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Original Research Article

Surgical site infections in elective and emergency general surgery cases in a tertiary public hospital of South India: a retrospective study

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ABSTRACT

Background: Surgical site infections (SSIs) are responsible for increased morbidity and mortality among post-operative patients worldwide. They also increase healthcare costs and prolong the duration of hospital stay. This study aims to determine the incidence of SSIs in elective and emergency general surgery and its association with various risk factors.
Methods: A retrospective cohort study was carried out using the case sheets of 200 patients who underwent general surgery in a tertiary public hospital of South India. The patients were selected from two cohorts- emergency and elective (100 from each). The data retrieved from the hospital's electronic medical records were analyzed using STATA version 14.0.
Results: Of the 200 patients included in the study, 57% were men and the mean (range) age was 49.3 (18-88) years; 122 patients (61%) had contaminated wounds, 68 patients (34%) had a pre-existing comorbidity and the average duration of hospital stay was 6.98 days. The overall surgical site infection rate was 11%; 13% in emergency surgery and 9% in elective surgery. *Staphylococcus aureus* was isolated from 36% of the patients with surgical site infections.
Conclusions: Emergency surgery reported a higher infection rate than elective surgery. Old age, pre-existing medical illnesses, wound contamination and prolonged hospital stay were also found to increase the risks for developing SSIs.

Keywords: Surgical site infection, Morbidity, Mortality, Hospital stay, Post-operative care

INTRODUCTION

A surgical site infection (SSI) is defined as an infection that develops within 30 days after a surgical procedure if no implants are placed and within one year if an implantable device is placed in the patient. In general, the incidence of SSIs depends on the interaction between four important factors: inoculum of bacteria, pathogenicity of bacteria, microenvironment of the surgical site, and host immunity. Surgeries having a long operation time and those that involve body cavities naturally inhabited by bacteria are associated with a higher incidence of SSIs. The surgical site can also be classified as clean, clean-contaminated, contaminated and dirty which can then be used to predict the risk of acquiring an SSI.[1] Host factors like extremes of age, malnutrition, diabetes, smoking, cancer and other comorbidities that decrease immunity can also predispose to SSIs.

Despite the advancements made in asepsis, antimicrobial prophylaxis, sterilized operation techniques and hospital care, surgical site infection continues to be one of the major problems that develops post-operatively.[2] Even in hospitals with the most modern facilities, having standard protocols of preoperative preparation and antibiotic prophylaxis, SSIs increase the cost, morbidity and mortality rates related to surgical procedures. They even deteriorate the quality of life and productivity of patients who undergo surgery.[3] SSIs can prolong hospital stay, increase laboratory expenses for the diagnosis as well as antimicrobial susceptibility testing of the infecting organism, and increase the use of antibiotics to manage the infection. Patients who develop an SSI are 5 times more likely to revisit the hospital for the management of the infection. Such patients are 60% more likely to spend time in an ICU, and their mortality rate doubles when compared to a non-infected patient. It is important to note that almost 40-60% of these infections can be prevented by taking proper precautions.[4]

A fall in the infection rate can help increase patient comfort and reduce the expenses spent on medical resources in public hospitals. Hence, SSIs serve as an index of the quality of care provided by hospitals.[5] A study conducted by the World Health Organization (WHO) showed high income countries to have low infection rates, ranging from 0.9% in the US to 2.8% in Australia, while low to middle income countries, like India, persistently reported higher incidence of SSIs in the range of 6.3-9.3%.[6] When compared to first world nations, these countries often record a higher rate of SSIs mainly due to their limited resources resulting in irregular guidelines and a poor implementation of any such guidelines in the fields of antibiotic use and infection control. These hospitals also suffer from overcrowding, a lack of trained medical professionals, healthcare supplies, and an effective surveillance programme contributing to increased risk of nosocomial infections as a whole.[7] In developing countries like India, SSIs are the most commonly reported hospital acquired infection.[8]

Although people are under the general impression that the incidence of SSIs is higher in emergency when compared to elective surgeries, the literature to support or disprove it has been rather vague.[9] This study aims to compare the prevalence of SSIs in elective and emergency general surgical procedures in a tertiary care centre of South India. The study was done in South India because it represents a unique healthcare environment with a diverse patient population and experiences a high burden of surgical procedures. By elucidating the specific challenges and characteristics of SSIs in this region, our study will enable healthcare providers to implement targeted preventive measures, thus reducing the incidence of SSIs, and improving patient outcomes.

