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Study of Surgical Site Infections after Elective Abdominal Surgery: An Observational Study in a Teaching Hospital of North East India

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ABSTRACT

Surgical site infection (SSI) is defined by the Centres for Disease Control and Prevention as a wound infection that occurs within 30 days of an operative procedure or within a year if an implant is left in place and the infection is thought to be secondary to surgery. The rates of SSI are much higher with abdominal surgery than with other types of surgery. Aim of this study is to take an account of SSI following abdominal surgery, find out the proportion of postoperative cases with surgical site infection and identify the microorganisms responsible for infection and their antibiogram. The present study was a Hospital based observational study. This Study was conducted from (December 2019 to November 2021) at Dept. of general Surgery collaboration with Department. of microbiology. Total 84 patients were included in this study. 13 (15.5%) patients had Inervalappendicectomy, 57 (67.9%) patients had Open cholecystectomy, 6 (7.1%) patients had Open cholecystectomy with CBD exploration, 6 (7.1%) patients had partial gastrectomy with GJ anastomosis, 1 (1.2%) patient had partial pyloromyotomy (CHPS) and 1 (1.2%) patient had Right Hemicolectomy with anastomosis. It was found that surgical site infection rate was decreased in Pyloromyotomy (CHPS) and right hemicolectomy with anastomosis surgery which was not statistically significant and found that most of the SSI patients were Hindu which was not statistically significant.

INTRODUCTION

Surgical site infection (SSI) is defined by the Centres for Disease Control and Prevention define wound infection as happening within 30 days of an operating procedure or within a year if an implant is left in place and the infection is considered to be subsequent to surgery. Abdominal surgery has a significantly greater SSI rate than other types of surgery[1].

Surgical site infections (SSIs) are the most prevalent healthcare-associated infections (HAIs) worldwide, with a prevalence ranging from 2-20%, or even more, depending on the type of surgery and patient characteristics. SSI are associated with increased morbidity and mortality, as well as longer hospital stays and higher expenses[2].

SSI is caused by microbial contamination of the surgical site, which might be incisional or organ/space. Incisional SSI can be superficial (including only the skin and subcutaneous tissues) or profound (involving deeper soft tissues). Organ/space Except for the incised layers of the body wall (i.e., intra-abdominal abscess), SSIs can affect any region of the anatomy. SSIs with superficial incisions are more common than the other two.

The national nosocomial infection surveillance system (NNIS) surgical infection risk index includes risk factors such as the American Society of Anaesthesiologists (ASA) index, which classifies patients based on their clinical condition the Wound class, which represents the surgical wound classification by the surgical team in terms of the potential presence of microorganisms and the Duration of Surgery. BMI, smoking, diet and immunity, prophylactic antibiotics, operation type and duration, shaving technique, blood transfusion, failure to perform a preoperative bath and pre-existing chronic conditions are all risk factors.

The distribution of bacteria identified from surgical site infections has not changed significantly during the last many decades. *Staphylococcus aureus*, Coag(-) *Staphylococci*, *Enterococcus* spp. and *E. coli* are the most prevalent strains. Furthermore, the proportion of surgical site infections caused by resistant bacteria species (MRSA, Candida albicans) has been continuously growing[3].

The primary objectives of this study are to describe the occurrence and risk factors for SSI in patients undergoing abdominal surgery. Secondary goals include researching the microbiological pattern of SSI in their population, as well as their antibiotic sensitivity and researching the influence of SSI on postoperative length of stay.

MATERIALS AND METHODS

Study design: Hospital based observational study.

Study set up: In the Department of general Surgery collaboration with Department. of microbiology.

Study duration: The procedure was carried out for two years (December 2019 to November 2021).

Study population: All the patients who were attended to the surgery OPD after elective abdominal surgery in department of General Surgery, AGMC and GBPH during my study duration.

