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Original Research Article

# Superficial Surgical Site Infection: An Analysis of Compliance with Good Infection Control Practices in a Tertiary Care Institute

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**Abstract:**

**Aim:** To determine the incidence of SSI and evaluate the role of presurgical infection control practices in preventing superficial surgical site infection.

**Methodology:** This study was conducted for a period of 3 months from January 2023 to March 2023. A total of 200 surgical cases were included in the study. Active surveillance for superficial surgical site infections was done along with the analysis of presurgical infection control practices.

**Results:** The incidence of SSI in our study was 6.5 per 100 surgical cases. Surgeries done by the Obstetrics and gynecology department and Emergency surgeries were found to be significantly associated with the occurrence of SSI. Escherichia coli were the commonest pathogen, followed by coagulase-negative staphylococcus.

**Keywords:** SSI, Presurgical infection control practices.



## Introduction

A surgical site infection (SSI), often referred to as a post-operative wound infection, is a wound infection that develops after surgery and affects the deep tissues or wounds at the surgical site. [1]

Although SSIs are likely the most avoidable of all nosocomial infections, their prevalence has come to represent a universal barometer of surgical practice quality in hospitals. [2]

Simple measures like Preoperative skin preparation, hair removal, antimicrobial prophylaxis, tool sterilization, and hand washing are some of the key variables and procedures that can reduce the risk of surgical site infections. [3]

This study aimed to determine the incidence of SSI and to evaluate the role of presurgical infection control practices in its prevention at a tertiary care institute.

## Material and methods

This study was conducted in the Department of Microbiology, Integral Institute of Medical Sciences and Research, Lucknow for a period of 3 months from January 2023 to March 2023. 200 surgical cases of various types from departments like ENT, general surgery, Orthopedics, and Obstetrics & and gynecology were included in the study. Demographic data like age, gender, department, and type of surgery (Elective/Emergency) with infection control practices like presurgical blood glucose level, antimicrobial Prophylaxis, hair removal, Preoperative bathing, bowel Preparation, Preparation of surgical site with an alcohol-based antiseptic solution and Surgical hand disinfection by the team were analyzed. The study was initiated after approval by the Institutional Ethics Committee vide letter no IEC/IIMS&R/2023/28.

Active surveillance was carried out daily, and the number of patients operated along with the type of operative procedure & and type of surgery (Elective / Emergency) was noted each day. These patients were monitored in their follow-up OPDs on the 7$^{th}$ and 10$^{th}$ day and telephonically thereafter for the development of any sign and symptom of SSI till 30 days from the day of the event.

Two pus swab samples were obtained for microbiological analysis from suspected SSI cases.

The collected sample was sent to the Microbiology lab within half an hour of collection and was directly inoculated on blood agar and McConkey agar and incubated aerobically at 37°C the media was

examined for any growth at 24 and 48 hours of incubation.

The microorganisms isolated were identified based on standard protocols including Gram stain, colony characteristics on solid media, and biochemical reaction. The data was recorded in an Excel sheet and was analyzed using frequency and percentages. $P \leq 0.05$ was used to determine statistical significance.

**Results and observation**

The study aimed to determine the incidence of SSI and to evaluate the role of presurgical infection control practices in the prevention of superficial surgical site infections. A total of 200 surgical cases were studied over a period of 3 months and the incidence of SSI was 6.5% per 100 operative procedures. Out of these 200 cases, 103 (51.5%) were males and 97(48.5%) were females. Among the operated cases, the maximum number of patients 75 (36.5%) were from 16-30 years of age followed by 31-45 years (31.5%) and 6% from 46-60 years of age. Out of the 200 operated cases, 99 (49.5%) were from the General surgery department followed by ENT 32(16%), Orthopedics 35 (17.5%), and Obs & gynecology 34 (17%). (Fig.1)