METHODS

This was a record-based, retrospective cohort study. Hence no new data were collected from the patients and a waiver of consent was obtained from the institution. The approval of the institute's ethics committee was also obtained. The data from the case records of patients who underwent general surgery in the tertiary care centre between 15 May 2022 and 15 July 2022 were collected. Only those patients, above 18 years of age, who had undergone surgery under general or regional anaesthesia and had completed the 30 days of follow-up before August 2022 were included in the study. Patients who have had a previous abdominal surgery, immuno-compromised patients, patients on chemotherapy, and patients who came to the emergency in a state of septic shock were excluded from the study.

Assuming the difference between the incidence of SSIs in elective and emergency general surgery to be 15% (lower in elective surgeries,[10] and to achieve this with 80% power and an alpha error of 0.05, the data of a total of 200 patients were required with 100 in each category (emergency and elective). The case sheets of the patients were collected from the hospital's medical records department to compile data regarding patient parameters like age, gender, dates of admission, surgery and discharge as well as presence of comorbidities. Details of the surgery like wound class, diagnosis, surgical procedure done, duration of hospital stay and antibiotic prophylaxis were also collected.

Generally, in a hospital, patients are monitored by their primary physician for signs of SSIs for up to 30 days following the surgery. This study was based on the data recorded by physicians that attended the patients during their follow up visits. A patient was considered positive for an SSI if any one of the signs of inflammation like redness, warmth, swelling, pain or tenderness had appeared at the surgical site or there was purulent discharge or a positive bacterial culture in a swab or fluid collected from the surgical site

Analysis of the data was done using STATA version 14.0. The various categorical variables are summarized as proportions or percentages. Continuous variables are represented as means with standard deviation or medians with interquartile range depending on the normality of the data.

RESULTS

The general characteristics of the study population are given in (Table 1). The mean age of the study group was 49.3 years (range 18 to 88 years). The overall surgical site infection rate was 11%. Emergency surgeries reported a higher incidence of SSIs (13%) than elective ones (9%). The Chi-square test value is 0.8172 and the p value is 0.366 which is not significant as p is greater than 0.05. Out of the 22 cases that were positive for post-operative infections, abscess drainage and diabetic foot debridement accounted for about 36.4% of the infections (Table 2).

The average age of the population which showed signs of an SSI was 57 years. Among those who developed an SSI, almost 59% were above the age of 50 years. Only 3 patients, from a group of 78 with clean surgical sites, developed an SSI (3.84%) while in the remaining 122 patients with contaminated or dirty wounds, 19 of them developed an SSI (15.57%). After analysis, the relative risk came out to be a staggering 4.05 meaning patients with any degree of wound contamination (belonging to wound classes clean-contaminated, contaminated, or dirty) are 4.05 times more prone to develop an SSI than those with clean wounds.

Table 1: Demographic and clinical details of the study group (n=200).

Characteristics	N (%)
Age (in years)	
18-24	13 (6.5)
25-34	25 (12.5)
35-44	42 (21)
45-54	43 (21.5)
55-64	40 (20)
65-74	25 (12.5)
75-84	8 (4)
85 or above	4 (2)
Gender	
Male	114 (57)
Female	86 (43)
Surgical procedure	
Emergency	100 (50)
Elective	100 (50)
Wound class	
Clean	78 (39)
Clean-contaminated	89 (44.5)
Contaminated	30 (15)
Dirty	3 (1.5)
Comorbidities	
No comorbidities	132 (66)
Diabetes mellitus	29 (14.5)
Hypertension	20 (10)
Both	19 (9.5)
Duration of hospital stay (in days)	
0-3	47 (23.5)
4-7	92 (46)
8-11	40 (20)
12-14	9 (4.5)
15 or more	12 (6)

Table 2: Risk factors associated with SSIs.

