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Original Research Article

Prevalence of surgical site infection in general surgery in a tertiary care centre in India

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ABSTRACT

Background: Surgical site infection (SSI) can be defined as an infection that is present up to 30 days after a surgical procedure if no implants are placed and up to one year if an implantable device was placed in the patient. SSI is a significant problem associated with major surgeries and is the 3rd most frequently reported nosocomial infection. This study aims to study the prevalence of SSI in the Department of Surgery, Rajendra Institute of Medical Sciences (RIMS), Ranchi.
Methods: A retrospective study was undertaken at the department of general surgery for a period of one year. Retrospective chart review was conducted from the hospital database. The rate of SSI was studied in relation to its type, the type of surgical procedure and elective vs emergency surgeries.
Results: The present study revealed 12.5% prevalence of SSI in department of general surgery, RIMS. Among the 3 types, superficial incision SSI was most prevalent followed by deep incisional SSI and finally by organ/space SSI. The surgical procedure most commonly associated with SSI was exploratory laparotomy. An alarming 17.7% of SSI was associated with emergency surgeries as compared to 12.5% of elective surgeries.
Conclusions: The consequences of SSIs greatly impact patients and the healthcare systems. Prevention of SSI requires a multifaceted approach targeting pre-, intra-, and postoperative factors. It is imperative that facilities have open-minded management teams, regulatory agencies and medical associations that want to provide the foundation required to generate a culture of patient safety in our health care systems.

Keywords: General surgery, Nosocomial infection, SSI, Surgical site infection, Surgery

INTRODUCTION

Until the middle of the 19th century, when Ignaz Semmelweis and Joseph Lister became the pioneers of infection control by introducing antiseptic surgery, most wounds became infected. In cases of deep or extensive infection this resulted in a mortality rate of 70-80%.[1] Since then a number of significant developments, particularly in the field of microbiology, have made surgery safer.

However, the overall incidence of surgical site infection (SSI) remains high and represents a substantial burden of disease. Surgical site infections (SSI) are serious postoperative complications with significant impact on morbidity and mortality. According to the National Nosocomial Infections Surveillance (NNIS) system, SSI are the third most frequently reported nosocomial infections, accounting for 12%-16% of all nosocomial infections among hospitalized patients.[2]

Advances in infection control practices include improved operating room ventilation, sterilization methods, barriers, surgical technique and availability of antimicrobial prophylaxis. Despite these activities, SSIs remain a substantial cause of morbidity and mortality among hospitalized patients. This may be partially explained by the emergence of antimicrobial-resistant pathogens and the increased numbers of surgical patients who are elderly and/or have a wide variety of chronic, debilitating, or immunocompromising underlying diseases. There also are increased numbers of prosthetic implant and organ transplant operations performed.

SSI prolongs hospital stay and increases antibiotic prescribing and laboratory costs. Patients who develop infection are 60% more likely to spend time in an ICU, 5 times as likely to be readmitted and their mortality rate is twice of non-infected patient. It is noteworthy that an estimated 40-60% of these infections are preventable.[3] The present study was done to study the prevalence of SSI in the Department of Surgery.

METHODS

A retrospective study was undertaken on patients admitted to general surgery units at the Department of General Surgery, Rajendra institute of medical sciences (RIMS), Ranchi, India. The study period in this super specialty teaching institution was one year. A total of 3321 elective surgical patients and 452 emergency surgical patients were included in the study. The elective surgical procedures included cholecystectomy, hernioplasty, gastrectomy, mastectomy, resection anastomosis of bowel, hemorrhoidectomy, fistulectomy, parotidectomy, thyroidectomy. The commonly performed surgeries under emergency conditions were exploratory laparotomy and resection anastomosis of bowel. During the time period of the study, a retrospective chart review was conducted from the hospital database. In this retrospective chart review, existing data that had been recorded for reasons other than research was studied. It was referred as "chart reviews" because the data source was the medical record of the patient. Details that were recorded included the type of surgery by wound class, type and duration of operation, antimicrobial prophylaxis if given, drain used, preoperative and total hospital stay.[4] Each patient's data was assessed from the time of admission till discharge from the hospital and also on follow up visits which extended up to 30 days.