Sample size:

$$N = \frac{4\,PQ}{d^2}$$

Where:

P = 30% [as per unpublished data of ICMR Short Term Studentship (STS) project done on AGMC and GBP Hospital with the Reference ID:- 2012-01271]

Q = (100-30) = 70

d = 5% (absolute precision)

So by formula my sample size is 84

Sampling method: All the patients to be taken as sample after fulfilling the inclusion and exclusion criteria's

Inclusion criteria:

- Patients of all sex and all age group
- Patients those are willing to participate
- Patients of elective abdominal surgery who were attended to surgery OPD for follow-up

Exclusion criteria:

- Patients who refuse to give consent
- Patients with pre-existing severe infections
- Emergency abdominal surgery

RESULTS AND DISCUSSIONS

Surgical site infection (SSI) is defined by wound infection defined by the Centres for Disease Control and Prevention as occurring within 30 days of an operational procedure or within a year if an implant is left in place and the infection is regarded to be subsequent to surgery. Abdominal surgery has a substantially higher rate of SSI than other types of surgery. Surgical site infections (SSIs) are the most common healthcare-associated infections (HAIs) globally, with a 2-20%, or even greater, prevalence depending on the type of surgery and patient characteristics. SSI are linked to greater morbidity, mortality, longer hospital stays and higher costs.

This hospital-based observational study was carried out at the Department. General surgery will collaborate with AGMC's Department of Microbiology and GBPH to carry out the treatment for two years.

During the time of my study, all patients who attended the surgery OPD after elective abdominal surgery in the departments of general surgery, AGMC and GBPH.

We include patients of all sexes and ages, patients wanting to participate and patients undergoing elective abdominal surgery who will return to the surgery OPD for follow-up.

Total 84 patients were taken in our study. Out of this 10 patient found SSI. Alkaaki *et al*.[1] found that the overall incidence of SSI was 16.3% (55/337) had deep infections, 5 (9%) had superficial infections and 25 (45%) had both superficial and deep infections. In open versus laparoscopic surgeries, the incidence of SSI was 35% versus 4% ($p<0.001$). According to Siddiqiui *et al*.[4], surgical site infections (SSIs) account for 14-16% of nosocomial infections and are a major cause of increased morbidity, hospital stay, cost of care and even fatality.

In our study we found that 3 (30.0%) patients had *E. coli*, 2 (20.0%) patients had klebsiella, 1 (10.0%) patient had pseudomonas and 4 (40.0%) patient had *Staphylococcus aureus* in Organisam causing SSI. Association of Organisam with SSI was statistically significant ($p<0.0001$). In a study done by Alexiou *et al*.[3], *Escherichia coli*, *Klebsiella pneumoniae*, *Enterobacter cloacae*, *Pseudomonas aeruginosa*, *Bacteroidesfragilis*, *Staphylococcus aureus* and *Enterococcus faecalis* were the primary pathogens recovered from SSI patients. *Staphylococcus aureus* (17.3%), *E. faecalis* (19.5%), *P. aeruginosa* (10.5%), *B. Fragilis* (13.4%), *E. coli* (20.4%), *Enterobacter cloacae* (9.1%) and *K. Pneumoniae* (9.8%) grew at different rates. Janugade *et al*.[5] shows that Pseudomonas was the most usually isolated organism from SSIs (42.85%), followed by Klebsiella sp. (28.5%) and other microorganisms. The vast majority of the microbes isolated were multidrug resistant.

On antibiogram we also found among 4 isolates of staphylococcus 50% (2 isolates) was sensitive and 50% (2 isolates) was resistant for Erythromycin, Azithromycin, *Amoxycilline* clavulanate and Piperacillin tazobactam. 25% (1 isolate) resistance was observed in Levofloxacin, Meropenem and Clindamycin while 75% (3 isolates) showed sensitivity. Ciprofloxacin, Amikacin, Cotrimoxazole and Doxycycline resistant and sensitivity was observed in 75 and 25% cases respectively. All 4 isolates were sensitive for Vancomycin, Linozolid and resistant for Benzylpenicillin. Among 3 isolates of *E. oli*, 66.7%(2 isolates) was sensitive and 33.3% (1 isolate) was resistant for Ampicillin, Amoxicillin/clavulanic acid, Cefazolin, Gentamycin, Tetracycline and Trimethoprim/ Sulfamethoxazole. 33.3% sensitivity was observed in Cefeprime, Amikacine, Ciprofloxacin and Piperacillin tazobactam while 66.7% showed resistant. All three isolates were resistant to Cefotaxime, Ceftriaxone, Tobramycin and Nitrofurantoin. All three were sensitive to Meropenem and Imipenem. Klebsiella Shows that among 2 isolates, 50% (1 isolates) was sensitive and 50% (1 isolates) was resistant for Aztreonam, Cefuroxime, Cotrimoxazole, Gentamicin and Piperacillin tazobactam. All 2 patient were sensitive for Cefoxitin and Chloramphenicol. All 2 isolates were resistance for Azithromycin, Cefepime, Imipenem, Nitofurontoin and Tetracyclin. Pseudomonas Shows that patient was fully sensitive for Ampicillin, Amoxicillin, Meropenum, Imepenem, Amikacin, Ciprofloxacin, Tetracycline and Piperacillin tazobactam. 100% Resistsnce for Cefazolin, Cefotaxime, Ceftriaxone, Cefeprine, Gentamycin, Tobramycin, Levofloxacin, Nitrofurantoin and Trimethoprim/Sulfamethoxazole. In a similar study conducted by Yang *et al*.[6] found that MRSA was sensitive to vancomycin (522/522) and linezolid (93/94), while 79.9% (95%CI 67.4-88.4%, I2 = 0%) and 92.0% (95%CI 80.2-97.0%, I2 = 0%) of MRSA was resistant to clindamycin and erythromycin, respectively.

