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Original Article

Surgical Site Infection in Patients following Elective Surgeries, A Prospective Observational Study

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ABSTRACT

Background: Surgical site infections (SSIs) are one of the major sources of morbidity and prolonged hospital stays in surgical patients, with approximately 15% of all nosocomial infections being attributed to SSIs. Despite recent surgical advancements, sterilization methods, and antimicrobial therapies, SSIs continue to pose an increased concern in healthcare. Understanding various factors influencing SSI development is critical to improving patient outcomes.

Methods: A prospective study (June 2023–December 2024) included 126 patients (18–60 years) undergoing elective general surgery. Data from preoperative, intraoperative, and 30-day postoperative follow-ups were analyzed. Variables: demographics, comorbidities, surgery type, duration, infection rates, and microbial cultures.

Results: Out of 126 patients, the overall infection rate was 9.52%, with a higher rate in clean-contaminated surgeries (23.33%) compared to clean surgeries (5.21%). Diabetic patients exhibited a higher infection rate (75%), particularly those with poor glycemic control (HbA1c > 7). The highest infection rate in clean-contaminated surgeries was observed in lower gastrointestinal tract resections (71.43%). Additionally, infections were more common in surgeries requiring drains and those with longer durations. Staphylococcus aureus was the most common pathogen identified, with all strains showing penicillin resistance.

Conclusions: This study highlights the significant role of patient-related factors, surgical class, and surgical techniques in the development of SSIs. Diabetes, poor glycemic control, prolonged surgeries, and the use of drains were identified as major risk factors. The findings underscore the importance of preventive strategies targeting the factors that reduce the incidence of SSIs and enhance the outcomes for the one's undergoing elective surgeries.

Key-words: Clean surgeries, Clean-contaminated surgeries, Glycemic control, Hypoalbuminemia, Nosocomial infections, Surgical Site Infections (SSIs)

INTRODUCTION

Surgical Site Infections (SSIs) are the most common infections acquired by surgical patients, accounting for roughly 15% of all nosocomial infections [1]. "SSIs are defined as infections occurring up to 30 days after surgery (or up to one year after surgery in patients receiving implants) and affecting either the incision or deep tissue at the operation site" [2].

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Postoperative infections can prolong hospital stays, increase expenses, higher readmission rates, and compromise health outcomes, emphasizing the critical importance of preventing these infections in the first place [3].

The etiology of SSI is multifactorial, involving a complex interplay of patient-specific factors, procedural variables, and environmental considerations [4]. Patient-related risk factors encompass a broad spectrum of conditions and behaviors that can compromise the body's natural defenses against infection, increasing the susceptibility to SSI. These include age, obesity, diabetes mellitus, malnutrition, smoking, immunosuppression, and the presence of remote infections [5]. Patients with diabetes mellitus undergoing surgical procedures face a

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heightened risk of developing SSI, necessitating a comprehensive understanding of the underlying mechanisms and effective preventative strategies [6,7].

Antimicrobial prophylaxis is also recommended in certain situations; however, the Centers for Disease Control and Prevention's guidelines for SSI prevention place a strong focus on aseptic practice, proper surgical technique, and adequate patient preparation [8,9]. There is a compelling case for evaluating developing technologies and implementing them into routine clinical practice when appropriate, given their potential to seal and immobilize skin flora throughout a surgical procedure. Microbial sealants are one example of this type of technology [10-12]. All present investigations demonstrated a significant risk of bias, primarily due to insufficient management of outcome events, missing data, lack of model performance evaluation, and overfitting, necessitating further research. This study aims to assess the prevalence, describe the risk factors, and analyze the microbial etiology of SSIs in elective surgeries at a tertiary care hospital in Mandya.

MATERIALS AND METHODS

Study Design and Setting- This hospital-based prospective observational study was conducted from June 2024 to December 2024 in the General Surgery Department of a tertiary care hospital in Mandya.

