

A Study of Incidence and Risk Factors in Post Operative Abdominal Wound Infection in Tertiary Care Centre

Deepak Thombare¹ and Dinesh Joshi^{2*}

¹PG Resident, Department of Surgery, Dr. Vasant Rao Pawar Medical College Hospital and Research Centre, Adgaon - 422003, Nashik, Maharashtra, India; dr.dkthombare@gmail.com

²Assistant Professor, Department of Surgery, Dr. Vasant Rao Pawar Medical College Hospital and Research Centre, Adgaon - 422003, Nashik, Maharashtra, India; dineshvjoshi@gmail.com

Abstract

Introduction: Surgical site infections are associated with substantial morbidity and mortality, increase in hospital stay and enhanced cost of health care. Objective of present study is to analyse the incidence of surgical site infections after major abdominal surgeries and risk factors for development of SSIs. **Methods:** It is observational study carried out at Department of General Surgery, Dr. Vasant Rao Pawar Medical College, Nashik, Maharashtra, India. This study carried on 70 patients operated in general surgery department. The various parameters studied were age and sex of patients, presence of diabetes, hypertension malignancy, type of surgery (emergency and elective surgery), duration of surgery, and the class of wound etc. **Results:** Hypertension, malignancy of operated patients had surgical site infection. Significant risk factors are age, obesity, emergency surgery, dirty and contaminated wounds, prolonged hospital stay, Diabetes mellitus. *Staphylococcus aureus* and *E. coli* are most commonly identified organisms in culture. **Conclusions:** Post-operative abdominal wound infection represents a substantial burden of disease, both for the patients and the healthcare services in terms of the morbidity, mortality and economic costs.

Keywords: Abdominal Surgery, Surgical Site Infection

1. Introduction

Surgical Site Infection (SSI) previously termed postoperative wound infection is defined as that infection presenting up to 30 days after a surgical procedure if no prosthesis is placed and up to 1 year if a prosthesis is implanted in the patient¹.

According to the US Center for Disease Control (CDC), National Nosocomial Infections Surveillance system, SSI is the third most frequent nosocomial infection, accounting for 14%-16% of infections among hospitalized patients and 38% of infections in surgical patients². The surgical site infection rates for intra-

abdominal procedures are still higher i.e., upto 20% (range from 3.4% - 36.1% in different studies)³.

In India, a study conducted on SSI in tertiary care hospital showed incidence of 2.06% and 16.16% in MIS (minimal invasive surgery) and OS (open surgery) respectively⁴. Another literature which has reviewed the studies on SSI 1995 to 2010 reported SSI incidence of 2% to 23% for all surgical procedures in India⁵.

The incidence of SSI following abdominal surgery varies according to the nature of the procedure undertaken and the degree of wound contamination. For example, the incidence of wound infection following an elective splenectomy in which the Gastro-Intestinal (GI)

*Author for correspondence

tract is not entered would be expected to be much lower than that of following an emergency laparotomy for a colonic perforation during which contamination of the surgical site is inevitable. In acknowledgment of this it is common practice to stratify surgical wounds according to the degree of contamination⁶:

- *Clean*: an uninfected operative wound in which no inflammation is encountered and the alimentary, genital or urinary tract is not entered.
- *Clean contaminated*: a wound in which the alimentary, genital or urinary tract is entered in a controlled manner.
- *Contaminated*: open, new accidental wounds, or operations in which there is a significant break in aseptic technique (e.g. gross contamination with GI tract contents) or acute non-purulent inflammation is encountered.
- *Dirty*: old traumatic wounds with devitalised tissue, or those involving existing infection or visceral perforation.

SSI leads not only to substantial morbidity and mortality, but also to longer hospital stays and greater health-care costs. SSI can also influence patient quality of life and work productivity because of time spent in hospital. These infections are usually caused by exogenous and/or endogenous micro-organisms that enter the operative wound either during the surgery (primary infection) or after the surgery (secondary infection).

