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SURGICAL SITE INFECTIONS IN GASTROINTESTINAL SURGERIES – AN OBSERVATIONAL STUDY

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Abstract

Background: Gastrointestinal surgery is frequently associated with an increased risk of surgical site infections (SSIs), contributing to considerable morbidity and financial burden. However, data on SSIs in Indian settings, which are characterised by resource scarcity, remain limited. This study aimed to investigate the incidence of SSI and identify factors associated with gastrointestinal surgeries in a hospital setting in India. **Materials and Methods:** This prospective observational study was conducted at tertiary care hospital. We collected data from 300 patients who underwent gastrointestinal surgery in the Department of General Surgery were included. Sociodemographic details, obesity status, and medical history, including anaemia, diabetes, and hypoproteinaemia, were recorded. The surgical plan (elective or emergency), wound class, surgery duration, and causative organisms were collected. **Result:** Of the 300 patients, 31 were infected (10.3% infection rate). Among males (n=190), 22 (11.57%) developed infections compared to 9 (8.18%) females (n=110). Surgeries under 2 h had a 7.90% infection rate (19 out of 240 cases), while longer surgeries accounted for 20% (12 out of 60 cases). Elective surgeries had a lower infection rate (2.70%) than did emergency surgeries (21.60%). The dominant causative organisms were Pseudomonas (45.10%), Klebsiella (25.80%), Escherichia coli (22.50%), and Streptococcus (6.45%). Risk factors were significantly associated with anaemia (30.90% infection rate), diabetes mellitus (34%), hypoproteinaemia (26.30%), and obesity (23.70%). **Conclusion:** This study highlights the significant risk factors for SSI, including diabetes, obesity, anaemia, and hypoproteinaemia, with Pseudomonas as the most common causative organism. Identifying these risks allows surgeons to implement targeted SSI prevention strategies, particularly in resource-limited settings with unclear SSI reduction policies.

INTRODUCTION

Surgical site infection (SSI) is defined as an infection that develops in a wound created during surgery. SSI is particularly prevalent in lower- and middle-income countries and is the most frequently reported hospital-acquired infection, with markedly elevated risk compared to developed nations. The pooled incidence of SSI is 11.8% across lower- and middle-income countries.[1] The reported incidence of SSIs among hospitalised patients is approximately 2%. However, this figure might underestimate the true rate because of incomplete postoperative discharge records. Additional evidence indicates that SSIs occur at rates varying from 3% to 20% for certain procedures, potentially increasing among high-risk patients. SSIs entail significant morbidity and long-term complications due to compromised wound healing and extensive tissue damage.[2,3]

SSI typically emerges within 30 days post-surgery, or up to one year if an implant is involved.4 According to the World Health Organization (WHO), SSIs is the second most prevalent hospital-acquired infection, particularly in the USA and Europe. They prolong hospital stays and impose additional financial constraints on the healthcare systems. Notably, the incidence of SSI tends to be higher in developing nations than in developed nations. A 2019 surveillance initiative examined SSI occurrences post-discharge among patients who had undergone clean and clean-contaminated surgical procedures, revealing an incidence rate of 15% in lower-middle-income countries.[4-6]

In India, SSIs are a prominent contributor to both morbidity and mortality.[1] The incidence of SSIs varies widely, with rates ranging from 1.6% to 38% depending on the specific setting. This variability can be attributed to diverse factors including the demographics of the hospital population, variations in clinical protocols, disparities in infection control practices, and differences in hospital environments.[7-9]

Despite advancements in surgical practices and infection prevention efforts, surgical site infections remains a significant global concern. Even in hospitals with modern facilities and standard protocols, these rates are increasing. Moreover, in resource-limited developing countries, essential procedures such as appendectomies and caesarean sections carry high infection rates and mortality.[10]

Given the variability of SSI rates across different regions of India and the limited availability of data from various hospitals, there is a need to comprehensively assess the incidence and determinants of SSIs. This study aimed to address this gap by estimating the SSI incidence rate and identifying the associated factors in a specific hospital setting in India.

MATERIALS AND METHODS

This was a prospective observational study carried out in a tertiary care hospital. The data for the present study were collected from patients who underwent gastrointestinal surgery.

Inclusion Criteria

All patients undergoing elective and emergency abdominal surgeries and those over 18 years of age, of both sexes, were included.