Sample Size and Selection Criteria- A total of 126 patients (aged 18–60 years) undergoing elective clean or clean-contaminated surgeries were included. The sample size was determined using the formula:

$$N = Z(1-\alpha/2)^2 \times p \times q/d^2,$$

with an infection rate (P) of 8.95%, q = 91.05, and a 5% error.

Inclusion Criteria- Adult patients who consented to a 30-day follow-up.

Exclusion Criteria- Immunocompromised patients and those with vascular flow-altering conditions (IHD, CKD).

Data Collection and Follow-up- Preoperative, intraoperative, and postoperative data were collected, including:

Demographics- Age, sex, comorbidities (diabetes, hypertension).

Surgical Variables- Type of surgery, duration, use of drains.

Antibiotic Prophylaxis:

- Clean cases: Single-dose Ceftriaxone 1g.
- Clean-contaminated cases: Ceftriaxone 1g (twice daily) + Metronidazole (thrice daily) for three days.

Postoperative Monitoring- Wound healing was assessed weekly for 30 days.

Statistical Analysis- Data were entered into Microsoft Excel and analyzed using descriptive statistics (mean, SD, frequency). The Chi-square test assessed associations between SSI and variables (age, sex, HbA1c, WBC count). A p-value≤0.05 was considered statistically significant.

Ethical approval- This study was approved by the Institution Ethics Committee, Mandya Institute of Medical Sciences (MIMS), Mandya (Approval No. MIMS/IEC/2025/1015, dated 27 March 2025). Written informed consent was obtained from all participants before their inclusion in the study.

RESULTS

Our study demonstrated the majority of the 126 patients (26) had inguinal hernia surgeries, followed by umbilical hernia surgeries (14) and amongst the total, 96 (76.19%) had clean surgeries and 30 (23.33%) had clean-contaminated surgeries. The group with diabetes had a mean age of 55.3 years, while the non-diabetic group was 45.8 years. Both groups exhibited a preponderance of infection in males. Twelve of the 190 patients in this study experienced surgical site infections, yielding a 9.52% overall infection rate. SSI rate was 23.33% in clean-contaminated surgeries and 5.21% in clean surgeries (Table 1).

Table 1: Surgical site Infection rate overall and by wound classification

Wound class	Number of Patients (%)	Number infected (%)
Clean	96(76.19%)	5(5.21%)
Clean-contaminated	30(23.81%)	7(23.33%)
Total	126	12(9.52%)

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It was determined that the difference was statistically significant. Mesh repair for umbilical hernias had the highest infection prevalence (21.43%) among clean operations, whereas patients who underwent inguinal hernia, fibroadenoma, thyroid, and appendectomy surgeries did not experience any surgical site infections (Table 2). Infection rates were extremely high in clean-contaminated procedures, particularly for patients who had lower gastrointestinal tract surgery for cancer that required resection and anastomosis (71.43%). While the surgical site infection rate was significantly high (32.42%) for operations lasting 120 minutes or more, there was comparatively less infection in procedures lasting less than 30 minutes.

Table 2: Surgical site infection in various surgeries

Operation	Number of Patients	Patients (%)	Number infected	Infected (%)
Hydrocele	11	8.73%	2	18.18%
Inguinal hernia	26	20.63%	0	0.00%
Umbilical hernia	14	11.11%	3	21.43%
Cholelithiasis – Lap*	9	7.14%	0	0.00%
Cholelithiasis – Open*	1	0.79%	1	100.00%
Breast (malignancy)	10	7.94%	0	0.00%
Breast (Benign)	8	6.35%	0	0.00%
Thyroid	9	7.14%	0	0.00%
Appendix*	10	7.94%	0	0.00%
Benign upper GI disease*	3	2.38%	0	0.00%
Upper GI Malig*	3	2.38%	1	33.33%
Lower GI Malig*	7	5.56%	5	71.43%
Phimosis	8	6.35%	0	0.00%
Others#	7	5.56%	0	0.00%
Total	126		12	

** Clean contaminated cases; # Others include – excisions like sebaceous cyst, lipoma, neurofibroma and other benign epidermal swellings*