Wound infection was diagnosed if any of the following criteria were fulfilled: serous or non-purulent discharge from the wound with signs of inflammation; edema, redness, warmth, raised local temperature, fever >38ºC, tenderness, induration; and wound deliberately opened up by the surgeon due to localized collection (serous/purulent). Stitch abscesses were excluded from the study. SSI thus detected was divided into three categories: superficial incision SSI, deep incision SSI and organ/space SSI.[4] Diagnosis of SSI was made by a surgeon or attending physician. SSI was considered if an infection occurred within 30 days after the operation (in case of superficial incision SSI), occurred within 30 days after the operation if no implant is left in place or within one year if implant is in place (in case of deep incision SSI and)

The infection involved only skin and subcutaneous tissue in superficial incision SSI, deep soft tissue (e.g. fascia, muscle) of the incision in deep incision SSI and any part of the anatomy (e.g., organs and spaces) other than the incision which was opened or manipulated during an operation in organ/space SSI and at least one of the following:

- Purulent drainage from the superficial/deep incision (in superficial/deep incision SSI) and from a drain (in organ/space SSI)
- Organisms isolated from an aseptically obtained culture of fluid or tissue from the incision (in superficial SSI and organ/space SSI)
- At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture-negative (in superficial/deep incision SSI)
- An abscess or other evidence of infection is found on direct examination, during reoperation, or by histopathologic or radiologic examination (in deep incision SSI and organ/space SSI).

A standard protocol was followed by the institute to prevent infections for all elective surgical procedures. Preoperatively, patient preparation included hair removal (if interfering with incision site) immediately before operation, adequate control of serum blood glucose levels (in diabetics), pre-operative antiseptic bath, skin preparation using antiseptic agent. Universal precautions were followed by the surgical team. Prophylactic antibiotic agents were prescribed to all patients and usually administered through intravenous route. Intra-operatively standard sterilization and disinfection guidelines were followed. Post-operatively the patients were discharged as early as possible to prevent SSI.

RESULTS

The present study which included 3321 elective surgeries and 452 emergency surgeries during the period between 1st June 2010 to 31st May 2011, revealed rate of SSI as 12.5% (415) in elective surgeries and 17.7% (80) in emergency surgeries at the Department of General Surgery, RIMS.

Among the 3 types, superficial incision SSI was most prevalent (215 cases) followed by deep incisional SSI (169 cases) and finally by organ/space SSI (111 cases) (Figure 1). The surgical procedure most commonly performed and the respective rates of SSI associated with them are shown in Table 1.

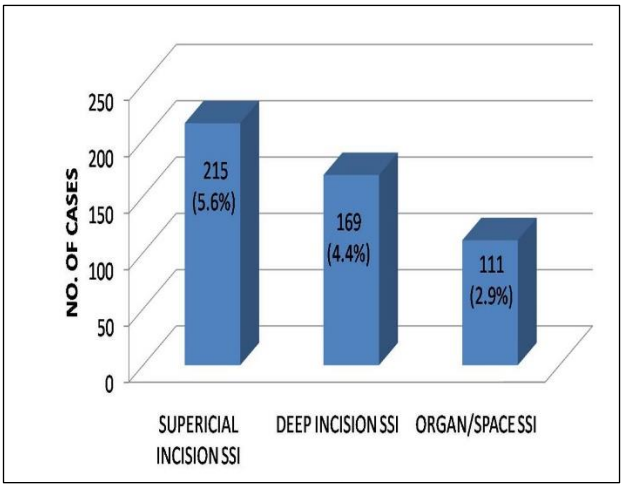

Figure 1: Type of SSI.

Table 1: Surgical procedure most commonly performed and the respective rates of SSI associated with them.

Surgical procedure	Rate of SSI
Small bowel	58 (12%)
Colon	103 (21%)
Gastric	24 (5%)
Hepato-pancreatico-biliary	20 (4%)
Exploratory laparotomy	172 (34%)
Appendectomy	78 (16%)
Hernia repair	16 (3%)
Urological	24 (5%)

Exploratory laparotomy (34%) was the procedure most commonly associated with SSI followed by colon surgery (21%) and appendectomy (16%). Hernia repair (3%) and Hepato-pancreatico-biliary surgery (4%) were least commonly associated with SSI.

The site of the infection was most commonly the incision site (8.2%) and the microbiological organism most commonly detected were group A beta hemolytic streptococci and staphylococcus aureus.

In the present study which included 3321 elective surgeries and 452 emergency surgeries, significant difference in SSI incidence of was noted among elective and emergency surgeries. Table 2 shows baseline data of patients included in the study who underwent elective and emergency surgeries. The patients in the elective surgery group ranged from 11 years to 72 years with a mean of 56 (±8 years). Of these 1360 were females and 1961 were males. In the emergency surgery group, 272 were males and 180 were females, with a mean age of 44 years (range 16-75 years). The body mass index (normal range 18.5-25 kg/m^2) averaged 22 in case of elective surgery patients and 24 in case of emergency surgery patients. The numbers of known diabetic patients in the elective age group were 1262 (38%) and in the emergency age group were 104 (23%). Among the patients posted for elective surgeries, 71% had ASA status I, followed by ASA II in 18%, ASA III in 11% of the patients. The patients who required emergency surgical intervention was most commonly in ASA III status (67%), followed by ASA II in 22%, ASA I in 7% and ASA IV in 4% patients. Ninety-one percent (3022 patients) were administered prophylactic antibiotics in the elective surgery section compared to 357 (79%) in the emergency surgical intervention. The data comparing the above parameters in relation to elective and emergency surgeries has been shown in Table 2.