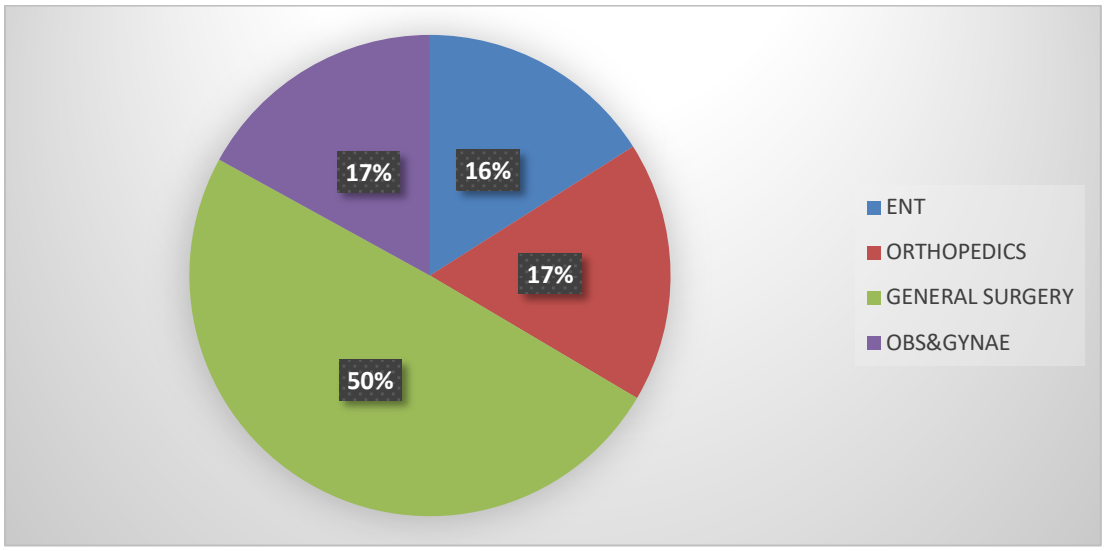


**Figure 1: Department-wise distribution of study group (N=200)**

Of the total, 93.5% of surgeries were planned elective surgeries, and only 6.5% were emergency surgeries.

Among the study groups, presurgical infection control practices were evaluated to assess their role in the prevention of superficial surgical site infections. Of 200 patients, 138 (69%) required presurgical hair removal. For hair removal, the use of a clipper (26%) was the most preferred method followed by the use of hair removal cream (9%) and in only 5% of cases shaving was done.

Out of the total cases, 188(94%) received presurgical antimicrobial prophylaxis, among those who received presurgical antimicrobial prophylaxis 165(82.5%) received it at the recommended time (60-120 min before surgery) while 23 (11.5%) received it outside the recommended time window.

Out of the total cases, 121(60.5%) patients had normal blood sugar levels before the surgery, and only 13(6.5%) patients had higher blood sugar levels. Presurgical bowel preparation was required by 66% out of which 23% had taken oral medication for presurgical bowel preparation. Only 23 (11.5%) underwent a preoperative bath, while the majority of patients 176 (88%) had not taken a presurgical preoperative bath

Surgical site preparation was done with an alcohol-based antiseptic solution and the surgical team performed surgical hand hygiene in all the 100 cases.

Presurgical infection control practices and their correlation with SSI analyzed in the study are shown in Table 1.

**Table 1: Presurgical infection control practices and SSI**

| S.No. | Variables | Operated Cases | Infected Cases | SSI Rate (%) | P Value |
|---|---|---|---|---|---|
| 1 | **Type Of Surgery** | | | | |
| | Elective | 187 | 10 | 5.34% | The p-value is .012166. The result is significant at p < .05. |
| | Emergency | 13 | 3 | 23.76% | |
| 2 | **Department** | | | | |
| | ENT | 32 | 0 | 0% | The p-value is .019653. The result is significant at p < .05. |
| | Orthopedics | 35 | 2 | 5.71% | |
| | General surgery | 99 | 4 | 4.04% | |
| | Obs & gynae | 34 | 7 | 20.58% | |
| 3 | **Hair Removal** | | | | |
| | Required | 138 | 10 | 7.24% | The p-value is .411031. The result is not significant at p < .05. |
| | Not required | 62 | 3 | 4.83% | |
| | DONE (in which required) | 126 | 10 | 7.93% | |
| | Not done | 12 | 0 | 0% | |
| | Methods that are preferred | | | | |
| | Clipper | 76 | 7 | 9.21% | |
| | Shaving | 18 | 2 | 11% | |
| | Hair removal Cream | 32 | 1 | 3.12% | |
| 4 | **Antimicrobial Prophylaxis** | | | | |
| | Given | 188 | 12 | 6.38% | The p-value is .461436. The result is not significant at p < .05. |
| | Not given | 12 | 1 | 8.33% | |
| | Recommended time | 165 | 10 | 6.06% | |
| | Inappropriate time | 23 | 3 | 13% | |
| 5 | **Blood Glucose Level** | | | | |
| | Normal | 121 | 12 | 9.91% | The p-value is .79674. The result is not significant at p < .05. |
| | High | 13 | 1 | 7.69% | |
| | Report not available | 66 | 0 | 0% | |
| 6 | **Bowel Preparation** | | | | |
| | If required | 133 | 13 | 9.77% | The p-value is .471649. The result is not significant at p < .05. |
| | Not required | 67 | 0 | 0% | |
| | Done | 34 | 3 | 8.82% | |
| | Not done | 101 | 10 | 9.09% | |
| 7 | **Preoperative Bathing** | | | | |
| | Done | 23 | 3 | 13.04% | The p-value is .179053. The result is not significant at p < .05. |
| | Not done | 176 | 10 | 5.68% | |
| 8 | **Preparation Of Surgical Site With Alcohol-Based Antiseptic Solution** | | | | |
| | Done | 200 | 13 | 6.5% | |
| | Not done | 0 | 0 | 0% | Not applicable |
| 9 | **Surgical Hand Disinfection By The Team** | | | | |
| | Done | 200 | 13 | 6.5% | |
| | Not done | 0 | 0 | 0% | Not applicable |