Our study showed that, 5 (6.0%) patients were 11-20 years old, 10 (11.9%) patients were 21-30years old, 20 (23.8%) patient were 31-40years old, 31 (36.9%) patients were 41-50years old, 11 (13.1%) patients were 51-60 years old and 7 (8.3%) patients were >60years old. 52 (61.9%) patients were Female and 32 (38.1%) patients were Male. We also found that without SSI, the mean Age (mean± s.d.) of patients was 40.7162±12.8089. In with SSI, the mean Age (mean±s.d.) of patients was 52.7000±9.9672. Distribution of mean Age with SSI was statistically significant ($p = 0.0057$). Janugade *et al*.[5] shows that Male patients were impacted at a higher rate (18.2%) than female ones (5.9%). The rate of SSI rose with age and it also increased dramatically with the length of pre-operative hospitalisation. Alexiou *et al*.[3] found that Several studies have shown that patient features and coexisting morbidities such as obesity, smoking, heart or renal failure, pre-existing localised infections and patients' age (particularly if over 65) appear to be independent predictive factors for surgical field infections.

Our study showed that 65 (77.4%) patients were General Caste, 7 (8.3%) patients were SC and 12 (14.3%) patients were ST. In without SSI, 58 (78.4%) patients were General Caste, 6 (8.1%) patients were SC and 10 (13.5%) patients were ST. In with SSI, 7 (70.0%) patients were general caste, 1 (10.0%) patient was SC and 2 (20.0%) patients were ST. Association of caste with SSI was not statistically significant ($p = 0.8281$). 8 (9.5%) patients were <20 BMI, 22 (26.2%) patients were 20.1-25 BMI, 28 (33.3%) patients

Table 1: Distribution of organisams, name of surgery

	Organisms	Frequency	Percentage
Organisms	*Escherichia coli*	3	30.0
	Klebsiella	2	20.0
	Pseudomonas	1	10.0
	Staphylococcus aureus	4	40.0
	Total	10	100.0
Name of surgery	Inerval appendicectomy	13	15.5
	Open cholecystectomy	57	67.9
	Open cholecystectomy with CBD exploration	6	7.1
	Partial gastrectomy with GJ anastomosis	6	7.1
	Pyloromyotomy (CHPS)	1	1.2
	Right hemicolectomy with anastomosis	1	1.2
	Total	84	100.0

were 25.1 -30 BMI and 26 (31.0%) patients were >30 BMI. Our study showed that in without SSI, 7 (9.5%) patients were <20 BMI, 19 (25.7%) patients were 20.1 -25BMI, 24 (32.4%) patients were 25.1 -30BMI and 24 (32.4%) patients were >30BMI. In with SSI, 1 (10.0%) patient was <20 BMI, 3 (30.0%) patients were 20.1 -25 BMI, 4 (40.0%) patients were 25.1 -30BMI and 2 (20.0%) patients were >30BMI. Association of BMI with SSI was not statistically significant (p = 0.8833). 10 (11.9%) patients were High school passed, 37 (44.0%) patients were higher secondary and above passed, 18 (21.4%) patients had Middle school and 19 (22.6%) patients had Primary Education.

