International Surgery Journal
Save M et al. Int Surg J. 2020 Feb;7(2):520-525
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20200308

Original Research Article

A study of incidence and factors determining the occurrence of surgical site infection in abdominal surgeries

Maitreyee Save*, Reina Khadilkar, Priti Shah, R. Shiva

Department of Surgery, Dr. D.Y. Patil Hospital and Research Centre, Pimpri, Pune, Maharashtra, India

Received: 17 October 2019
Revised: 18 December 2019
Accepted: 19 December 2019

***Correspondence:**
Dr. Maitreyee Save,
E-mail: save.maitreyee@gmail.com

ABSTRACT

Background: Surgical site infection (SSI) can be defined as infections which develops within 30 days after surgery involving the skin and subcutaneous tissue of the incision and/or the deep soft tissue and/or any part other than the incision handled during surgery. This study has been taken up to determine the incidence of SSI in abdominal surgery and to determine factors responsible for its occurrence.
Methods: The study was conducted in Dr. D.Y. Patil Medical College, Hospital and Research Centre located in Pimpri, Pune between July 2017 to September 2019.It is a prospective longitudinal descriptive study. Information collected from the patients included patient's age, gender, diabetes mellitus status, smoking status and haemoglobin and albumin levels.
Results: Total 150 cases with abdominal operations were included in this study. Among them 29 patients developed SSI. Incidence of SSI among them was 19.3%. There was no significant difference among gender between both the groups. (p=0.172). Among 29 SSI cases, 10 (34.5%) had diabetes while 19 (65.5%) did not have diabetes. There was significant difference in diabetes status between both the groups (p=0.021). Patients having diabetes has more risk of getting SSI post operatively. Among 29 SSI cases, 8 (27.6%) were smokers while 21 (72.4%) were non-smokers.
Conclusions: The incidence of SSI among cases underwent abdominal surgery was 19.3%. In our institute where most patients come from low economic state, poor hygiene and nutrition status, with current preoperative protocol for SSI prevention SSI rate is comparable to that of most developing countries.

Keywords: Emergency, Elective, Surgical site infection

INTRODUCTION

Surgical site infection (SSI) can be defined as infections which develops within 30 days after surgery involving the skin and subcutaneous tissue of the incision and/or the deep soft tissue and/or any part other than the incision handled during surgery.[1]

Skin is natural barrier against infection. Even with many precautions and protocols to prevent infection, any surgery causing break in skin can lead to infection. Most surgical site infections are caused by contamination of an incision with microorganisms from the patient's own body during surgery. A surgical site infection may range from a spontaneously limited wound discharge within 7-10 days of an operation to a life-threatening postoperative complication, such as a sternal infection after open heart surgery.[2]

Global incidence rates of SSIs vary from 4.5% to 20%, depending on the region and facilities available.[3]

Many factors in the patient's journey through surgery have been identified as contributing to the risk of SSI like age, sex, type of surgical wound, emergency surgery, immune status, comorbidities, duration of surgery,

preoperative preparation, antibiotic coverage, operation theatre environment and postoperative care.

This study has been taken up to determine the incidence of SSI in abdominal surgery and to determine factors responsible for its occurrence.

METHODS

It is a longitudinal descriptive study. The study was conducted in Dr. D.Y. Patil Medical College, Hospital and Research Centre located in Pimpri, Pune between July 2017 to September 2019.

Inclusion criteria

The patients having emergency and elective abdominal operations in age group 18 to 80 were included in the study.

Exclusion criteria

Immunocompromised status patients i.e. HIV positive, malignancy, pregnancy.

All cases admitted to the hospital and underwent abdominal surgeries were considered for inclusion. All necessary baseline pre-operative information regarding case was taken. All details regarding preoperative preparation were noted in the cases sheet. Information collected from the patients included patient's age, gender, diabetes mellitus status, smoking status and haemoglobin and albumin levels. Intra operatively information like duration of surgery, antibiotics use during surgery, type of wound, emergency / elective surgery was documented. Following the surgical procedure, surgical sites were examined on postoperative day 3 and every 3 days thereafter. SSI was diagnosed as per CDC criteria.