SSIs were common in diabetics when compared to non-diabetics 9 (75%). Among the diabetic group only once with FBS <180mg/dl on the day of surgery underwent surgery and amongst them, 77.8% of them had HbA1c levels over 7 indicating inadequate glycaemic control. Wound infection was seen in the cases where a drain was placed which includes a corrugated tube for hydrocele, suction drain for mesh repair and ADK drain for abdominal cases. Significant statistical difference was observed when compared to the group without drain. The wound infection rate with blood loss did not show any significant changes. Wound infection was also significant in patients with hypoalbuminemia 4 (30%).

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Out of 12 infected wounds, four had negative cultures. The most frequent isolate from the remaining eight infected wounds was *S. aureus*, which was followed by *Klebsiella*. Each of the four strains of *S. aureus* exhibited penicillin resistance.

DISCUSSION

In this study, 126 patients undergoing various surgical procedures had their incidence of SSIs assessed. The overall SSI rate was 9.52%, with a significantly higher infection rate observed in clean-contaminated surgeries (23.33%) compared to clean surgeries (5.21%) [13]. This finding aligns with previous studies highlighting the increased risk of infection in procedures involving the gastrointestinal tract and other potentially contaminated fields [14].

Among clean surgeries, mesh repair for umbilical hernia showed the highest infection rate (21.43%) [15]. Factors such as the presence of foreign material (mesh), subcutaneous dissection and plane creation, and longer operative times likely contributed to the increased infection risk. Conversely, no infections were reported in surgeries for inguinal hernia, thyroidectomy, fibroadenoma excision, and laparoscopic cholecystectomy, indicating a lower risk in these procedures [16].

In clean-contaminated surgeries, the infection rate was significantly elevated in lower gastrointestinal malignancy cases (71.43%), which is consistent with the inherent risk of bacterial contamination during bowel resections and anastomoses [17]. This suggests the need for stricter perioperative management and prophylactic antibiotic use in these cases [18].

Diabetes emerged as a significant risk factor for SSI, with 75% of the infected patients being diabetic [19]. Poor glycemic control, indicated by HbA1c levels over 7 in 77.8% of diabetic patients, contributed to the higher infection rates [20]. This underlines the importance of preoperative glycemic optimization to mitigate SSI risk.

A notable association was observed between increased operative time and SSI. Procedures lasting ≥120 minutes had a higher infection rate (32.42%) compared to those completed in 30 minutes or less [21]. Longer operative times often lead to greater tissue trauma, increased bacterial exposure, and higher infection risk, emphasizing the need for efficient surgical practices [22].

A greater incidence of SSI was linked to the use of surgical drains, particularly in procedures using corrugated tubes, suction drains, and ADK drains [23]. While drains may be necessary in certain cases to prevent fluid accumulation, their presence can serve as a conduit for bacterial entry. Careful assessment of drain necessity and ensuring strict aseptic measures are essential [24].

Additionally, hypoalbuminemia was linked to a higher infection rate (30%), reflecting its role as a marker of poor nutritional status and impaired wound healing [25]. Nutritional optimization should be considered as part of preoperative management [26].

Among the culture-positive infections, *S. aureus* was the most common isolate, followed by *Klebsiella* [27]. Notably, every strain of *S. aureus* exhibited penicillin resistance, highlighting the need for appropriate empirical antibiotic selection based on local antimicrobial resistance patterns [28].

CONCLUSIONS

The study demonstrates that SSI rates are significantly influenced by factors such as type of surgery, diabetes, glycemic control, operative duration, use of drains, and nutritional status. Preventive strategies including optimized glycemic control, judicious use of drains, minimizing operative time, and addressing hypoalbuminemia can reduce the burden of SSI significantly. Further multicenter studies are warranted to validate these findings and develop comprehensive SSI prevention protocols.

CONTRIBUTION OF AUTHORS

Research concept- Sathkar U Shetty, Abhishiek CV
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