Primary infections are usually more serious, appearing within five to seven days of surgery. Majority of SSIs are uncomplicated involving only skin and subcutaneous tissue but sometimes can progress to necrotizing infections. The usual presentation of infected surgical wound can be characterized by pain, tenderness, warmth, erythema, swelling and pus formation.

A number of patient related factors (old age, nutritional status, pre-existing infection, co-morbid illness) and procedure related factors (suture material, poor surgical technique, prolonged duration of surgery, pre-operative part preparation and inadequate sterilization of surgical instruments) can influence the risk of SSIs significantly².

Multi and single centered studies showed that the majority of organisms causing SSI are gram positive cocci e.g. *Staphylococcus aureus* and gram negative bacilli e.g. *E. coli*, *Klebsiella*, *pseudomonas* and *enterobacter* SPP⁷.

However, the most significant change in the microbiology of SSI has been the increased involvement of resistant organisms like MRSA.

Studies on rates of SSIs as well as on the causative agents and their antimicrobial susceptibility from this part of India are relatively scanty. We thus aimed to study the incidence and investigate the risk factors for SSI together with the identification of the etiological bacterial agents and their antimicrobial susceptibility in a major teaching hospital in Maharashtra.

2. Aim and Objectives

1. To study the incidence of surgical site infection in surgical abdominal wounds in patients undergoing elective and emergency abdominal surgery at tertiary care centre.
2. To study the risk factors associated with surgical site infections.
3. To study the various micro-organisms causing surgical site infections.

3. Materials and Methods

This prospective observational study was conducted over 70 patients who underwent an elective or emergency open abdominal surgery during the period of August 2015 to December 2017, in the Department of General Surgery for various abdominal ailments. The method of including patients in the study was non-random, purposive, i.e., all the patients undergoing open abdominal surgeries. The design of Study was prospective. The target patient population was post-operative surgical patients. The initial criterion of including patients to the study was any patient who has undergone an “open” abdominal surgery, followed by primary closure of the wound, for any intra-abdominal pathology. Informed written consent was taken from the patients or their guardian willing to participate in the study. Detailed history was taken from the study group to establish proper diagnosis and to know about the presence of the risk factors regarding surgical site infection. The basic investigations and essential imaging reports were noted down. All of the preoperative factors, especially those known to increase the risk of Surgical Site Infection in the patient were noted down. The patients had satisfied the Inclusion and Exclusion Criteria.

3.1 Eligibility Criteria

Inclusion Criteria

- Patients in the age group of 16 – 80 years.
- Patients undergoing an open abdominal surgery (elective and emergency).
- Willing to participate in the study.

Exclusion Criteria

- Multiple abdominal surgeries in the past (defined as >2 surgeries).
- Pre-operative usage of antibiotics > 3 weeks.
- Presence of co-existing foci of infection (eg. Genito-Urinary tract infection, Pneumonia, Cellulitis).
- Prolonged hospitalization or multiple hospital admissions prior to surgery.

4. Results

Table 1. Incidence of SSI observed in study

Incidence of SSI	N	%
Yes	10	14.3%
No	60	85.7%
Total	70	100.0%

Incidence of SSI observed in present study was 14.3% (Figure 1, Table 1).

Table 2. Association of SSI with gender

Gender	SSI		Total
	No	Yes	
Female	26	4	30
	86.7%	13.3%	100.0%
Male	34	6	40
	85.0%	15.0%	100.0%
Total	60	10	70
	85.7%	14.3%	100.0%

p- value - 1.0

No association was observed between incidences of SSI with gender (p-1.0) (Table 2).

