Original Research Article

BACTERIOLOGICAL PROFILE OF SURGICAL SITE INFECTION AND THEIR ANTIBIOTIC SENSITIVITY PATTERN

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ABSTRACT

Background: Surgical site infections (SSIs) remain among the most common healthcare-associated infections and are associated with increased morbidity, prolonged hospitalization, increased healthcare expenditure, and mortality. The emergence of multidrug-resistant organisms has further complicated the management of postoperative wound infections. Understanding the bacteriological profile and antimicrobial susceptibility pattern of SSI pathogens is essential for guiding empirical therapy and infection control strategies. **Aim:** To determine the bacteriological profile of surgical site infections and evaluate the antimicrobial susceptibility patterns and resistance mechanisms among isolated pathogens.

Materials and Methods: A hospital-based prospective observational study was conducted over a period of 18 months among 400 postoperative patients clinically suspected of surgical site infections in the Department of General Surgery at a tertiary care hospital. Pus samples, wound discharge, aspirates, and drain fluids were collected aseptically and processed using standard microbiological techniques. Bacterial identification was performed by Gram staining, culture characteristics, and biochemical testing. Antimicrobial susceptibility testing was carried out using the Kirby–Bauer disk diffusion method according to CLSI 2022 guidelines. Detection of ESBL, AmpC β-lactamase, methicillin resistance, and metallo-β-lactamase(MBL) and MRSA production was performed by phenotypic methods.

Results: Out of 400 suspected SSI samples, 184 were culture positive, giving an overall prevalence of 46%. The rate of SSI was 6%. Gram-negative organisms predominated (85.32%), while Gram-positive organisms accounted for 14.67% of isolates. The most common isolates were *Escherichia coli* (22.82%), *Klebsiella pneumoniae* (19.02%), *Acinetobacter baumannii* (15.21%), *Pseudomonas aeruginosa* (14.67%), and *Staphylococcus aureus* (12.50%). Higher SSI rates were observed among males, elderly patients, obese individuals, diabetic patients, prolonged hospital stay, and surgeries lasting more than 2 hours. Imipenem, tigecycline, amikacin, and piperacillin-tazobactam showed higher efficacy against Gram-negative isolates, while vancomycin and linezolid remained highly effective against Gram-positive organisms. ESBL production was identified in 25.94% isolates, AmpC production in 10.12%, ESBL-AmpC co-production in 13.92%, and MBL production in 12.65% isolates. MRSA prevalence among *S. aureus* isolates was 71.42%.

Conclusion: SSI pathogens were predominantly multidrug-resistant Gram-negative bacilli. Increasing resistance to cephalosporins and β-lactam antibiotics highlights the need for continuous surveillance, antimicrobial stewardship, early microbiological diagnosis, and strict infection control measures to reduce SSI burden and improve patient outcomes.
Keywords: Surgical site infection, antimicrobial resistance, ESBL, AmpC, MBL, MRSA, multidrug-resistant organisms, bacteriological profile.

INTRODUCTION

Surgical site infection (SSI) is one of the most common postoperative complications encountered worldwide and remains a significant contributor to healthcare-associated morbidity and mortality. SSI is defined by the Centers for Disease Control and Prevention (CDC) as an infection occurring within 30 days after surgery or within one year if an implant is placed in orthopaedic, cardiac and breast surgeries and the infection appear related to the operative procedure. SSIs may involve superficial incisional tissue, deep soft tissues, or organ spaces manipulated during surgery. Despite advancements in surgical techniques, sterilization protocols, and antimicrobial therapy, SSIs continue to impose a substantial burden on healthcare systems globally.[1]

The incidence of SSI varies widely depending on patient-related factors, type of surgery, duration of hospital stays, wound classification, operative environment, and local infection control practices. In developing countries, the prevalence of SSI ranges from 10–40%, which is considerably higher than in developed nations. Increased prevalence in resource-limited settings is attributed to overcrowding, inadequate infection control measures, irrational antibiotic usage, poor nutritional status, and delayed diagnosis. [2,3]