We found that 13 (15.5%) patients had Inerval appendicectomy, 57 (67.9%) patients had Open cholecystectomy, 6 (7.1%) patients had Open cholecystectomy with CBD exploration, 6 (7.1%) patients had Partial gastrectomy with GJ anastomosis, 1 (1.2%) patient had Pyloromyotomy (CHPS) and 1 (1.2%) patient had Right hemicolectomy with anastomosis. In with SSI, 2 (20.0%) patients had Inervalappendicectomy, 4 (40.0%) patients had Open cholecystectomy, 2 (20.0%) patients had Open cholecystectomy with CBD exploration and 2 (20.0%) patients had Partial gastrectomy with GJ anastomosis. Association of Name of surgery with SSI was not statistically significant (p = 0.2227). Ejaz *et al*.[7] found that risk factors for any inpatient SSI (superficial and deep) were evaluated using multivariable logistic regression. Median patient age was 58 y (interquartile range 47, 68), surgical procedures included colorectal (59.0%), liver (26.2%) and pancreas (14.8%) resections. SSI occurred in 7.6% (n = 132) of patients (Table 1).

Out of 84 patient in our study 73 (86.9%) patients were used Prophylactic antibiotic. In without SSI, 67 (90.5%) patients were used Prophylactic antibiotic. In with SSI, 6 (60.0%) patients were used Prophylactic antibiotic. Association of Prophylactic antibiotic use with SSI was statistically significant (p = 0.0072). Miliani *et al*.[8] was done a study to determine which surgical antibiotic prophylaxis (SAP) practices alter surgical site infection (SSI) risk showed that no significant relationships were observed between SSI and the other SAP parameters. Too-short SAP duration was the most important SAP malpractice associated with an increased risk of SSI (Table 2).

Table 2: Association between Insertion of drain, prophylactic antibiotic use: SSI

	SSI		
	Absent	Present	Total
Prophylactic antibiotic use			
Given	67	6	73
Row (%)	91.8	8.2	100.0
Col (%)	90.5	60.0	86.9
Not given	7	4	11
Row (%)	63.6	36.4	100.0
Col (%)	9.5	40.0	13.1
Total	74	10	84
Row (%)	88.1	11.9	100.0
Col (%)	100.0	100.0	100.0
Insertion of drain			
No	6	1	7
Row (%)	85.7	14.3	100.0
Col (%)	8.1	10.0	8.3
Yes	68	9	77
Row (%)	88.3	11.7	100.0
Col (%)	91.9	90.0	91.7
Total	74	10	84
Row (%)	88.1	11.9	100.0
Col (%)	100.0	100.0	100.0

77 (91.7%) patients had Insertion of drain out of 84 patient in our study in without SSI, 68 (91.9%) patients had Insertion of drain. In with SSI, 9 (90.0%) patients had Insertion of drain. Association of Insertion of drain with SSI was not statistically significant (p = 0.8390). Cheng *et al*.[9] showed that Multivariate analysis identified multiple parameters correlating with the occurrence of SSI: Their data suggest that insertion of drain reduce incidence of SSI.

Our study showed that in In without SSI, the mean Duration of surgery in hours (mean±SD) of patients was 1.5604±0.7948. In with SSI, the mean duration of surgery in hours (mean±SD) of patients was 1.9060±1.2986. Distribution of mean duration of surgery in hours with SSI was not statistically significant (p = 0.2389). Razavi *et al*.[10] done This study suggests that by reducing the average operation time to less than 2 hours, the average pre-operative hospital stay to 4 days and the overall stay to less than 11 days, the SSI may be reduced to a more acceptable level.

CONCLUSION

We found that most of the patients were 41-50 years old and the mean Age of patients was 42, 14, 29 years. In our study female population was higher than the male population. It was found that most of the SSI patients were Hindu which was not statistically significant. We observed that BMI<20 was less observed in patients with surgical site infection and this was not statistically significant. We examined that Middle class Education and Primary Education were most common in patients with surgical site infection which was not statistically significant. It was found that surgical site infection rate was decreased in Pyloromyotomy (CHPS) and right hemicolectomy with anastomosis surgery which was not statistically significant. Our study showed that Prophylactic antibiotic treatment was not given to less number of patients with surgical site infection and most of the SSI patients had Prophylactic antibiotic treatment which was statistically significant. Present study showed that Staphylococcus Aureus was common Organism who was responsible for surgical site infection in highest number patients and this was statistically significant. We also found that Duration of surgery had no significant difference with surgical site infection. Independent risk factors for SSI after abdominal surgery that are potentially controllable, such as open surgical approach, contaminated wound class and emergency surgery, should be addressed systematically. In individuals at higher risk for SSI, we recommend customising the antibiotic preventive prescription to target the most often identified pathogens. We concluded that surgical site infections are significant consequences that affect healthcare services, hospital costs and the patient himself. Future comprehensive investigations are expected to disclose a lot more information about predisposing and prophylactic patient and hospital features.

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