Variables	Patients with SSIs, N (%)	Patients without SSIs, N (%)	Odds ratio (95% CI)	P value
Age (in years)				
<Mean age	8 (4)	98 (49)	2.14 (0.86-5.37)	0.097
>Mean age	14 (7)	80 (40)		
Surgical procedure				
Emergency	13 (6.5)	87 (43.5)	1.51 (0.61-3.71)	0.366
Elective	9 (4.5)	91 (45.5)		
Wound class				
Clean	3 (1.5)	75 (37.5)		
Clean-contaminated	6 (3)	83 (41.5)	4.61 (1.32-16.15)	<0.001
Contaminated	11 (5.5)	19 (9.5)		
Dirty	2 (1)	1 (0.5)		
Comorbidities				
No comorbidities	9 (4.5)	123 (61.5)		
Diabetes mellitus	5 (2.5)	24 (12)	3.23 (1.30-8.00)	0.008
Hypertension	2 (1)	18 (9)		
Both	6 (3)	13 (6.5)		
Duration of hospital stay (days)				
<7	6 (3)	118 (62)	5.24 (1.95-14.09)	<0.001
≥7	16 (8)	60 (30)		

In the 68 patients with comorbidities (hypertension or diabetes or both) nearly 13 people developed an SSI (19.11%) whereas only 9, from a group of 132 patients (6.81%) without any comorbidities, reported an infection at the surgical site. All the patients who developed SSIs were given peri-operative antibiotic prophylaxis. The average duration of hospital stay for the whole group was 6.98 days while for those who developed a wound infection, it was 10.25 days. *Staphylococcus aureus* accounted for nearly 36.37% of the infections closely followed by *Escherichia coli* at 31.82% (Table 3).

Table 3: Microbiological profile of SSIs (n=22)*.

Organism	Patients with SSIs, N (%)
S. aureus	8 (36.37)
E. coli	7 (31.82)
Streptococcus pyogenes	5 (22.73)
Klebsiella sp.	5 (22.73)
Pseudomonas sp.	4 (18.18)

n*: The total number of patients who developed SSIs (N) does not add up to 22 because more than one organism was isolated from the same surgical site

DISCUSSION

The overall surgical site infection rate of 11% is much higher than those reported in developed countries like the UK (3.1%) and the Netherlands (4.3%).[11] Studies in India have shown SSI rates to vary from 6.1% to 38.7%.[10] Besides people often assume emergency surgeries carry a greater risk of developing SSIs because the surgical site is relatively more contaminated. However, a study conducted on 697 patients in Vietnam reported emergency surgeries to have a lower incidence of SSIs when compared to elective cases (8.7% versus 13.1%) despite emergency cases having a greater proportion of dirtier wounds. This is because patients who underwent elective surgery had a longer pre-operative stay than their counterparts.[12] Similarly another study on 248 patients who underwent general surgery in Malaysia, found elective surgeries (19.4%) to have a higher incidence of SSIs in comparison to emergency surgeries (15.47%).[13] They substantiated this finding with the reason that elective surgeries had a longer operative duration than emergency surgeries thus increasing the risk for infection.

Our results showed a greater incidence of SSIs in emergency surgery (13%) when compared to elective surgery (9%). This finding, however, is not statistically significant as the p value (0.366) is greater than 0.05. The higher rates of infection in emergency surgical procedures can be attributed to the increased number of contaminated or dirty wounds, the lack of adequate pre-operative care and the delay in starting antibiotic prophylaxis. In this study, only 7 emergency cases (out of 100) had clean surgical sites in comparison to 71 cases in elective surgery. A similar study was done by Sriranjani et al. on 150 patients in India where she found emergency surgeries (27.11%) to have a higher prevalence of SSIs than elective surgeries (10.29%).[14] Likewise, another study on post-operative infections in a tertiary care centre in India, came to the conclusion that emergency surgeries are associated with a higher risk of acquiring SSIs than elective ones (17.7% and 12.5% respectively).[15]