Table 2: Baseline data of patients included in the study who underwent elective and emergency surgeries.

Patient parameters	Elective surgeries	Emergency surgeries
Age	56 (±8 years)	44 years (±7 years)
Male:female	0.7	1.5
Body mass Index (kg/m^2)	22	24
Diabetics	38%	23%
ASA status	I	III
Prophylactic antibiotics given	91%	79%
Rate of SSI*	12.5% (415/3321)	17.7% (80/452)

Various risk factors which could be related to SSI were assessed in this study. Table 3 showing comparison of various risk factors for SSI revealed statistically significant differences in the number of SSI cases when antibiotic prophylaxis was given compared to when antibiotic prophylaxis was not used. Furthermore, use of drains was associated with higher number of SSI cases compared to when the drain was not used and this difference was also found to be statistically significant.

The impact of SSI on health care systems was studied. Overall hospital mortality was 1.8%, which was reported for patients with organ/space SSI (2 of 111). During the post-operative period, re-exploratory surgery had to be carried out on 2.7% of organ/space SSI patients (3 of 111) and 1.8% of deep incisional SSI patients (3 of 169). The mean duration of post-op antibiotics was 3-5 days in case of superficial SSI patients, 5-7 days in case of deep incisional SSI patients and 7-10 days in case of organ/space SSI patients.

The mean duration of stay in the intensive care unit was 2 days (ranged from 0 to 12 days) for patients with deep incisional and organ/space SSI. The patients with superficial SSI were those who were shifted directly from recovery to their respective wards. The mean in-hospital stay for superficial SSI patients was 2 days (ranged from 0 to 8 days), for deep incisional SSI was 5 days (ranged from 2 to 11 days) and for organ/space SSI patients was 7 days (ranged from 4 to 18 days).

Table 3: Comparison of various risk factors for SSI.

Variable	No. SSI/total (percentage)	P-value
Gender		
Males	301/2233 (13.5%)	0.1090
Females	185/1540 (12.0%)	
Age		
<30 years	63/574 (10.9%)	
31-60 years	327/2460 (13.2%)	0. 1003
> 60 years	125/739 (16.9%)	
Type of wound		
Clean	197/2279 (8.6%)	
Clean contaminated	209/1190 (17.5%)	0.0732
Contaminated	89/304 (29.2%)	
Duration of surgery		
0-1 hour	157/1854 (8.4%)	
1-2 hours	178/1096 (16.2%)	0.1540
>2 hours	160/823 (19.4%)	
Antibiotic prophylaxis given		
Yes	381/3379 (11.2%)	0.0000
No	114/394 (28.9%)	
Drain used		
Yes	156/615 (25.3%)	0.0000
No	339/3158 (10.7%)	
Total hospital stays		
<2 days	56/520 (10.7%)	
2-5 days	339/2614 (12.9%)	0.-3715
> 5 days	100/639 (15.6%)	

DISCUSSION

Surgical site infection is the most frequently reported complication in surgical patients. Surgical site infections (SSI) are the third most commonly reported nosocomial infection and they account for approximately a quarter of all nosocomial infections.[5] The present study showed the SSI rate of 12.5% for elective surgeries and 17.7% for emergency surgeries. Among the 3 types, superficial incision SSI was most prevalent (215 cases) followed by deep incisional SSI (169 cases) and finally by organ/space SSI (111 cases). Exploratory laparotomy (34%) was the procedure most commonly associated with SSI and the site of the infection was most commonly the incision site (8.2%).

The rate of SSI in elective surgery of the present study is comparable to other studies done in developing countries.[6] The observed incidence rate of SSI (12.5%) was higher than incidence rates reported from developed countries, such as the United Kingdom (3.1%) and the Netherlands (4.3%).[7,8] In the Asian context, the SSI rates in the present study are higher than few previously reported studies.[5,9,1] However, infection rates varying from 20% to as high as 76.9% have also been reported.[8-12,15] The incidence rate of infections according to surgical procedures was highest for exploratory laparotomy (34%). In the present study, it was found that the higher SSI incidence were observed in colon surgery (21%) and appendectomy (16%). These rates are more than two-fold higher than those reported by European studies, and by the U.S. NNIS reports.[16-19] This difference in the incidence rates could be attributed to higher standards of care in developed countries. Nevertheless, the variability of data collection and surveillance methods should also be considered.

The present study reported a higher rate of SSI incidence in emergency surgeries (17.7%) as compared to elective surgeries (12.5%). This is in accordance to previously reported studied wherein emergency surgeries have shown higher rate of SSI.[13,20-23] In emergency surgeries, the type of wound was more commonly contaminated or clean contaminated; antibiotic prophylaxis was less commonly given and duration of surgery was longer as compared to elective surgeries.

