

## Original Research Article

# An observational study of incidence of surgical site infections in gastrointestinal surgeries

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## ABSTRACT

**Background:** This study analysed the incidence of surgical site infections in gastrointestinal surgeries and its risk factors. so this study helped us in reducing surgical site infection by avoiding or minimizing that risk factors.

**Methods:** The present study was conducted at general surgery department, SMIMER, Surat. An observational study of 400 cases that have undergone abdominal surgery in SMIMER hospital and were followed up from the day of operation to 30 days after discharge was done.

**Results:** The overall infection rate for a total of the 400 cases was 17.25%. The incidence rate in this study was well within the infection rates of 2.8% to 17% seen in other studies. Different studies from India at different places have shown the SSI (surgical site infection) rate to vary from 6.09% to 38.7%.

**Conclusions:** Our study reveals that though SSIs have been widely studied since a long time, they still remain as one of the most important causes of morbidity and mortality in surgically treated patients.

**Keywords:** SSI, Superficial incisional SSI, Deep incisional SSI, Gastrointestinal surgeries, Postoperative

## INTRODUCTION

### Criteria for defining an SSI

#### Superficial incisional SSI<sup>1</sup>

Infection occurs within 30 days after the operation and infection involves only skin or subcutaneous tissue of the incision one of the following: purulent drainage, with or without laboratory confirmation, from the superficial incision; organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision; at least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness; diagnosis of superficial incisional SSI by the surgeon or attending physician.

Do not report the following conditions as SSI: stitch abscess (minimal inflammation and discharge confined to

the points of suture penetration); infection of an episiotomy or newborn circumcision site; infected burn wound; and incisional SSI that extends into the facial and muscle layers (see deep incisional SSI).

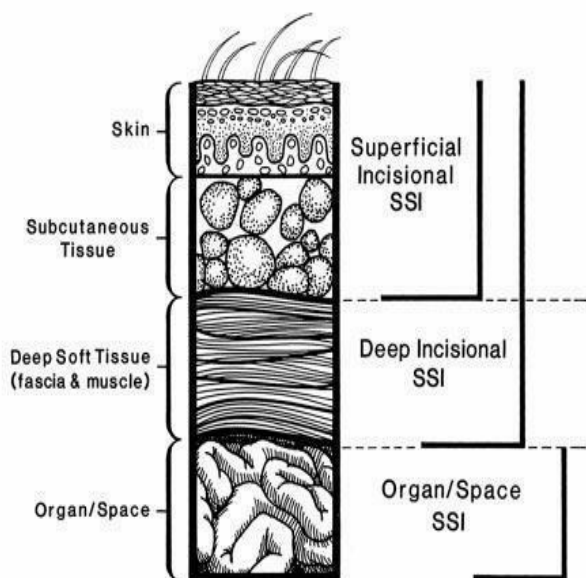
#### Deep incisional SSI<sup>1</sup>

Infection occurs within 30 days after the operation if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation and infection involves deep soft tissues (e.g. facial and muscle layers) of the incision and at least one of the following: purulent drainage from the deep incision but not from the organ/space component of the surgical site; a deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38°C), localized pain, or tenderness, unless site is culture-negative; an abscess or other evidence of

infection involving the deep incision is found on direct examination, during reoperation or by histopathologic or radiologic examination; and diagnosis of a deep incisional SSI by a surgeon or attending physician.

### Organ/space SSI<sup>1</sup>

Infection occurs within 30 days after the operation if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation and infection involves any part of the anatomy (e.g. organs or spaces), other than the incision, which was opened or manipulated during an operation and at least one of the following: purulent drainage from a drain that is placed through a stab wound into the organ/space; organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space; an abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation or by histopathologic or radiologic examination; and diagnosis of an organ/space SSI by a surgeon or attending physician.



**Figure 1: Types of SSI according to the type of tissue involved.<sup>12</sup>**

### Surgical wound classification<sup>2</sup>

#### Class 1: Clean

An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital or uninfected urinary tract is not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow nonpenetrating (blunt) trauma should be included in this category if they meet the criteria.

#### Class 2: Clean-contaminated

An operative wound in which the respiratory, alimentary, genital or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.

#### Class 3: Contaminated

Open fresh and accidental wounds. In addition, operations with major breaks in sterile technique (e.g. open cardiac massage) or gross spillage from the gastrointestinal tract and incisions in which acute, non-purulent inflammation is encountered are included in this category.

#### Class 4: Dirty-infected

Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation.

### Aims and objectives

The aims and objectives were to access the incidence of SSI in GI surgeries and observation of factors associated with SSI in GI surgeries.

### METHODS

#### Source of data

The material for the present study was obtained from patient's who underwent GI surgeries in department of general surgery of Surat municipal institute of medical education and research, Surat from 02 August 2019 to 20 March 2020.

Surgical sites were considered to be infected according to the definition by NNIS.

As this procedure was not well documented, who volunteered after thorough explanation about the merits and demerits of the procedure, 400 patients were included in the study who fulfilled the inclusion criteria.

