoes the findings of Patnaik et al. [14] in neighboring Bhubaneswar and necessitates stringent contact isolation protocols for infected patients. Fortunately, all Gram-positive isolates remained universally susceptible to Vancomycin and Linezolid, preserving these as reliable definitive therapies.

A pivotal finding is the significant collective burden of Gram-negative bacilli (53.85%), spearheaded by E. coli (23.08%) and P. aeruginosa (12.31%). Their prevalence, particularly in General Surgery and OBG, underscores the endogenous translocation of bowel and genitourinary flora during complex cavitary surgeries [15]. The antibiogram of these Gram-negative isolates revealed a stark resistance crisis against third-generation cephalosporins (Ceftriaxone sensitivity <30%). This reflects the selective pressure exerted by the routine use of Ceftriaxone as a first-line prophylactic agent across peripheral health centers in Odisha. Carbapenems (Meropenem, Imipenem) and Piperacillin-Tazobactam continue to exhibit robust efficacy and should be judiciously reserved for deep-seated, severe SSIs to prevent the advent of Carbapenem-Resistant Enterobacteriaceae (CRE).

CONCLUSION

This study delineates that while Staphylococcus aureus remains the paramount causative agent of SSIs at FM Medical College and Hospital, Balasore, there is an aggressive encroachment by multidrug-resistant Gram-negative Enterobacteriaceae and non-fermenters. The substantial prevalence of MRSA and high-level cephalosporin resistance necessitates an immediate paradigm shift away from generic antibiotic prophylaxis. Institutional antibiograms must be dynamically updated, and infection control audits must be fortified to mitigate the escalating threat of antimicrobial resistance in surgical wards.

REFERENCES

1. Berríos-Torres SI, Umscheid CA, Bratzler DW, et al. Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017. JAMA Surg. 2017;152(8):784-791.

2. World Health Organization (WHO). Global Guidelines for the Prevention of Surgical Site Infection. Geneva: WHO; 2016.
3. Magill SS, Edwards JR, Bamberg W, et al. Multistate point-prevalence survey of health care-associated infections. N Engl J Med. 2014;370(13):1198-1208.
4. Owens CD, Stoessel K. Surgical site infections: epidemiology, microbiology and prevention. J Hosp Infect. 2008;70(Suppl 2):3-10.
5. Bhattacharya S, Pal K, Jain S, Chatterjee SS, Konar J. Surgical site infection by Methicillin Resistant Staphylococcus aureus- on decline? J Clin Diagn Res. 2016;10(9):DC32-DC36.
6. Procop GW, Church DL, Hall GS, Janda WM, Koneman EW, Schreckenberger PC, Woods GL. Koneman's Color Atlas and Textbook of Diagnostic Microbiology. 7th ed. Philadelphia: Wolters Kluwer; 2017.
7. Clinical and Laboratory Standards Institute (CLSI). Performance Standards for Antimicrobial Susceptibility Testing. 33rd ed. CLSI supplement M100. Wayne, PA: CLSI; 2023.
8. Anusha S, Slathia P, Bedi MPS. Aerobic bacteriological profile with their antibiogram in surgical site infections. Int J Adv Med. 2021;8(4):504-508.
9. Negi V, Pal S, Juyal D, Sharma MK, Sharma N. Bacteriological profile of surgical site infections and their antibiogram: A study from resource constrained rural setting of Garhwal region. J Clin Diagn Res. 2015;9(10):DC17-DC20.
10. Rajput A, Prajapati B, Chauhan B, Shah P. Bacteriological profile of surgical site infections and their antibiogram at a tertiary care hospital in Gujarat. Natl J Med Res. 2012;2(4):415-418.
11. Gadepalli R, Dhawan B, Sreenivas V, Kapil A, Ammini AC, Chaudhry R. A clinico-epidemiological study of surgical site infections in a tertiary care hospital in India. J Med Microbiol. 2014;63(Pt 10):1342-1348.
12. Kaye KS, Anderson DJ, Sloane R, et al. The effect of surgical site infection on older operative patients. J Am Geriatr Soc. 2009;57(1):46-54.
13. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection, 1999. Hospital Infection Control Practices Advisory Committee. Infect Control Hosp Epidemiol. 1999;20(4):250-278.
14. Patnaik N, Mallick B, Kar A. Aerobic Bacteriological Profile of Surgical Site Infection with Special Reference to MRSA at Hitech Medical College and Hospital, Bhubaneswar. Int J Curr Microbiol App Sci. 2019;8(2):309-314.
15. Mundhada AS, Tenpe S. A study of organisms causing surgical site infections and their antimicrobial susceptibility in a tertiary care government hospital. Indian J Pathol Microbiol. 2015;58(2):195-200.