Statistical analysis

Data from each patient will be collected and tabulated using Microsoft Excel. Qualitative variables were presented by frequency and percentage. Quantitative variables were presented by mean and standard deviation. Later on, cases were grouped in to those who developed SSI and those who did not develop SSI. Both groups were compared to assess associated factors using tests of significance like Chi square and t test using Epi Info version.

RESULTS

Total 150 cases were included in the study considering inclusion and exclusion criteria. Among them 29 patients developed SSI. Incidence of SSI among them was 19.3 %.

SSI was found in 3 (10.3%) cases of below 30 years age group, 16 (55.2%) cases of 30-50 years age group and 10 (34.5%) cases of above 50 years age group of patients. There was no significant age difference between both the groups (p=0.830) (Table 1).

Among 29 SSI cases 18 (62.1%) were males while 11 (37.9%) were females. In non-SSI group, among 121 participants 58 (47.9%) were males while 63 (52.1%) were females. There was no significant difference among gender between both the groups (p=0.172) (Table 2).

Table 1: Age wise comparison of SSI and non SSI cases.

Age in years	SSI		No SSI		Total	P value
	Cases	Percentage (%)	Cases	Percentage (%)		
<30	3	10.3	15	12.4	18	0.830
30-50	16	55.2	71	58.7	87	
>50	10	34.5	35	28.9	45	
Total	29	100	121	100	150	

Table 2: Sex wise comparison of SSI and non SSI cases.

Sex	SSI		No SSI		Total	P value
	Cases	Percentage (%)	Cases	Percentage (%)		
Male	18	62.1	58	47.9	76	0.172
Female	11	37.9	63	52.1	74	
Total	29	100	121	100	150	

Among 29 SSI cases, 10 (34.5%) had diabetes while 19 (65.5%) did not have diabetes. In non SSI group, among 121 participants, 19 (15.7%) had diabetes while 102 (84.3%) did not have diabetes. There was significant difference in diabetes status between both the groups. (p=0.021) Patients having diabetes has more risk of getting SSI post operatively (Table 3).

Among 29 SSI cases, 8 (27.6%) were smokers while 21 (72.4%) were non-smokers. In non SSI group, among 121 participants, 18 (14.9%) were smokers while 103 (85.1%)

were non-smokers. Smokers had more chances of getting SSI post operatively but the difference between smokers and non-smokers was not found statistically significant. (p=0.104) (Table 4).

Table 3: Comparison of diabetic status among SSI and non SSI cases.

Diabetes	SSI		No SSI		Total	P value
	Cases	Percentage (%)	Cases	Percentage (%)		
Yes	10	34.5	19	15.7	29	0.021
No	19	65.5	102	84.3	121	
Total	29	100	121	100	150	

Table 4: Comparison of smoking status among SSI and non SSI cases.

	SSI		No SSI		Total	P value
Smoking	**Cases**	**Percentage (%)**	**Cases**	**Percentage (%)**		
Smoker	8	27.6	18	14.9	26	0.104
Non smoker	21	72.4	103	85.1	124	
Total	29	100.0	121	100.0	150	

Table 5: Comparison of pre-operative Hb among SSI and non SSI cases.

Pre-op Hb	SSI	No SSI	P value
Median	11.9	12.2	0.098
IOR	10-14	10-14	

Table 6: Comparison of pre-operative albumin among SSI and non SSI cases.

Pre-op Alb	SSI	No SSI	P value
Median	30	37	0.003
IOR	26-34	33-40	

Table 7: Comparison of wound class among SSI and non SSI cases.