SSIs are associated with prolonged hospitalization, increased antibiotic consumption, repeated surgical interventions, delayed wound healing, and elevated healthcare costs. In severe cases, SSIs may lead to septicemia, multiorgan dysfunction, and death. Early diagnosis and identification of causative organisms are therefore essential to minimize postoperative complications and optimize antimicrobial therapy.[4]

The bacteriological profile of SSIs varies according to geographical region, hospital environment, surgical specialty, and antimicrobial prescribing practices. Traditionally, Staphylococcus aureus was considered the predominant pathogen responsible for postoperative wound infections. However, recent studies have shown an increasing predominance of Gram-negative organisms such as Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Acinetobacter baumannii.[5,6] The emergence of multidrug-resistant organisms(MDRO), including methicillin-resistant Staphylococcus aureus (MRSA), extended-spectrum β-lactamase (ESBL) producers, AmpC β-lactamase producers, and carbapenem-resistant organisms, has complicated treatment protocols and increased therapeutic failures.[7]

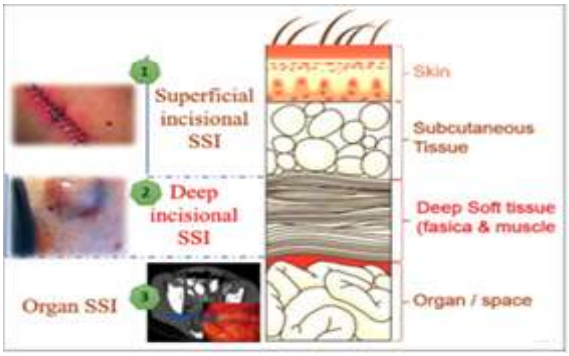
Antimicrobial resistance among SSI pathogens has become a major public health concern due to indiscriminate antibiotic usage, self-medication, incomplete treatment courses, and widespread empirical therapy without microbiological confirmation. Resistant organisms limit therapeutic options and increase morbidity, mortality, and economic burden. Continuous monitoring of antimicrobial susceptibility patterns is therefore necessary to formulate appropriate antibiotic policies and ensure effective empirical therapy.[8]

Several host-related factors predispose patients to SSIs, including diabetes mellitus, obesity, anaemia, smoking, malnutrition, advanced age, prolonged preoperative hospitalization, and immunosuppression. Operative factors such as emergency surgeries, prolonged duration of surgery, poor aseptic techniques, and contaminated wounds further contribute to infection risk. Identification and modification of these risk factors are crucial for prevention strategies.[9]

Microbiological evaluation of SSI involves direct microscopy, bacterial culture, biochemical identification, and antimicrobial susceptibility testing. Modern microbiology laboratories also perform phenotypic detection of resistance mechanisms such as ESBL, AmpC, and metallo-β-lactamase production to guide targeted antimicrobial therapy. Early identification of resistant strains assists clinicians in implementing appropriate treatment and infection control measures.[10]

In India, the prevalence of SSIs and antimicrobial resistance patterns differ significantly across hospitals and regions. Hence, periodic institutional surveillance studies are essential to understand local pathogen distribution and resistance profiles. Such data help clinicians choose suitable empirical antibiotics and assist policymakers in developing antibiotic stewardship programs.[11]

The present study was therefore undertaken to determine the bacteriological profile of surgical site infections and evaluate the antimicrobial sensitivity patterns of isolated pathogens among postoperative patients admitted in a tertiary care hospital. Additionally, the study assessed various resistance mechanisms including ESBL, AmpC, MBL, and MRSA production among SSI isolates.



MATERIALS AND METHODS

A hospital-based prospective observational study was conducted in the Department of Microbiology in collaboration with the Department of General Surgery at a tertiary care teaching hospital in Central India over a duration of 18 months from June 2022 to December 2023. Ethical clearance was obtained from the Institutional Ethics Committee prior to commencement of the study. Written informed consent was obtained from all participants included in the study.