The incidence of SSI in our study was 6.5 per 100 operative procedures (13 out of the 200 patients), out of the 13 cases of SSI 2.5% showed culture positivity. The most common organism isolated from the cases of SSI was E.coli followed by Co-agulase-negative Staphylococcus.

**Discussion**

Superficial surgical site infection is defined as infection at the surgical site within 30 days of surgery. A total of 200 surgical cases were studied over a period of 3 months in which 13 (6.5%) developed SSI.

The SSI rate in our study was 6.5 per 100 operating procedures, It was comparable to studies done by Shahane V et al (Pune, 2012), and Nayan et al (Mumbai, 2022) 6%, and 7% respectively, A much higher rate than our study26% and 14.5% was reported by P. vigneshwaran et al (Chidambaram, 2020), Kurhade A et al. (Manipal, 2015) respectively and a comparatively lower SSI rate also reported by Golia S et al (Bangalore,2014) 4.3%.[5,6,7,8,9]

In our study, the surveillance was conducted daily which reduced the chances of missing out on SSI. In our study, the case definition of SSI as per the

NHSN guidelines including the clinical criteria and microbiological conformation makes the case definition stringent enough to prevent over or under-diagnosis of SSI.

In our study, the rate of SSI was higher in females (9.27%) as compared to male patients (3.88%). A similar female predominance in SSI rate was recorded in a study done by Huda F et al (AIIMS Rishikesh, 2022) where the rate of SSI was in females (68.8%) and Males (31.2%). [10]

This difference in SSI rate in the male and female patients is not significant statistically (p-value 0.12) the existing literature also shows that gender is not a risk factor for SSI. [11] In our study among the different age groups that were analyzed, patients in the 45–60-year had the maximum SSI cases 8.69%. Followed by patients in the 0–15-year age group with 8% of SSI cases. Notably, patients in the 16-30year age group had the lowest SSI cases 5.33%.

In a study done by Huda F et al (2022) the mean age of patients who developed SSI were 42.58±15.19 years. [10] As compared to studies done by Nayan et al. (Mumbai, 2022), and Narula, et al (Rishikesh, 2020) where the incidence of SSI was more in the mean age group of more than 60 years.[5,12]

The difference in age group could be because of sample size in our study was low and the study was conducted for a very short period. It was observed that the rate of SSI was higher in surgeries done in emergency conditions (23.76%) in comparison to the planned elective surgeries (5.34%) and this difference was statistically significant.

Similar findings were reported by studies done by Nayan et al (Mumbai, 2022), Narula, et al (Rishikesh, 2020), Kumar A, et al (2017), A. Pathak et al. (Ujjain, 2014). [5,12,13,14]

It was observed that the rate of SSI was maximum in the surgeries done by the Obs and Gynae departments (20.6%). This observation could be because the Obs and Gynae department deals with the maximum number of emergency surgeries (LSCS).

Similar findings were observed in a study done by G.K. Bunduki et al. (2020) where the SSI rate was 52.9% for the surgeries in the Gynae department. [15]

The Various factors contributing to SSI analyzed in our study including age distribution, gender, type of surgery, department, pre-operative hair removal methods, pre-operative antimicrobial prophylaxis, pre-operative blood glucose level, pre-operative bowel preparation, pre-operative bathing, preparation of the surgical site with an alcohol-based antiseptic solution, and surgical hand disinfection by the surgical team.