#### Type of study

The study was a prospective observational study.

#### Statistical tool (software)

The statistical tool (software) was SAS/STAT software.

Sample size calculated by using SAS/STAT software considering proportion of surgical site infection patient in department of general surgery at present institute as 4% (p), with 95% level of inference (z alpha/2) with allowable error as 5% (L),

$$N = \left( \frac{z \alpha / 2}{L} \right)^2 \frac{pq}{L}$$

$$N = (1.96)^2 (0.44)(1 - 0.04)(0.05)^2$$

$$N = 200$$

Authors have taken 2N number of cases, that was 400.



**Figure 2: Infected post operative wound.**



**Figure 3: Infected post operative wound with pus discharge.**

### **Study population**

Patients who underwent GI surgeries in department of general surgery, SMIMER were the study population for the study.

### **Inclusion criteria**

Patients aged <60 years, both male and female and patients undergoing exploratory laparotomy for peptic ulcer perforation (PUP), simple and complicated acute appendicitis (appendicular perforation), small bowel

obstruction (SBO), traumatic and non-traumatic perforation of small and large bowel GI malignancy, penetrating abdominal injuries and other GI surgeries were included in the study.

### **Exclusion criteria**

Patients lost to follow up, patients not giving consent to be part of the research, patients with incidental intra/post operative findings of additional pathology, patients who were unable to receive sensitive antibiotics and patients with predominant symptoms related to GI pathology not undergoing surgery were excluded from the study.



**Figure 4: Wound after suture removal.**



**Figure 5: Wound in healing phase.**

### **Technique**

An elaborate study of these cases with regard to date of admission, history, clinical features of wound infection, type of surgery, emergency or elective, preoperative preparation and postoperative management was done till patient was discharged from hospital and then followed up the patient on OPD basis for any signs of wound infection. In history, presenting complaints, duration, associated diseases, coexistent infections at a remote

body site personal history including diet, smoking and alcoholism were noted.

Preoperative findings which included preoperative bath, skin preparation, type and time of preparation, preoperative abdominal skin culture, nasal swab for culture for commensals, preoperative antibiotics use.

Operative findings which included type of incision, wound contamination, drain used and its type and duration of operation.

Postoperative findings which included day of wound infection, day of 1st dressing and frequency of change of dressing.

Findings on the day of diagnosis of wound infection were noted which included fever, erythema, discharge, type and colour and the exudates was collected from the depth of the wound using sterile cotton swab and was sent to microbiology department for culture and sensitivity.

**Procedure in laboratory**

In the microbiology department, the swabs were inoculated onto blood agar plate, McConkey’s agar plates and nutrient broth. Inoculated media were incubated aerobically at 37°C for 24-48 hours.

**RESULTS**

In our study among 400 patients, 280 patients were males and 120 patients were females. Among them 58 male patients (20.71%) and 11 female patients (9.16%) were found to develop SSI who had undergone GI surgeries (Table 1).

In my study 70% cases were males and remaining were females.

In our study 400 patients who underwent GI surgeries among them 69 patients found to develop SSI. Incidence of SSI was high 32.81% (35 out of 110 cases) in patients where total duration of surgery was more than two hours (Table 2). However, incidence of SSI appeared to be relatively low (11.72%) (34 out of 290 cases) in patients where duration of surgery was less than 2 hour. In our study among 400 patients, 136 patients were undergone elective surgery and 264 patients were undergone emergency surgeries. Among them 60 patients (22.72%) who had undergone emergency surgeries and 9 patients (6.61%) who had undergone elective surgeries were found to develop SSI who had undergone GI surgeries (Table 3). In our study among 400 patients, 69 patients were found to develop SSI, among them we further divided the causative organism causing SSI (Table 4).

**Table 1: Sex wise distribution.**

Sex	Total patients	Infected patients	Percentage
Male	280	58	20.71
Female	120	11	9.16

**Table 2: Duration of surgery.**

Duration of surgery (in hrs)	Total no. of cases	Infected cases	Percentage
Less than 2	290	34	11.72
More than 2	110	35	31.81

**Table 3: Plan of surgery.**

Plan of surgery	Total no. of cases	Infected cases	Percentage
Elective	136	09	6.61
Emergency	264	60	22.72

**Table 4: Causative organism.**

Name of the organism	No. of cases	Percentage
<i>Pseudomonas</i>	33	47.82
<i>Klebsiella</i>	14	23.33
<i>E. coli</i>	12	17.39
<i>Streptococcus</i>	05	7.24
<i>Acinetobacter</i>	02	2.89
<i>Helicobacter</i>	01	1.44
<i>Providentia</i>	02	2.89



**Table 5: Risk factors.**

Risk factors	Total cases	Infected cases	Percentage
<b>Anaemia</b>	125	43	33.6
<b>Diabetes mellitus</b>	64	23	35.93
<b>Hypoproteinaemia</b>	48	13	27.08
<b>Obesity</b>	140	31	22.14

□ **Table 6: Incidence of SSIs.**

Total no. of cases	Infected cases	Percentage
<b>400</b>	69	17.25

In our study among 400 patients, 69 patients were found to develop SSI, among them we further divided the causative organism causing SSI (Table 5).