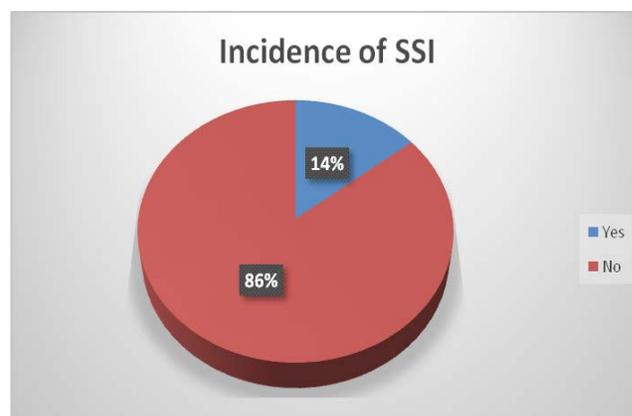


Figure 1. Incidence of SSI

Table 3. Mean comparison of age and BMI between cases with and without SSI

Variables	SSI	N	Mean	SD	p- value
Age	Yes	10	57.67	5.67	<0.05
	No	60	53.42	6.49	
BMI	Yes	10	25.62	3.32	<0.05
	No	60	21.97	5.39	

Mean age (57.67 vs 53.42 years) and BMI (25.62 vs 21.97 Kg/m²) was higher in cases with SSI (p<0.05) (Table 3).

Table 4. Association of SSI with associated co-morbidities

Associated Co-morbidity	SSI		Total	p-value
	No	Yes		
Diabetes	18	7	25	<0.05
	72.0%	28.0%	100.0%	
Hypertension	13	3	16	0.68
	81.3%	18.8%	100.0%	
Malignancy	3	1	4	0.46
	75.0%	25.0%	100.0%	
CRF	5	2	7	0.26
	71.4%	28.6%	100.0%	

Diabetes was observed to be significantly associated with incidence of SSI (28% vs 6.7%; p<0.05). No association was observed with hypertension, malignancy and cases of CRF (Table 4).

Table 5. Association of SSI with type of surgery

Type of Surgery	SSI		Total
	No	Yes	
Emergency	10	6	16
	62.5%	37.5%	100.0%
Elective	50	4	54
	92.6%	7.4%	100.0%
Total	60	10	70
	85.7%	14.3%	100.0%

p-value < 0.05

Incidence of SSI was significantly higher in emergency surgeries (37.5%) as compared to elective surgeries (7.4%) (Table 5).

Table 6. Association of SSI with type of wound

Type of wound	SSI		Total
	No	Yes	
Clean	22	1	23
	95.7%	4.3%	100.0%
Clean Contaminated	30	4	34
	88.2%	11.8%	100.0%
Contaminated	7	4	11
	63.6%	36.4%	100.0%
Dirty	1	1	2
	50.0%	50.0%	100.0%
Total	60	10	70
	85.7%	14.3%	100.0%

p-value < 0.05

A significantly higher incidence of SSI was noted in contaminated (36.4%) and dirty wounds (50%) (p<0.05) (Table 6).

Table 7. Association of SSI with type of wound closure

Closure of Wound	SSI		Total
	No	Yes	
Monolayer	23	4	27
	85.2%	14.8%	100.0%
Multilayer	37	6	43
	86.0%	14.0%	100.0%
Total	60	10	70
	85.7%	14.3%	100.0%

p-value - 1.0

No association of SSI was observed with type of wound closure i.e. monolayer or multiplayer (p-1.0) (Table 7).

Table 8. Association of SSI with duration of surgery and hospital stay

Variables	SSI	N	Mean	SD	p- value
Duration of Surgery	Yes	10	2.13	0.49	0.67
	No	60	2.37	0.67	
Duration of Hospital stay	Yes	10	16.52	6.71	<0.05
	No	60	11.23	5.41	

Mean duration of surgery was comparable between cases with and without SSI (2.13 vs 2.37 hours; p=0.67). However, cases of SSIs had increased in prolonged preoperative hospitalization (16.52 vs 11.23 days; p<0.05) (Table 8).

Table 9. Association of SSI with type of surgery

Type of Surgery	N	%	SSI	%
Inguinal Hernia	19	27.1%	2	10.5%
Umbilical Hernia	2	2.9%	0	0.0%
Paraumbilical Hernia	2	2.9%	0	0.0%
Incisional Hernia	4	5.7%	1	25.0%
Appendectomy	14	20.0%	2	14.3%
Laparotomy	15	21.4%	4	26.7%
Cholecystectomy	10	14.3%	1	10.0%
Pyelolithotomy	4	5.7%	0	0.0%
Total	70	100.0%	10	14.3%

Highest incidence of SSI was observed with Incisional hernia (25%) and laparotomy cases (26.7%) (Table 9).