Exclusion Criteria

Patients who had already been on antibiotic therapy for more than one week and those undergoing re-operations were excluded.

Surgical sites were considered infected based on the criteria set by the National Nosocomial Infection Surveillance System (NNIS).

The NNIS parameters assign a point value based on specific criteria: a point value of 0 is given for ASA grade 1 or 2, wound class 1 or 2, and operations lasting less than T hours (where T is the 75th percentile duration for the procedure); a point value of 1 is assigned for ASA grades 3, 4, or 5; wound class 3 or 4; and operations lasting > T hours.

The NNIS Risk Index indicates the risk of surgical site infection (SSI) as follows: a score of 0 corresponds to a 1.5% risk, a score of 1 corresponds to a 2.9% risk, a score of 2 corresponds to a 6.8% risk, and a score of 3 corresponds to 13% risk.

The wound classification was categorised as follows: Class 1, clean; Class 2, clean-contaminated; Class 3, contaminated; and Class 4, dirty-infected.

Ethical Consideration

Approval from the Institutional Ethics Committee was obtained before conducting the study. All patients provided written informed consent prior to inclusion in the study.

Data Collection

We included a total of 300 patients who volunteered and received a comprehensive explanation of the procedure's merits and demerits in the study, provided they met the inclusion criteria. Furthermore, we collected information on various risk factors, including the sociodemographic profile and biomedical characteristics of the subjects, such as body mass index (BMI) and past medical history of anaemia, diabetes, and hypoproteinaemia.

Information related to the surgical plan (elective or emergency) was recorded before surgery. Intraoperatively, data regarding the wound class and duration of surgery were recorded. The primary outcome of interest was superficial SSI, defined as an infection confined to the skin and subcutaneous tissue with organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.

Statistical Analysis

Data were entered and analysed using SPSS software. The frequencies of all the variables were derived to ensure data completeness. The magnitude was expressed as a percentage and the incidence rate of SSI was estimated.

RESULTS

Of the 300 total cases, 31 were infected, resulting in an infection rate of 10.3%. Among the male patients (n=190), 22 (11.57%) developed infections, whereas among the female patients (n=110), 9 (8.18%) developed infections. The duration of surgery had a notable impact on infection rates: surgeries lasting < 2 hours had a 7.90% infection rate (19 cases) out of 240 cases, whereas those lasting more than 2 hours had 12 out of 60 cases (20%).

Table 1: Characteristics of SSI Cases: plan of surgery, causative organisms, and associated risk factors

		Total cases (n=300)	Infected cases (n=31)	Percentage infected (10.3%)
Sex	Male	190	22	11.57%
	Female	110	9	8.18%
Duration of surgery	< 2 hours	240	19	7.90%
	> 2 hours	60	12	20%
Plan of surgery	Elective	180	5	2.70%
	Emergency	120	26	21.60%
Causative organisms	Pseudomonas		14	45.10%
	Klebsiella		8	25.80%
	E. coli		7	22.50%

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	Streptococcus		2	6.45%
Risk factors	Anaemia	84	26	30.90%
	Diabetes mellitus	97	33	34%
	Hypoproteinaemia	38	10	26.30%
	Obesity	135	32	23.70%

The surgical plan also significantly influenced the infection rates. Elective surgeries had a lower infection rate, with 5 cases of infections out of 180 cases (2.70%), compared to emergency surgeries, which had 26 cases of infections out of 120 cases (21.60%). The most common causative organisms identified were Pseudomonas (14 cases, 45.10%), followed by Klebsiella (8 cases, 25.80%), E. coli (7 cases, 22.50%), and Streptococcus (2 cases, 6.45%).
Various risk factors are associated with higher rates of infection. Among patients with anaemia (n=84), 26 (30.90%) developed infections. Patients with DM (n=97) had an infection rate of 34%. Hypoproteinaemia was present in 38 patients, 10 (26.30%) of whom developed infections. Moreover, among obese patients (n=135), 32 (23.70%) experienced infections [Table 1].