In our observation *Pseudomonas* appeared to be the most common (33 out of 69 cases) (47.82%) causative organism followed by *Klebsiella* (14 cases out of 69) (23.33%), *E. coli* (12 out of 69 cases), *Streptococcus* (5 out of 69) (17.39%), *Acinetobacter* (2 cases out of 69) (2.89%), *Helicobacter* (1 case out of 69) (1.44%), *Providentia* (2 cases out of 69) (2.89%).

In our study among 400 patients, 69 patients were found to develop SSI, among them the incidence of SSI increases as the patient's with various risk factors, who had undergone gastrointestinal surgeries (Table 6).

In our study among 69 infected patients, incidence of SSI appeared to be increased in with risk actors as follows. Incidence was 33.6% (43 out of 125) in patients with anemia, incidence was 35.93% (23 out of 64) in patients with diabetes, incidence was 27.08% (13 out of 48) in patients with hypoproteinemia and incidence was 22.14% (31 out of 140) in patients with anemia. In our study among 400 patients, 69 patients were found to develop SSI who had undergone GI surgeries. This study included 400 GI surgical patients, out of which 69 were infected. So the gross incidence was 17.25%.

So the incidence of SSI in gastrointestinal surgeries was 17.25%. Incidence of SSI in male patient was 20.71% and in female patient was 9.16%. Incidence of SSI in long duration (>2 hour) surgery was 31.81% and in short duration (<2 hour) surgery was 11.72. Incidence of SSI in emergency surgery was 22.72% and in planned (elective) surgery was 6.61%. Incidence of *Pseudomonas* infection in SSI was 47.82%. Incidence of SSI increased in comorbid patients.

## DISCUSSION

The present study was conducted at general surgery department SMIMER Surat. This was a observational study of 400 cases that have undergone abdominal

surgery in SMIMER hospital and were followed up from the day of operation to 30 days after discharge.

### *Incidence of abdominal SSI*

The overall infection rate for a total of the 400 cases was 17.25%.

The incidence rate in this study was well within the infection rates of 2.8% to 17% seen in other studies. Different studies from India at different places have shown the SSI rate to vary from 6.09% to 38.7% .

There was statistically significant association of SSI with wound class, longer surgery and hospital stay and surgeon experience and grade and emergency surgeries.<sup>3</sup>

The prevalence of surgical site infection in the study population was still high. Preoperative hospital stay, premorbid illness, preoperative and postoperative hospital stay, ASA score and the type of wound were the independent predictors of surgical site infection.<sup>4</sup>

Male sex, obesity transfusion, type of procedure and prolonged duration were significant factors associated with overall infection risk after adjusting other factors.<sup>5</sup>

A host of patient related and operative procedure related factors may contribute to the development of SSIs.<sup>6</sup>

The risk of infection was related to the specific surgical procedure performed and surgical wounds were classified according to the relative risk of SSI occurring, clean, clean-contaminated, contaminated and dirty. In the national nosocomial infection surveillance system, the risk of patients was stratified according to three important factors: wound classification (contaminated or dirty); longer duration operation, defined as duration that exceeded the 75th percentile for a given procedure; and medical characteristics of patients as determined by American society of anaesthesiology classification of 3, 4 or 5 (presence of severe systemic disease that resulted in functional limitations, was life threatening or was expected to preclude survival from the operation) at the time of operation.<sup>7</sup> The infection rate in Indian hospitals

was much higher than that in other countries; for instance in the USA, it was 2.8% and it was 2-5% in European countries. The higher infection rate in Indian hospitals may be due to the poor set up of our hospitals and also due to the lack of attention towards the basic infection control measures.

## CONCLUSION

Incidence of surgical site infection in GI surgeries is around 17.25%, but it may vary according to patient factors or surgical factors. Emergency surgeries and longer duration of surgeries have higher infection rates. Comorbidities like anaemia, diabetes mellitus, hypoproteinemia and obesity are associated with increase wound infection rate. Pseudomonas is the most common organism isolated in the surgical site infections.

## Recommendations

The following methods were recommended for further reducing infection. Regular surveillance and feedback of results to surgeons, presumably influencing surgical technique; reducing the preoperative stay to minimum; minimizing the length of operation; avoiding wound drains, if this was not possible, using a closed drainage system and removal of drains as soon as possible; ensuring that the patient was as fit as possible; using a good surgical technique; encouraging efforts in reducing the known risk factors to a bare minimum in elderly patients; proper collection and transport of samples from the surgical site, immediately on suspicion of infection; and awaiting antibiotic sensitivity test results for appropriate antibiotic therapy, to avoid emergence of resistant strains as there was evidence to indicate that hospital acquired MRSA was developing resistance to vancomycin.

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