Table 10. Distribution of organism from SSI isolates

Organism	N	%
Staphylococcus aureus	3	30.0%
Escherichia Coli	3	30.0%
Klebsiella	1	10.0%
Citerobacter	1	10.0%
Enterococcus	1	10.0%
Pseudomonas	1	10.0%
Total	10	100.0%

Most common organism isolated from the SSI isolates was *S. aureus* (3 cases) and *E. coli* (3 cases) (Table 10).

5. Discussion

Surgical site infection is a common complication of surgery. Its morbidities range from delayed healing to systemic sepsis. It has great impact on the economy and health care resources. According to CDC the overall incidence of SSI is estimated as 2.8% in the USA⁸. In incidence rate, SSIs are still higher in developing countries like India (9-23%)⁹.

The present study was planned to evaluate the incidence of surgical site infection in surgical abdominal wounds in patients undergoing elective and emergency abdominal surgery at tertiary care centre. We also aimed to identify the associated risk factors and profile various micro-organisms causing surgical site infections.

5.1 Prevalence of Surgical Site Infection

Incidence of SSI observed in present study was 14.3%. Various authors have evaluated the incidence and risk factors for surgical site infection in surgical abdominal wounds. Giri S *et al.*,¹⁰ observed that out of 230 patients included, 53 were identified as having a SSI, resulting in an overall rate of SSI of 23%. Nwankwo E *et al.*,¹¹ in their study observed that out of 2880 patients studied, 585 (20.3%) developed SSI.

However few others observed a somewhat lower incidence of SSI as compared to present study. Kakati B *et al.*,¹² studied 685 patients undergoing various abdominal surgical procedures admitted in the dept. of general surgery. The overall infection rate of 7.44% was observed among 685 patients included in the study. Incidence of SSI as observed in the study by Khairy *et al.*,¹³ was 6.8%.

5.2 Risk Factors for Surgical Site Infections

5.2.1 Age and BMI

Mean age (57.67 vs 53.42 years) and BMI (25.62 vs 21.97 Kg/m²) was higher in cases with SSI (p<0.05).

Increasing age has been observed as a risk factor for SSI and overall infections in general have been observed in many previous studies^{11,13}. Dwindling immunity associated with age can be attributed for this observation. Superimposed co-morbidities further diminish the innate immunity in elderly.

Results from various studies show that risk of SSI increased with increase of BMI¹¹. Adipose tissue is poorly vascularised and the consequent effect on oxygenation

of the tissues and functioning of immune response is thought to increase the risk of SSI.

5.3 Co-Morbidities

Diabetes was observed to be significantly associated with incidence of SSI (28% vs 6.7%; p<0.05). No association was observed with hypertension, malignancy and cases of CRF.

Patients with type 2 diabetes mellitus are at increased risk of infections. Various impairments in the immune system, in addition to poor metabolic control of diabetes may all contribute in the higher incidence of SSI in diabetics. Undiagnosed diabetes and postoperative hyperglycemia more specifically within 48 hours of surgery have been associated with increased SSI risk. Khairy *et al.*,¹³ in their study observed rate of infection in diabetics to be significantly higher than non-diabetics.

5.4 Type of Surgery

Incidence of SSI was significantly higher in emergency surgeries (37.5%) as compared to elective surgeries (7.4%).

The high rates of infection in emergency surgeries can be attributed to inadequate pre-operative preparation, the underlying conditions which predisposed to the emergency surgery like uncontrolled diabetes or other medical comorbidities. More frequency of contaminated or dirty wounds is seen in emergency surgeries which lead to higher incidence of SSI in this group¹⁴.

Emergency surgeries as significant risk factor for development of SSI were observed by many authors¹¹⁻¹³. Khairy *et al.*,¹³ observed that emergency operations showed significantly higher rates of infection compared to elective counterparts.

