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Clinical study on surgical site infections in a tertiary care hospital

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ABSTRACT

Introduction. Surgical site infection (SSI) is one of the most important causes of morbidity and mortality in postoperative patients, but it is preventable in some cases. Our aim is to study the prevalence of surgical site infections and to determine the risk factors that influence the rate of SSI in a tertiary care hospital. *Materials and Methods*. This is an observational study conducted in the department of general surgery, Mayo Institute of Medical Sciences, Barabanki, Uttar Pradesh, from July 2021 to June 2022. *Results*. The present study includes 59 men and 34 women. Out of 93 patients, most patients were in the age group of 40-50 years. In our study, there was a 3.722-fold higher probability of developing SSI in patients with comorbidities. Emergency surgery also has a 7.187 times higher risk of developing SSI than elective surgery. The prevalence in this study of SSI was 8.60%; of 8 patients, only 1 developed SSI on deep incision. *Conclusion*. The following conclusions/ recommendations emerged from this study: reducing the duration of surgical procedures by adopting appropriate techniques and early resumption of patient mobilization. Judicious use of drains is also recommended, paying more attention in emergency operations and/or with a high risk of contamination.

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Introduction

Surgical site infection (SSI) is one of the most important causes of morbidity and mortality in postoperative patients. Even so, it can be prevented in most cases if proper assessment of resources and patients and appropriate measures are taken by surgeons, nursing staff and patients in the pre-operative, intra-operative and post-operative period [1-3].

Surgical site infections are clinically classified into those affecting the superficial tissues (skin and subcutaneous layer) of the incision and those affecting the deeper tissues (deep incision or organ space) according to the CDC definition [4,5]. A time period of 30 days after surgery was taken for an infection to be called an SSI in cases without implants, but it can extend up to a year in patients with implants [6,7]. SSIs are one of the major causes of morbidity and mortality in resource-limited countries, including India, despite recent advances in aseptic techniques [8,9].

Postoperative wound infections, now known as Surgical Site Infections (SSIs), result from bacterial contamination during or after a surgical procedure. The risk of wound infection is largely influenced by the degree of contamination, but there are other factors that contribute to the evolution of this process. These risk factors also play an important role in the occurrence of SSIs, which are investigated in this study [10-12].

The use of antibiotic prophylaxis before surgery has evolved greatly in the last twenty years. It is generally recommended in elective clean surgical procedures using a foreign body and in clean-contaminated procedures that a single dose of cephalosporin, such as cefazolin, cefotaxime, ceftriaxone etc. be administered intravenously in the operative suit just before incision. Surgical site infection still causes high morbidity and economic burden to the health care system [13-15].

We did an observational study at a tertiary care center to study prevalence of SSIs in general surgery and to determine various associated risk factors.

The aim of this study is to investigate the prevalence of surgical site infections and to determine different risk factors influencing the rate of SSI in a tertiary care hospital, Barabanki (U.P).

Materials and Methods

This observational study was carried out in the Department of General Surgery of Mayo Institute of Medical Sciences, Barabanki, Uttar, Pradesh, from July 2021 to June 2022.

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Primary objectives: to study prevalence of SSI and to determine various risk factors influencing the SSI rate in general surgeries in a tertiary care hospital. *Study design*: an observational study. *Study period*: July 2021 to June 2022. *Study setting*: Department of General Surgery, Mayo Institute of Medical Sciences Barabanki, U.P., India.

Inclusion criteria

- Patients admitted in the general surgical department that underwent surgical procedures under either spinal or general anesthesia.
- Patients who developed infection post operatively at the surgical site when followed up to 30 days of surgery.

Exclusion criteria

- Preoperatively infected cases.
- Postoperatively infected cases at surgical site but beyond 30 days of operation.
- Old cases operated at another hospital and came to our hospital already with infection.

Patient evaluation and case selection

After taking detailed history, thorough clinical examination carried out, relevant investigations and informed written consent were recorded and provisional diagnosis was made for all patients and operative procedure planned and recorded.

Preoperative preparation

- Nil by mouth for 6 hours.
- Preoperative hair removal of surgical site was done.
- Xylocaine sensitivity test with 0.1 ml of 2% Xylocaine was done.
- Injection Tetanus toxoid 0.5 ml given intramuscular.
- Inform written consent was taken.
- Preoperative dose of antibiotic was given.