The study included postoperative patients clinically suspected to have surgical site infections following elective or emergency surgeries. A total of 400 postoperative wound samples were collected from patients admitted in surgical wards and intensive care units. Sample size was calculated using the formula:

$$n = \frac{Z^2 pq}{e^2}$$

where ($Z = 1.96$) at 95% confidence interval, ($p = 49.57\%$), ($q = 50.43\%$), and permissible error ($e = 5\%$). The calculated sample size was approximately 384, which was rounded to 400 for better statistical significance.

Inclusion Criteria

1. Patients willing to provide informed consent.
2. Patients showing clinical signs and symptoms suggestive of postoperative wound infection.
3. Patients admitted for more than 48 hours and within 30 days of surgery.

Exclusion Criteria

1. Patients unwilling to participate.
2. Patients hospitalized for less than 48 hours.
3. Non-postoperative wound infections.
4. Stitch abscesses.

Sample Collection

Samples including pus, wound discharge, aspirates, and drain fluids were collected aseptically using sterile cotton swabs or sterile screw-capped containers prior to wound cleaning with antiseptic solution. Care was taken to avoid contamination with skin commensals. The specimens were transported immediately to the microbiology laboratory for processing.

Direct Microscopy and Culture

Direct smears were prepared from clinical samples, air dried, and Gram stained using standard techniques. Samples were inoculated onto Blood agar and MacConkey agar and incubated aerobically at 37°C for 16–18 hours. Colony morphology, hemolysis patterns, lactose fermentation, and Gram staining characteristics were studied.

Identification of Isolates

Bacterial isolates were identified using standard biochemical tests including catalase test, coagulase test, oxidase test, indole test, methyl red test, citrate utilization test, urease test, triple sugar iron test, oxidative-fermentative test, bile esculin test, nitrate reduction test, amino acid decarboxylation tests, and carbohydrate fermentation tests. Species-level identification was achieved using conventional microbiological methods.

Antimicrobial Susceptibility Testing

Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method on Mueller–Hinton agar according to CLSI 2022 guidelines. Bacterial inoculum turbidity was standardized to 0.5 McFarland standard before inoculation.

Antibiotic disks used for Gram-negative organisms included ampicillin, cefazolin, cefuroxime, ceftriaxone, cefotaxime, ceftazidime, cefepime, piperacillin-tazobactam, imipenem, aztreonam, gentamicin, amikacin, ciprofloxacin, levofloxacin, cotrimoxazole, tigecycline, and doxycycline. Gram-positive isolates were tested against penicillin, cefoxitin, vancomycin, gentamicin, erythromycin, clindamycin, linezolid, doxycycline, ciprofloxacin, chloramphenicol, and teicoplanin.

Detection of Antimicrobial Resistance Mechanisms

Phenotypic methods were used for detection of:

- Extended-spectrum β-lactamases (ESBL)
- AmpC β-lactamases
- Metallo-β-lactamases (MBL)
- Methicillin resistance in *Staphylococcus aureus*

Methods included double disk synergy tests, cefoxitin screening, Modified Hodge test, Carba NP test, and disk potentiation methods according to CLSI recommendations.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS software version 20. Categorical variables were expressed as frequencies and percentages. Statistical significance was assessed using Chi-square test, and p-values <0.05 were considered statistically significant.

RESULTS

A total of 400 postoperative wound samples from clinically suspected SSI patients were analyzed during the study period. Out of these, 184 samples yielded significant bacterial growth, resulting in an overall SSI prevalence of 46%, while 216 samples were culture negative. The rate of SSI was 6%.The relatively high culture positivity indicates the considerable burden of postoperative wound infections in the hospital setting.

Table 1: Culture Positivity and Type of Sample in Suspected SSI Cases

Parameter	Category	Total Samples	Culture Positive	Culture Negative	Percentage / Prevalence	p-value
Overall SSI culture result	Total samples	400	184	216	46% positive; 54% negative	<0.05
Sample type	Pus	272	128	144	47.05% positive	<0.05
	Drain fluid	128	56	72	43.75% positive	<0.05
Total	—	400	184	216	46%	—

Out of 400 clinically suspected surgical site infection samples, 184 were culture positive, giving an overall SSI prevalence of 46%. Pus samples showed slightly higher culture positivity, 128/272 cases (47.05%), compared with drain fluid samples, 56/128 cases (43.75%). This indicates that pus remains a highly useful specimen for bacteriological diagnosis of SSI.