DISCUSSION

In the present study, the SSI rate was 10.3%. This was lower than that reported in similar studies conducted in India. Mekhla and Borle found a cumulative incidence rate of superficial SSI to be 39% at a rural teaching hospital in central India,1 while Modi and Kalaria reported an overall infection rate of 17.25% among 400 cases in Surat, Gujarat, India.[11] Another study conducted by Jain, et al in Bhopal, Madhya Pradesh, found that the overall incidence of SSI was 23.07%.[12]
A recent study by Saad et al observed that, out of 384 patients who underwent abdominal surgery, 34.9% developed SSIs, with 54.2% being males and 45.8% being females.[13] Moreover, Jatoliya, et al. observed that out of 100 patients, 17 patients experienced SSIs, with 16.66% SSI incidence in male and 18.18% in female patients from Jodhpur, Rajasthan.[3]
The reduced incidence of SSI observed in this study may be attributed to the urban setting. Patients in urban areas tend to seek medical attention earlier during their illness, have fewer significant comorbidities, and benefit from better sanitation and personal hygiene practices. Additionally, the incidence of SSIs was higher in male patients than in female patients (11.57% vs. 8.18%). This difference may be attributed to the generally enhanced immune function observed in females and variations in skin colonization between males and females.[1]
Premorbid conditions, such as diabetes, anaemia, and hypoalbuminaemia, have consistently been identified as high-risk factors for developing SSI in previous studies, a finding supported by our study.[1,11,14] This increased risk is likely attributed to impaired wound healing in affected individuals.
Indeed, underlying conditions, such as anaemia, diabetes, and smoking, can compromise the immune system, substantially increasing the risk of SSI. Additionally, these conditions often prolong the preoperative stay of patients, further increasing the risk of SSI in such individuals.[7] In our study, several risk factors are associated with higher infection rates. Among patients with anaemia (n=84), 30.90% developed infections, whereas Patients with DM (n=97) had an infection rate of 34%. Hypoproteinaemia was present in 38 patients, with 26.30% of them developing infections. Moreover, among obese patients (n=135), 23.70% experienced infections. Each additional day of hospitalization contributes to the risk of acquiring SSI, as supported by studies in Mumbai and Western Rajasthan.[15,16]
Narula et al. found that the SSI rate was 7.25% in patients hospitalised for less than two days, 15.02% in those hospitalised for two–five days, and 26.61% in those hospitalised for more than five days. This trend may be attributed to the heightened likelihood of nosocomial strain colonization among patients during prolonged hospital stays.[16]
Additionally, our observations revealed that among the organisms cultured from postoperative wounds, Pseudomonas was the most prevalent (45.10%), followed by Klebsiella (25.80%), E. coli (22.50%), and Streptococcus (6.45%). Data from the NNIS indicate that there has been no significant change in the distribution of pathogens causing SSIs over the past decade.[17] Common pathogens include S. aureus, coagulase-negative staphylococci, Enterococcus spp., and E. coli. However, antimicrobial-resistant pathogens such as methicillin-resistant S. aureus (MRSA) and Candida albicans are increasingly implicated in SSIs, indicating a rise in their prevalence and contribution to SSIs.[3]
SSIs are associated with a prolonged postoperative stay and affect patient recovery. In addition, longer operative times were associated with higher SSI rates and prolonged hospital stays. Although our study did not assess economic implications, prolonged stays likely increased healthcare costs. Various modifiable factors contribute to SSIs, offering opportunities to prevent or reduce their incidence. Preoperative optimisation is vital in elective surgeries, and proper resuscitation in emergencies can reduce and improve outcomes and mitigate the risk of SSIs.

Limitations

The study's limitation lies in its single-centre design, potentially constraining the generalisability of the findings to diverse healthcare settings. Additionally, its focus on a specific geographic region raises concerns about its applicability to populations with differing demographics or healthcare systems. Notably, several known SSI-associated factors, such as preoperative shaving, antibiotic use, and hospital duration, have not been addressed. Furthermore, the study lacked an exploration of long-term outcomes or an assessment of interventions aimed at mitigating surgical site infections.

CONCLUSION

Identifying various risks allows surgeons to implement targeted SSI prevention strategies, especially in resource-constrained settings, without clear SSI reduction policies. Moreover, these findings aid in comprehending the SSI burden and guiding the development of infection control strategies to enhance the delivery of quality healthcare services to the population. Future research should focus on large prospective cohort studies with prolonged post-procedural follow-up periods.

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