Operative procedure

- Patient was given either SA or GA according to anesthesiologist
- Various operative procedures were performed according to diagnosis made after thorough evaluation.

Surgical procedure

Surgeries were done according to the disease process as follow:

- Hernioplasty
- Appendectomy
- Exploratory laparotomy
- Suprapubic cystolithotomy
- Open prostatectomy
- Eversion of sac
- Modified Radical Mastectomy (MRM)
- Orchidectomy
- Ureterolithotomy
- Pyelolithotomy
- Cholecystectomy

Postoperative management

- IV antibiotic was given at least for first three days of operation and shifted to oral antibiotics to be decided by operating surgeon as per requirement of patient according to surgery.
- Generally, on 5th day check and dressing of wound of surgery like exploratory laparotomy, pyelolithotomy, cholecystectomy was done and 3rd day for surgery like herniotomy, hernioplasty, appendectomy, suprapubic cystolithotomy was done and afterwards daily dressing was performed. Any evidence of infection noted in post-operative period was recorded and pus culture sent on the same day. Daily dressing and cleaning were performed till wound infection cleared and then patient is discharged and followed up to 30 days of surgery.

Follow up

- Every patient was reviewed in outpatient basis as follows – after fifteen days, one month.
- Patient were asked for any evidence of infection and watch for any signs of infection on surgical site on every visit.
- All above data was entered into the proforma of this thesis which was approved by Ethical Committee.

Consenting

Patients were included in this study only after taking proper informed written consent. They were not denied for treatment even if they did not give consent to be included in the study.

Methodology

Total 93 patients with major surgical procedure suspected of surgical site infections within 30 days of operative procedure in post operative period were included in our study. All patients underwent preoperative evaluation at least a day before surgery. After taking detailed history, thorough clinical examination carried out, relevant investigations and informed written consent were recorded and provisional diagnosis was made for all patients and operative procedure planned and recorded.

Further, when and what type of operative procedure done, how much time taken for the operative procedure, type of anesthesia given, who did the operative procedure, preoperative preparation done or not and preoperative period were recorded for all the cases.

Generally, on 5th day check and dressing of wound of surgery like exploratory laparotomy, pyelolithotomy, cholecystectomy was done and 3rd day for surgery like herniotomy, hernioplasty, appendectomy, suprapubic cystolithotomy was done and afterwards daily dressing was performed. Any evidence of infection noted in post-operative period was recorded and pus culture sent on the same day. Daily dressing and cleaning were performed till wound infection cleared and then patient is discharged and followed up to 30 days of surgery.

Results

Data was entered in Microsoft excel and was analyzed using SPSS version 16. Results were expressed in percentages. Chi-square test and multiple logistic regressions were applied to know the association between various risk factors and occurrence of SSI. Table 1 presents the prevalence of SSIs study cases (n =93).

Table 1. Prevalence of SSI cases, n =93

SSI	Frequency	Percentage
Present	8	8.6
Absent	85	91.4
Total	93	100

Tables 2 and 3 present the study distribution of age and comorbidities.

Table 2. Age distribution of cases, n=93

Age group	Frequency	Percentage
<= 20	4	4.3
21 – 30	22	23.7
31 – 40	18	19.4
41 – 50	35	37.6
> 50	14	15.1
Total	93	100

Table 3. Prevalence of comorbidities of SSIs in this study, n=93

Comorbidity	Frequency	Percentage
Present	22	23.7
Absent	71	76.3
Total	93	100

Tables 4 and 5 present the distribution of smoking and alcoholism in the study.

Table 4. Prevalence of smoking in this study, n=93

Smoking	Frequency	Percentage
Present	56	60.2
Absent	37	39.8
Total	93	100

Table 5. Prevalence of alcoholism in this study, n=93

Alcohol	Frequency	Percentage
Alcoholic	9	9.7
Non alcoholic	84	90.3
Total	93	100

Tables 6 and 7 show the types of anesthesia and surgery performed in this study.