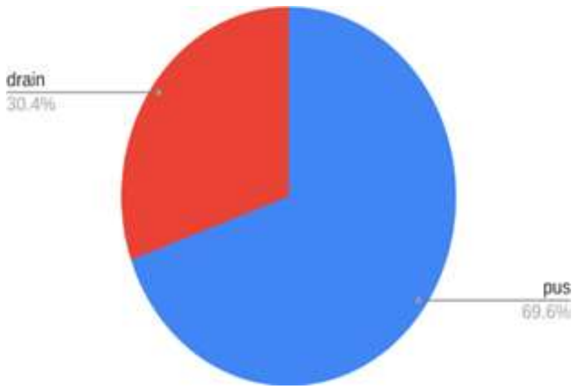
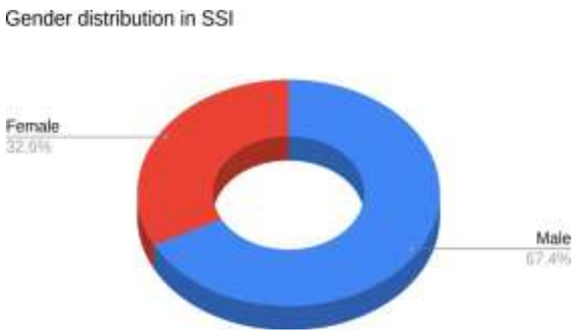
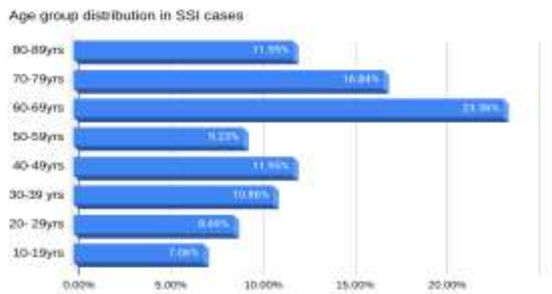


Table 2: Demographic, Clinical and Risk Factor Profile of Culture-Positive SSI Cases

Variable	Category	Positive SSI Cases	Percentage
Gender	Male	124	67.39%
	Female	60	32.60%
Age group	10–19 years	13	7.06%
	20–29 years	16	8.69%
	30–39 years	20	10.86%
	40–49 years	22	11.95%
	50–59 years	17	9.23%
	60–69 years	43	23.36%
	70–79 years	31	16.84%
	80–89 years	22	11.95%
Risk factor	Diabetes mellitus	96	52.17%
	Hypertension	85	46.19%
	Anemia	81	44.02%
	Hypertension + Diabetes	56	30.43%
	Smoking	41	22.28%
Hospital stay	<2 days	30	16.30%
	2–7 days	53	28.80%
	≥7 days	101	54.89%
Duration of surgery	≤2 hours	64	34.78%
	≥2 hours	120	65.21%

SSI was more common among males, 124 cases (67.39%), compared with females, 60 cases (32.60%). The highest positivity was observed in the 60–69 years age group (23.36%), followed by 70–79 years (16.84%). Diabetes mellitus was the most frequent risk factor, present in 96 cases (52.17%). Prolonged hospital stay of ≥7 days was associated with the highest SSI positivity, 101 cases (54.89%), and surgeries lasting ≥2 hours accounted for 120 cases (65.21%), suggesting that both prolonged hospitalization and operative duration significantly increase SSI risk.