5.5 Type of Wound

There is considerable variation in each class according to the surgery performed. As expected, rates are highest for dirty surgeries like intestinal perforation and incisional hernias. In present study too, a significantly higher incidence of SSI was noted in contaminated (36.4%) and dirty wounds (50%) (p<0.05).

Nwankwo E *et al.*¹¹ in their study observed incidence related to clean, clean contaminated, contaminated and dirty as 5.8%, 30.5%, 40.6%, and 64.8% wounds respectively. In 2012 study in tertiary care hospital in Gujarat, infection rates in different classes were as follows:

Clean - 3%, Clean contaminated- 11.4%, Contaminated - 20% and Dirty- 40.9%¹⁵.

5.6 Hospital Stay

As expected, we observed that prolonged hospital stay (16.52 vs 11.23 days; $p < 0.05$) to be significantly associated with incidence of SSI. In our study, we have taken total number of hospital stay including preoperative and postoperative hospital stay. Malik AZ *et al.*,¹⁶ in their also observed significant mean difference (8.3 ± 10.3 vs 3.3 ± 2.9 days, $p < 0.01$) in duration of hospital stay in patients who developed SSI in comparison to those who did not.

Prolonged hospital stay leads to colonization with microorganisms which may be resistant to routine antimicrobial drugs and itself directly affects patient's susceptibility to infection either by lowering host resistance or by providing increased opportunity for ultimate bacterial colonization.

6. Isolated Organisms

Most common organism isolated from the SSI isolates was Staph. aureus (3 cases) and E. Coli (3 cases).

Kakati B *et al.*,¹² in their study observed E. coli as the commonest isolate (41.17%). The most commonly isolated bacteria in the study by Khairy *et al.*,¹³ were: E. coli, Pseudomonas aurigenosa and Staphylococcus aureus. Khadilkar R *et al.*,¹⁷ also observed that SSI infection with E. coli and S. aureus were more common. Malik AZ *et al.*,¹⁶ observed that most common organisms isolated were Staphylococcus aureus (37.5%, 21/56), Escherichia coli (30.4%, 17/56) and Enterobacter (5.4%, 3/56).

7. Summary

1. Incidence of SSI observed in present study was 14.3%.
2. No association was observed between incidences of SSI with gender ($p < 1.0$).
3. Mean age (57.67 vs 53.42 years) and BMI (25.62 vs 21.97 Kg/m²) was higher in cases with SSI ($p < 0.05$).
4. Diabetes was observed to be significantly associated with incidence of SSI (28% vs 6.7%; $p < 0.05$). No association was observed with hypertension, malignancy and cases of CRF.
5. Incidence of SSI was significantly higher in emergency surgeries (37.5%) as compared to elective surgeries (7.4%).

6. A significantly higher incidence of SSI was noted in contaminated (36.4%) and dirty wounds (50%) ($p < 0.05$).
7. No association of SSI was observed with type of wound closure i.e. monolayer or multilayer ($p < 1.0$).
8. Mean duration of surgery was comparable between cases with and without SSI (2.13 vs 2.37 hours; $p < 0.67$). However cases of SSI had increased hospitalization (16.52 vs 11.23 days; $p < 0.05$).
9. Highest incidence of SSI was observed with incisional hernia (25%) and laparotomy cases (26.7%).
10. Most common organism isolated from the SSI isolates was Staph. aureus (3 cases) and E. Coli (3 cases).

8. Conclusion

The incidence of SSI observed in present study was comparable with other Indian studies and is considered as high as per international standards. The key risk factors for surgical site infection identified in present study were: increasing age elevated BMI, history of diabetes, emergency procedure and contamination of wounds. Other comorbidities did not directly affect the rate of surgical site infection in our series. E. coli and Staph. aureus were the most commonly isolated bacteria.

Identification of such risk factors is expected to help surgeons improve patient care and decrease mortality and morbidity as well as the hospital-care cost of surgical patients.

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