Table 6. Distribution of study cases according to type of anaesthesia

Type of anaesthesia	Frequency	Percentage
General	32	34.4
Spinal	61	65.6
Total	93	100.0

Table 7. Distribution of study cases according to nature of surgery

Nature of surgery	Frequency	Percentage
Elective	72	77.4
Emergency	21	22.6
Total	93	100

Tables 8 and 9 show the distribution of SSIs according to the type of cancer, as well as the depth of the contaminated incision.

Table 8. Diagnosis wise distribution in this study, n=93

Diagnosis	Frequency	Percentage
Left inguinal hernia	1	1.1
Acute appendicitis	11	11.8
Appendicular perforation	1	1.1
Bilateral inguinal hernia	1	1.1
BPH	1	1.1
Carcinoma LT breast	1	1.1
Cholelithiasis	3	3.2
Epigastric hernia	3	3.2
Incisional hernia	3	3.2
Left hydrocele	2	2.2
Left inguinal hernia	10	10.8
Left renal calculus	5	5.4
Perforation peritonitis	7	7.5
Right carcinoma breast	1	1.1
Right hydrocele	4	4.3
Right inguinal hernia	15	16.1
Right renal calculus	5	5.4
Right ureteric calculus	1	1.1
RT testicular torsion	2	2.2
SAIO	1	1.1
Umbilical hernia	7	7.5
Vesical calculus	8	8.6
Total	**93**	**100.0**

Table 9. Type wise distribution of SSIs in this study		
Type of SSI	**SSI Cases**	**Percentage**
Superficial Incisional	7	87.50%
Deep Incisional	1	12.50%
Organ /Space	0	0%
Total	08	100

The most common surgery done in our study was hernioplasty. The present study contains 59 (63.44%) males and 34 (36.56%) females. Among all 93 patients, most patients were in the 40-50 age group (37.6%), and of these 31 are men (40.8% of all men in the study), while women are 4 (23.5% of all women in the study).

In our study, among the 8 patients with SSI, only 1 was a deep-incision SSI, while the remaining 7 patients developed superficial-incision SSIs.

There are more chances of developing SSI in emergency surgery than elective surgery (p=0.005, chi square-7.979). The P value is significant, so the nature of surgery is an independent risk factor associated with SSI in our study.

In our study, patients with comorbidity were 3,722 times more likely to develop SSI than patients without comorbidity (95% C.I. from 0.847 -16.357).

Alcoholic patients are 3,714 times more likely to develop SSIs than non-alcoholic patients (95% C.I. from 0.628 – 21.967). Emergency surgery have 7.187 times more risk of developing SSIs than elective surgery (95% C.I. from 1.554-33.233).

In our study cases, the prevalence of SSIs was 8.60% (8 cases developing SSI). Among these 8 patients, the most prevalent type is superficial incisional type, i.e., about 87.5%, followed by deep incisional type, i.e., 12.5%; no organ/space related to SSIs is observed.

Discussion

Surgical site infections (SSIs) are clinically classified into infections affecting the superficial tissues of the incision (skin and subcutaneous layer), and those affecting deeper tissues (deep incision or organ space), according to the CDC definition [4,5].

Surgical Site Infections (SSIs), previously called post operative wound infections, result from bacterial contamination during or after a surgical procedure [10-12].

The present study includes 93 patients from department of general surgery in Mayo Institute of Medical Sciences, from July 2021 to June 2022. The obtained results reveal a prevalence of SSIs of 8.60%. Of the 93 patients suspected by surgical site infections, 8 patients were confirmed to have SSIs by CDC criteria and positive pus culture reports. Globally, SSI rates have been reported to range from 2.5 to 41.9% (depending on the study), with 15% SSIs reported by Reichman et al. in 2009 in their study [16].

In developed countries, SSIs rates have been reported to range from 1.2 to 5.2%, according to WHO 2011 [17,18]. Previous studies in India have shown SSI rates ranging from 4 to 30% [19].

The present study contains 59 (63.44%) males and 34 (36.56%) females. Among all 93 patients, most patients (35) were in the 40-50 age group, and of these 31 are men (40.8% of all men in the study) while women were only 4 (23.5% of all women in the study). In our study of 93 patients, among the 76 men operated on, 6 developed SSIs (7.89%), which is comparable to the study by Pathak et al. (2014), where men had an SSI rate of 5.3% (of 17 women operated on, only 2 developed SSI, i.e., 11.76%) [19]. These data are comparable to the 2017 study by Kumar et al. showing a female SSIs rate of 12% [20]. So, females are more likely to develop SSIs compared to males, which is comparable to the study of Khan et al., where females (27%) showed a higher prevalence of SSIs than males (18 %) [21]. However, according to Berard and Gandon, gender is not a predictor factor of SSI risk [22].