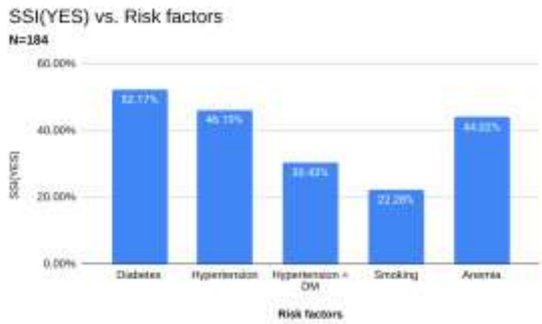
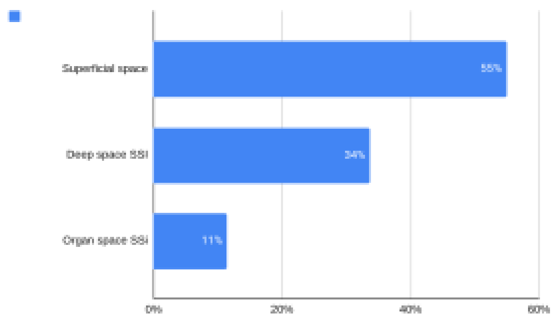


Table 3: Surgical Procedure, Type of SSI and Bacteriological Profile

Parameter	Category / Organism	Number of Positive Cases	Percentage
Surgery type	Internal abscess	15	8.15%
	Amputation	13	7.06%
	Appendectomy	31	16.84%
	Cholecystectomy	25	13.58%
	Hernia surgery	22	11.95%
	Laparotomy	37	20.19%
	Pelvic surgeries	18	9.78%
	GI surgeries	13	7.06%
	Scrotal surgery	8	4.34%
	Thyroidectomy	2	1.08%
Type of SSI	Superficial SSI	101	54.89%
	Deep SSI	62	33.69%
	Organ-space SSI	21	11.41%
Gram staining	Gram-negative organisms	157	85.32%
	Gram-positive organisms	27	14.67%
Isolated organism	*Escherichia coli*	42	22.82%
	Klebsiella pneumoniae	35	19.02%
	Acinetobacter baumannii	28	15.21%
	Pseudomonas aeruginosa	27	14.67%
	Staphylococcus aureus	23	12.50%
	Proteus mirabilis	8	4.34%
	Proteus vulgaris	6	3.26%
I	*Citrobacter koseri*	4	2.17%
	Enterococcus faecalis	4	2.17%

Laparotomy showed the highest SSI positivity with 37 cases (20.19%), followed by appendectomy with 31 cases (16.84%) and cholecystectomy with 25 cases (13.58%). Superficial SSI was the most common type, accounting for 101 cases (54.89%). Gram-negative organisms predominated markedly, forming 157 isolates (85.32%), while Gram-positive organisms accounted for 27 isolates (14.67%). Escherichia coli was the most common isolate, 42 cases (22.82%), followed by Klebsiella pneumoniae (19.02%), Acinetobacter baumannii (15.21%), Pseudomonas aeruginosa (14.67%), and Staphylococcus aureus (12.50%).The other medically important emerging pathogens were Citrobacter species,Enterobacter species,Providentia species ,Proteus species & Morganella morganii in Gram negative bacillis' & Enterococcus species in gram postive cocci arena.