The present study showed higher incidence of SSI with increasing age of the patient, though, such a difference was not noted between the two sexes. Increased age is associated with various predisposing factors like diabetes, anemia which could be attributed to this trend of increasing incidence of SSI with increasing age. An increase in SSI incidence was observed when the duration of surgery was >2 hours (19.4%). Prolonged duration of operation results in increased exposure of operation site to air, prolonged trauma, stress of prolonged anaesthesia and sometimes blood loss.[20]

The most common pathogen associated with SSI in the present study were A beta hemolytic *streptococci* and *staphylococcus aureus*. *Staphylococcus aureus (SA)* is, and has always been, the most important pathogen in SSI around the world. Colonization of the anterior nares and skin of humans with SA occurs frequently. About 20% of normal humans are persistently colonized with SA in the nares, while another 30-50% are intermittently colonized. Increased rates of carriage are seen in patients with underlying co-morbidities, such as diabetes, chronic kidney disease, HIV infection, and chronic dermatitis. The relative risk of SSI is 2-9 times greater in carriers of SA than in non-carriers.[24] Furthermore, molecular epidemiology has demonstrated that the strain of SA that causes a post-operative infection is identical to the strain isolated from the nasal cavity pre-operatively in 85% of patients.[25]

SSI incidence was found to be higher when antibiotic prophylaxis was not given. In 2002, the Centers for Medicare and Medicaid Services (CMS), collaborating with the CDC, developed and implemented the Surgical Infection Prevention Project.[26] Its goal was to provide evidence-based performance measures for the appropriate selection, administration, and termination of prophylactic antibiotics for patients undergoing clean-contaminated surgeries. The recommendations to prevent SSI were that the use of prophylactic antibiotics should be initiated

within one hour before surgical incision, or within two hours if the patient is receiving vancomycin or fluoroquinolones, patients should receive prophylactic antibiotics appropriate for their specific procedure and prophylactic antibiotics should be discontinued within 24 hours of surgery completion (within 48 hours for cardiothoracic surgery). For most patients undergoing clean-contaminated surgeries (e.g., cardiothoracic, gastrointestinal, orthopedic, vascular, gynecologic), a cephalosporin is the recommended prophylactic antibiotic.

In the present study, placement of drain was more commonly associated with SSI. Drains are placed commonly in the operative setting to prevent abscess or hematoma formation and are hypothesized to lead to surgical site infection (SSI) via external or luminal contamination and subsequent inward (retrograde) bacterial migration along the drain surface.[27] In contrast to passive (open) drains, closed-suction drains (CSDs) establish a pressure gradient between the wound and the external environment and empty into a sealed reservoir, and are believed to reduce the risk of retrograde microbial contamination. Across most surgical disciplines, studies to evaluate the risk of SSI associated with routine post-operative CSD have yielded conflicting results. A few studies do suggest an increased risk of SSI associated with drain placement, but are usually associated with open drainage and not the use of CSDs. No studies whatsoever attribute a decrease in the incidence of SSI (including organ/space SSI) to drain placement. Drain-associated complications such as enterocutaneous fistula, post-operative pain, foreign-body reaction, and increased transfusion requirements have been reported.

SSI is the index of the health care system of any hospital. In this study, the impact of three types of SSI on health care system were studied. It was observed that the patients with organ/space SSI had highest ICU stay and in-hospital stay. The duration of post-op antibiotics was highest (7-10 Days) and were associated with more often (2.7%) re-exploration surgery. Even 2 patients (1.8%) had succumbed to their infections of organ/space SSI. The cost of care for patients with surgical site infections is nearly threefold higher than that for surgical patients without the infections during the first eight weeks after hospital discharge. These infections reduce patients' quality of life and account for 3.7 million excess hospital days and more than $1.6 billion in excess costs annually in United States.[4] Furthermore, patients who develop surgical site infections are five times more likely to be readmitted to the hospital, 60 percent more likely to spend time in the intensive care unit, and twice as likely to die compared with surgical patients without the infections.[26]

CONCLUSION

Present study provided information on risk factors for SSI occurrence in a large population in general surgery setting in India. In particular it was observed that, increasing age of the patient, contaminated wound, prolonged duration of surgery, absence of prophylactic antibiotics, use of drains and prolonged hospital stay are associated with increased incidence of SSI.

From this study, the following steps emerged as priorities to set in the near future: definition of the antibiotic prophylaxis policy; reduction of length of stay; and reduction of the length of procedures through adequate training of the staff on proper surgical. Also recommended are judicious use of drains and extra care needs to be taken in case of emergency surgeries to lower the overall SSI incidence rates.

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