In the present study of 93 patients, 37 were non-smokers and 3 developed SSIs (8.10%), whereas among 56 smokers 5 developed SSIs (8.92%). So, there is not much difference in risk of developing SSIs among smokers and non-smokers, which is comparable with the 2014 study of Pathak et al., where SSI rates in smokers were 6.7% and 3.8% in non-smokers [19].

In our study, alcoholic patients have 3.714 times more risk of developing SSIs than non-alcoholic patients (95% C.I. from 0.628 – 21.967) and tobacco chewer have 1.829 times more risk of developing SSIs than non-tobacco chewer (95% C.I. from 0.402-8.309), which is comparable to the 2021 study of Bekiari et al. [23].

In the present study of 93 patients, 71 patients had no comorbidity, but 4 developed SSI (5.63%), while in 22 patients with associated comorbidity, 4 developed SSI (18.18%). So, patients with associated comorbidity have an increased risk of developing SSIs. In our study, patients with comorbidity were 3,722 times more likely to develop SSIs than patients without comorbidity (95% C.I. from 0.847 - 16.357). Comorbid conditions like anemia, diabetes and hypertension were the significant risk factors for SSIs. Our study is comparable to the study of Pathak et al. from 2014, in which the SSI rates in patients with comorbidities is 11.5%, and in patients without comorbidities is 4.8% [19]. National Academy of Science also reported higher rate of infection in patients with diabetes mellitus which is similar to our study [24]. Comparable results have been found in several studies involving different surgical procedures, such as: Xue et al. [25], Uzun et al. [26], or Giles et al. [27].

In the present study, 72 elective surgeries were performed, of which 3 developed SSIs (4.16%). Among 21 emergency surgeries, 5 subjects developed SSIs (23.80%). Emergency surgery have 7.187 times more risk of developing SSIs than the elective surgery (95% C.I. from 1.554-33.233). There is more chance of developing SSIs in emergency surgery than in elective surgery (p=0.005, chi square-7.979), which is comparable to the 2011 study by Satyanarayana et al. in which the SSIs rate was 7.6% in elective operations and 25.2% in emergency operations [28]. Similar results (with a higher rate of SSIs in emergency surgeries than in elective surgeries) were also reported in other studies, such as that of Lilani et al. from 2005 [29].

In our study, out of 32 patients who were operated under general anesthesia 5 developed SSIs (15.62%), while out of 61 patients who were operated under spinal anesthesia only 3 developed SSIs (4.9%). So, a patient with surgery performed under general anesthesia has a higher risk of developing SSIs compared to those operated under spinal anesthesia. There is no comparable study available in the literature review.

In our study, the prevalence of SSIs was 8.60%, that is, 8 cases developed this complication. Among these 8 cases, the most frequent were associated with the superficial incisional type (ie approximately 87.5%), followed by the deep incisional type (ie 12.5%). The data are comparable to the study by Lekshmi et al. from 2018, in which the frequency of SSIs was 91.8% for superficial incision, and 5.4% for deep incision [30].

Conclusions

Surgical site infections are the third most common hospital-associated infection, accounting for 14-16% of all inpatient infections. Among operated patients, surgical site infections are the most common cause of surgical infections, representing 38% of all postoperative infections. Despite all specific measures to maintain asepsis, most surgical wounds are considered to be contaminated to some extent. From this study, the following data emerged as possible measures to be adopted/improved in surgical interventions: reducing the duration of the operation by adopting appropriate surgical techniques and by permanent training of the staff, especially when new techniques or devices are used. Also, a judicious use of drains is recommended, and additional attention must be paid in the case of emergency surgical interventions, with a high potential for contamination, and which involve general anesthesia.

Conflict of interest disclosure

There are no known conflicts of interest in the publication of this article. The manuscript was read and approved by all authors.

Compliance with ethical standards

Any aspect of the work covered in this manuscript has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

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