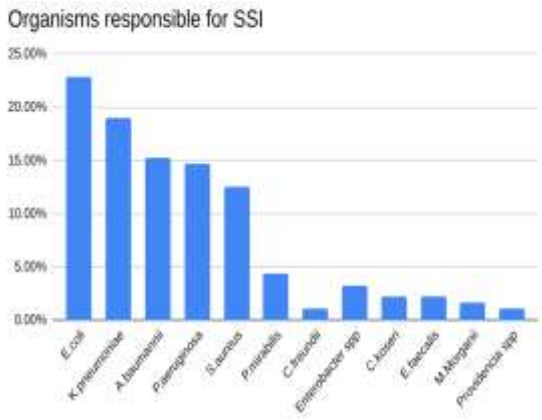
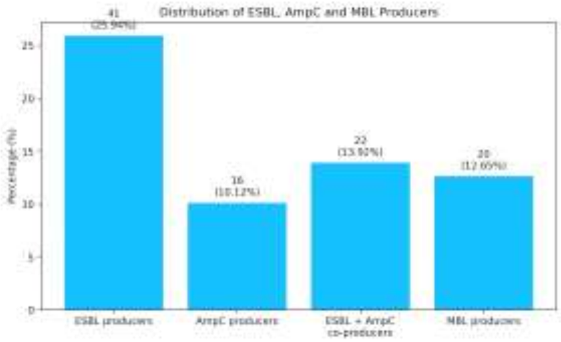
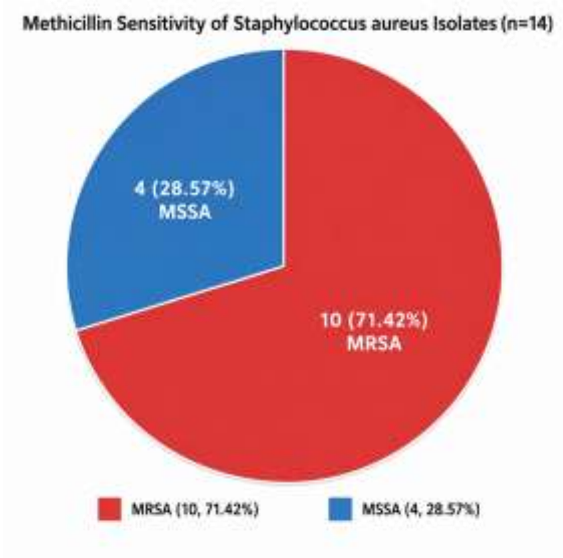


Table 4: Antibiotic Sensitivity and Resistance Mechanisms among SSI Isolates

Parameter	Organism / Resistance Pattern	Number / Sensitivity Pattern	Percentage
Enterobacteriaceae sensitivity	Imipenem sensitive isolates	—	95.24%
	Tigecycline sensitive isolates	—	94.29%
	Amikacin sensitive isolates	—	88.58%
	Gentamicin sensitive isolates	—	88.58%
	Piperacillin-tazobactam sensitive isolates	—	73.81%
Pseudomonas aeruginosa sensitivity	Aztreonam	—	92.60%
	Amikacin	—	88.89%
	Imipenem	—	77.78%
	Piperacillin-tazobactam	—	77.78%
Acinetobacter baumanii sensitivity	Tigecycline	—	96.43%
	Amikacin	—	82.15%
	Gentamicin	—	71.43%
	Imipenem	—	67.86%
Gram-positive sensitivity	Vancomycin	—	100%
	Linezolid	—	100%
	Teicoplanin	—	100%
Resistance mechanism (Beta lactamases)	ESBL producers	41	25.94%
	AmpC producers	16	10.12%
	ESBL + AmpC co-producers	22	13.92%
	MBL producers	20	12.65%
Methicillin resistance	MSSA	4	28.57%
	MRSA	10	71.42%





Among Gram-negative isolates, Imipenem, Tigecycline, Amikacin, Gentamicin, and

Piperacillin-tazobactam showed better antimicrobial activity. Pseudomonas aeruginosa showed maximum sensitivity to Aztreonam (92.60%) and Amikacin (88.89%), while Acinetobacter baumannii was most sensitive to tigecycline (96.43%) in non-fermenters category. Among Gram-positive organisms,Stapgylococcus aureus showed 100% sensitivity to Vancomycin, Linezolid, and Teicoplanin. ESBL production was observed in 25.94% isolates, AmpC in 10.12%, ESBL-AmpC co-production in 13.92%, and MBL in 12.65%. MRSA accounted for 71.42% of Staphylococcus aureus isolates, indicating a high burden of methicillin resistance.