In this study, the incidence of SSIs increased with advancing age. Older patients are likely to suffer from diabetes, hypertension and other comorbidities. Besides their immune system is also weak, thus predisposing them to the development of SSIs. Based on their research, Dominioni et al ranked age at the top of the hierarchy in a list of patient associated risk factors.[16] We also found a strong association between infection rates and the degree of contamination of the surgical site (p value <0.001). The prevalence of SSIs increased from 3.85% in clean wounds to 66.67% in dirty wounds. In another report on abdominal surgeries in India, they showed clean wounds to have an infection rate of 3.9% compared to dirty wounds at 56.7%.[10] This is because the micro-organisms, that cause infections, gain access to the surgical site prior to the surgery. However, classifying the surgical site into different wound classes is subjective and can vary from one observer to another. Hence they cannot be used to predict the risk of developing SSIs.[17]

In our study, comorbidities were found to have a strong association with SSI risk as well (p value=0.008). About 17.24% of the diabetic patients, 10% of the hypertensive patients and 31.58% of the patients having both diabetes and hypertension developed SSIs. Diabetic patients are likely to have a weak immune system and the high blood glucose levels favour bacterial growth as well. This explains why diabetic foot debridement had the highest incidence of SSIs in the present study. In hypertensive patients, the narrowing of blood vessels leads to decreased blood supply to the surgical site thus increasing the risk for SSIs. Khan et al in his study on SSIs, showed wound infections to be closely linked to comorbidities. Khan also explained how the Charlson comorbidity index (CCI) and the American Society of Anaesthesiologists (ASA) score can be used to predict the risk of SSIs by quantifying the severity of the comorbidity.[18]

Although there are many studies showing the benefits of antibiotic prophylaxis, our study showed no significant relation between the prophylactic use of antibiotics and SSI prevention. All the patients that developed a wound infection had been given antibiotic prophylaxis. Antibiotics are supposed to reduce the microbial burden of the surgical site so that they do not overwhelm the host defenses. However, overuse of these drugs can increase the risks of infection with resistant organisms. A recent study revealed that the incidence of SSIs can be reduced drastically by administering antibiotics at the right time, preferably within 120 minutes before the incision.[19] But antibiotics must be given only when indicated. In a study done by Fehr et al in a rural African hospital, he found 22% of the patients with preoperative antibiotic prophylaxis to develop infections and 60% of them turned out to be resistant organisms.[20]

In our study the most common organism isolated from wound infections was *S. aureus* (36.37%) followed closely by *E. coli* (31.82%). These findings are similar to those provided in another report on the risk factors for SSIs in emergency surgery.[21] The average duration of hospital stay for the whole study population was 6.98 days while for those who developed a wound infection, it was 10.25 days. Hence the risk for SSIs increases with increase in duration of hospital stay. This is because the longer exposure to micro-organisms in the hospital environment can predispose patients to the development of infections with drug resistant organisms. Two reports from Pakistan on post-operative infections showed a similar correlation between SSIs and duration of hospital stay. a longer hospital stay led to the colonization of the patient's skin with bacterial flora especially those that are antibiotic resistant.[22,23]

Limitations

Our study had a few limitations. First, the sample size was small, hence some of the findings were not statistically significant. Second, the medical records were analysed retrospectively. Hence, only those parameters, that were already recorded in the case sheets, could be used for data analysis i.e., some parameters like the patient's BMI, duration of surgery, use of drain and blood transfusion could not be assessed to determine if they are possible risk factors for SSIs. Third, there might have been some bias due to confounding factors as the study and control cohorts were not similar to each other in important variables other than those being compared.

CONCLUSION

SSIs are still one of the most serious complications of surgeries. The present study showed factors like the patient's age, wound class, pre-existing comorbidities and duration of hospital stay to have a strong association with the development of SSIs. Antibiotic prophylaxis can reduce the risk of wound infections, only if they are used judiciously. Post-operative infections cannot be eliminated completely, but the infection rates can be brought down drastically using appropriate measures thus reducing patient morbidity and mortality, and conserving the health care resources.

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