In our institute, clipper, shaving, and hair removal cream are the methods used for presurgical hair removal and it was observed that the rate of SSI was highest when shaving (11%) was used as a method of hair removal, followed by clipper (7.8%) and SSI rate was least when hair removal cream (3.1%) was used. Similar findings were also observed by Nayan et al (2022) where hair removal with shaving had a higher SSI rate of 93.7% as compared to clipping SSI rate of 2.1%. [5]

Presurgical antimicrobial prophylaxis refers to the administration of an efficient antimicrobial agent before exposure to microbial contamination during surgery to minimize infection problems. WHO suggests the administration of presurgical antimicrobial prophylaxis within 120 minutes before incision, considering the half-life and protein binding of the antibiotic.

In our study, antimicrobial prophylaxis was given at a recommended time in 87% of cases. The SSI rate was higher in patients who did not receive presurgical antibiotics prophylaxis in comparison to the SSI rate of 6.3% in patients who received presurgical antibiotics prophylaxis at the recommended time though the result was not statistically significant in our study.

Hyperglycemia increases the risk of perioperative infection. The stress of surgery results in the production of catabolic hormones and insulin inhibitors, which raise blood glucose levels.

In our study patients with high blood glucose levels had an SSI rate of 7.69%, compared to patients with normal levels, who had an SSI rate of 9.91%.

These findings could be because of the cancellation/postponement of the surgeries of patients with high blood glucose levels resulting in discrepancies in the denominator for analyzing blood glucose level as a risk factor for SSI.

In our study, Presurgical bowel preparation was required in 66% of cases depending on the type and site of surgery. Out of 66%, only 25.6% of cases received presurgical bowel preparation. Oral antibiotic bowel preparation was the preferred method in our institute for presurgical bowel preparation.

A marginal increase in SSI rate was observed in patients where bowel preparation was required but not done though not significant statistically. When a surgical incision naturally affects the superficial abdominal wall layers and produces an environment vulnerable to infection, the administration of oral antibiotic bowel preparation (OABP) offers a preventive option. [16,17]

The SSI rate found in those people who have not done preoperative baths was 5.68%. preoperative bathing was statically not significant in our study.

Our study was done during the winter season and because of this preoperative bathing was not done in most of the cases so we were unable to analyze preoperative bathing as a risk factor for SSI.

Dissimilar findings were also observed by A. Pathak et al. (Ujjain, 2014) who have done preoperative bathing had an SSI rate of 4.8% and those who have not done Preoperative bathing had an SSI rate of 10.7%. [14]

The team prepared the surgical site with an alcohol-based antiseptic solution and performed surgical hand disinfection in 100% of cases. We were not able to analyze these data as the presurgical site preparation rate was 100% in our study so we cannot evaluate whether it was related to SSI or not.

**Etiological Agent**

13 out of 200 patients developed SSI pus sample was taken from these 13 patients' bacterial growth was observed in 5 out of 13 SSI cases (2.5%) and most common organism was E.coli followed by CONS and Acinetobacter. 6.5% of the patients got surgical site infection, in which pus culture shows 4% no growth and the rest are 2.5% showing growth of isolated microorganisms, of which 1.5% were Escherichia coli and 1% were coagulase-negative Staphylococcus and the rest were 0.5% Acinetobacter.

Our study was conducted for a very short time period (3 months) that's why low growth of microorganisms was found, and E.coli was the most common pathogen in our study.

Similar studies have shown that E.coli was the most common pathogen Shahane V et al (2012), Huda F et al (2022), and in some other studies Staphylococcus aureus was the most common pathogen Dr. p. vigneshwaran et al (2020), A.Pathak et al. (2014), Golia S et al.(2014) and some studies shown that Acinetobacter species was the most common isolated microorganism Hirani S et al (Vadodara, 2022).[7,10,9,14,6]

**Conclusion**

A total of 200 surgical cases were studied over a period of 3 months of which 13 developed SSI.

- In the present study the incidence of SSI was found 6.5 per 100 operating procedures.
- The type of surgery (elective/emergency) was found to be associated with the development of SSI and the difference was statically significant.
- Significant cases were from Obs and Gynae department as the maximum number of Emergency surgeries (LSCS) was dealt in this department.
- No significant association was found between various pre-surgical infection control practices like pre-operative hair removal methods, pre-operative antimicrobial prophylaxis, pre-operative blood glucose level, pre-operative bowel preparation, pre-operative bathing, preparation of the surgical site with an alcohol-based antiseptic solution, and surgical hand disinfection by the surgical team. This could be because of low sample size or short study period
- Age and gender were not associated with SSI in our study suggesting that these factors are neither protective nor contributing to the development of SSI.

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