DISCUSSION

Surgical site infections (SSIs) remain one of the most important postoperative complications and continue to pose a major challenge to surgeons, microbiologists, and healthcare systems worldwide despite remarkable advancements in aseptic precautions, sterilization procedures, antimicrobial therapy, and operative techniques. SSIs are associated with increased morbidity, prolonged hospitalization, delayed wound healing, repeated surgical interventions, increased healthcare expenditure, and mortality. In the present study, the overall prevalence of culture-positive SSI was found to be 46%, which is relatively high but comparable to studies conducted in developing countries where SSI prevalence ranges between 20–50%. Similar observations were reported by Mangram et al. and Allegranzi et al., who emphasized that inadequate infection control measures, overcrowding, prolonged hospital stay, poor nutritional status, and irrational use of antibiotics contribute significantly to the increased burden of SSIs in resource-limited healthcare settings.[1,2]

The present study demonstrated a clear predominance of Gram-negative bacilli, which constituted 85.32% of the total isolates, whereas Gram-positive organisms accounted for only 14.67%. This finding correlates with studies conducted by Mawalla et al. and Owens and Stoessel et al, who also reported increasing predominance of Gram-negative pathogens in postoperative wound infections.[3,4] The increasing incidence of Gram-negative organisms in hospital-acquired infections may be attributed to extensive empirical use of broad-spectrum antibiotics, prolonged exposure to hospital environments, and selection pressure favouring resistant nosocomial pathogens. Gram-negative bacteria possess multiple resistance mechanisms including β-lactamase production, efflux pumps, and porin modifications, making them highly adaptable in healthcare settings.

Among the isolated organisms, Escherichia coli was the most common pathogen followed by Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Staphylococcus aureus. Similar bacteriological profiles have been documented in previous studies involving abdominal and gastrointestinal surgeries where Enterobacteriaceae predominated due to contamination from endogenous intestinal flora.[5] The predominance of E. coli in the present study may be related to the higher number of laparotomy and appendectomy procedures included in the study population. Furthermore, contamination during surgery, compromised aseptic handling, and increased use of invasive devices may facilitate transmission of these organisms in hospital environments.

Age-wise distribution in the present study revealed that elderly patients, especially those between 60–69 years, were more susceptible to SSIs. Elderly individuals are known to have impaired immune response, poor nutritional status, reduced tissue perfusion, delayed wound healing, and multiple comorbidities, all of which increase susceptibility to postoperative infections. Similar observations have been reported by Calderwood et al. and Megahed et al., who identified advanced age as an independent risk factor for SSI development.[6] In addition, male predominance observed in the present study may be explained by increased exposure to smoking, occupational stress, trauma, and delayed healthcare-seeking behavior among men.

Diabetes mellitus was identified as the most significant associated risk factor in the present study and was present in more than half of the SSI-positive patients. Hyperglycemia adversely affects leukocyte chemotaxis, phagocytosis, collagen synthesis, and tissue repair mechanisms, thereby predisposing diabetic individuals to postoperative infections. Similar findings were reported by Megahed et al., who demonstrated significantly higher SSI incidence among diabetic patients undergoing elective and emergency surgeries.[6] Other associated risk factors observed in the present study included hypertension, anemia, obesity, and smoking. Obesity particularly contributes to poor wound vascularity, tissue hypoxia, increased dead space, and technical difficulty during surgery, thereby increasing the risk of wound infection.

The present study also demonstrated a strong association between prolonged duration of surgery and development of SSI. Surgeries lasting more than two hours were associated with significantly higher infection rates. Longer operative duration increases tissue handling, exposure to environmental contaminants, blood loss, and operative stress, thereby facilitating bacterial contamination and postoperative infection. Similar observations have been documented in studies by Calderwood et al., who reported operative duration as an important independent predictor of SSI,[5] Furthermore, prolonged hospital stay exceeding seven days was significantly associated with increased SSI prevalence in the present study. Extended hospitalization increases exposure to resistant hospital flora and facilitates cross-transmission of multidrug-resistant organisms.

Antimicrobial susceptibility testing revealed alarming resistance patterns among Gram-negative isolates. High resistance rates were observed against cephalosporins, amoxicillin-clavulanic acid, and fluoroquinolones. However, imipenem, tigecycline, amikacin, and piperacillin-tazobactam retained relatively good efficacy against Enterobacteriaceae. Similar resistance patterns have been reported by Singh et al. and Golia et al., who documented increasing resistance to third-generation cephalosporins among SSI pathogens in tertiary care hospitals.[7,8] Excessive empirical use of cephalosporins and broad-spectrum antibiotics has likely contributed to the emergence and dissemination of resistant strains in hospital environments.

One of the most important findings in the present study was the high prevalence of ESBL-producing isolates. ESBL production was identified in 25.94% of isolates, while AmpC β-lactamase production was detected in 10.12% isolates. In addition, ESBL-AmpC co-production was identified in 13.92% of cases. Similar findings have been reported by Paterson and Bonomo as well as Philippon et al., who highlighted the growing global prevalence of β-lactamase-mediated resistance among Enterobacteriaceae.[9,10] ESBL-producing organisms exhibit resistance to multiple penicillins, cephalosporins, and monobactams, thereby severely restricting therapeutic options and increasing treatment failures. Klebsiella pneumoniae and Escherichia coli were identified as the major ESBL producers in the present study, which is consistent with previously published literature.

The prevalence of metallo-β-lactamase (MBL)-producing isolates in the present study was 12.65%, predominantly among Acinetobacter baumannii. Carbapenem-resistant Acinetobacter infections are particularly concerning because of their remarkable survival ability in hospital environments and limited therapeutic options. Similar concerns have been highlighted by Nordmann et al. and Peleg et al., who described the worldwide emergence of carbapenemase-producing Enterobacteriaceae and multidrug-resistant Acinetobacter baumannii as major threats to healthcare systems.[11,12] Carbapenem-resistant infections are associated with prolonged hospitalization, increased mortality, and significant economic burden.

Among Gram-positive isolates, Staphylococcus aureus demonstrated high resistance to penicillin and cefoxitin, indicating a high prevalence of methicillin-resistant Staphylococcus aureus (MRSA). MRSA accounted for 71.42% of S. aureus isolates in the present study. Similar high MRSA prevalence has been reported in tertiary healthcare settings by Chambers and Fowler, who emphasized the increasing burden of resistant Staphylococcus aureus strains in the antibiotic era.[13] MRSA infections significantly limit treatment options and often require administration of reserve antibiotics such as vancomycin and linezolid. Fortunately, all MRSA isolates in the present study remained sensitive to vancomycin, linezolid, and teicoplanin, indicating that these agents continue to be highly effective against resistant Gram-positive pathogens.

The increasing burden of multidrug-resistant organisms identified in the present study emphasizes the urgent need for strict infection control practices and rational antibiotic stewardship policies. Similar conclusions were drawn by Maia et al., who demonstrated that infections caused by multidrug-resistant bacteria significantly increase hospital mortality among critically ill patients.[14] Adherence to WHO guidelines for prevention of surgical site infections, including proper hand hygiene, sterilization protocols, appropriate surgical antibiotic prophylaxis, and perioperative patient optimization, remains essential for reducing SSI incidence.[15] Furthermore, implementation of standardized antimicrobial susceptibility testing systems and quality assurance programs in microbiology laboratories is critical for accurate detection of resistance mechanisms and appropriate antibiotic selection, as highlighted by Counts et al.[16]

Overall, the findings of the present study underscore the importance of continuous microbiological surveillance, institution-specific antibiograms, and culture-guided antimicrobial therapy in the management of surgical site infections. Early identification of resistant pathogens and implementation of targeted therapy can significantly reduce postoperative morbidity, shorten hospital stay, minimize healthcare costs, and improve patient outcomes.

CONCLUSION

The present study demonstrated that surgical site infections are predominantly caused by multidrug-resistant Gram-negative bacilli, particularly Escherichia coli and Klebsiella pneumoniae. Diabetes mellitus, obesity, prolonged hospital stay, elderly age, and extended operative duration were important risk factors associated with SSI development. High prevalence of ESBL, AmpC, MBL, and MRSA-producing organisms indicates increasing antimicrobial resistance among SSI pathogens. Imipenem, tigecycline, amikacin, vancomycin, and linezolid remained relatively effective against resistant isolates.

Strict infection control measures, rational antibiotic usage, continuous microbiological surveillance, and early culture-guided therapy are essential to reduce SSI incidence and improve postoperative patient outcomes.

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