Wound class	SSI		No SSI		Total	P value
	Cases	Percentage (%)	Cases	Percentage (%)		
Clean	3	10.3	22	18.2	25	0.003
Clean-contaminated	20	69.0	95	78.5	115	
Contaminated/dirty	6	20.7	4	3.3	10	
Total	29	100	121	100	150	

Table 5 shows comparison of pre-operative haemoglobin among SSI and non SSI cases. Median of pre-operative hemoglobin among SSI case was 11.9 g/dl while it was 12.2 g/dl among non SSI cases. There was no significant difference in pre-operative hemoglobin among both the groups.

Median of pre-operative albumin among SSI case was 30 g/l while it was 37 g/l among non SSI cases. Non SSI patients had higher level of pre-operative albumin in comparison to SSI patients. The difference in pre-operative albumin between both group was found statistically significant (p=0.003) (Table 6).

Among 29 SSI cases, 3 (10.3%) had clean wound, 20 (69.0%) had clean contaminated wound while 6 (20.7%) had contaminated/dirty wound. In non SSI group, among 121 participants, 22 (18.2%) had clean wound, 95 (78.5%) had clean contaminated wound while 4 (3.3%) had contaminated/dirty wound. The difference among wound class among SSI and non SSI cases was found statistically significant (p=0.003) (Table 7).

Table 8: Comparison of duration of operation among SSI and non SSI cases.

Duration of operation in min	SSI	No SSI	P value
Median	178	93	<0.001
IQR	121-269	58-157	

Median of duration of operation among SSI case was 178 minutes while it was 93 minutes among non SSI cases. SSI patients had higher duration of operation in comparison to non SSI patients. The median difference in duration of operation between both groups was found statistically significant (p<0.001) (Table 8). Median of post-operative stay among SSI case was 17 days while it was 5 days among non SSI cases. SSI patients had higher post-operative stay in comparison to non SSI patients. The median difference in post-operative stay between both groups was found statistically significant (p<0.001) (Table 9).

Table 9: Comparison of post operative stay among SSI and non SSI cases.

Post op stay (days)	SSI	No SSI	P value
Median	17	5	<0.001
IQR	14-22	4-8	

Table 10: Comparison of preoperative bathing among SSI and non SSI cases.

Preoperative bathing	SSI		No SSI		Total	P value
	Cases	Percentage (%)	Cases	Percentage (%)		
Yes	14	48.3	93	76.9	107	0.002
No	15	51.7	28	23.1	43	
Total	29	100	121	100	150	

Among 29 SSI cases, 14 (48.3%) had preoperative bath while 15 (51.7%) did not have preoperative bath. In non SSI group, among 121 participants, 93 (76.9%) had preoperative bath while only 28 (23.1%) did not have preoperative bath. Prevalence of SSI was found higher among patients who did not have preoperative bath. The difference between both the groups was found statistically significant (p=0.002) This shows that preoperative bath plays important role in prevention of SSI (Table 10).

DISCUSSION

Surgical branch has always been associated with risk of developing SSI. SSIs are any infections occurring in a surgical wound within 30 days. SSI is the most common healthcare-associated infection (HCAI). Large number of studies reported surgical site infection in abdominal surgeries between 3.4% and 36.1%.[4-9]

SSI was found in 3 (10.3%) cases of below 30 years age group, 16 (55.2%) cases of 30-50 years age group and 10 (34.5%) cases of above 50 years age group of patients. There was no significant age difference between both the groups. More than half of the patients were between age of 30 to 50 years. In a similar study conducted in an Iranian teaching hospital average age of the patients was 46.70 years.[7]

Regarding sex distribution of the patients, among the total 150 cases 76 (50.67 %) were male and 74 (49.33 %) were female. Male-female ratio was 1.01: 1. So, it can be assumed that there is no difference according to gender by acute abdominal conditions requiring surgery. Among 29 SSI cases 18 (62.1%) were males while 11 (37.9%) were females. In non SSI group, among 121 participants 58 (47.9%) were males while 63 (52.1%) were females. There was no significant difference among gender between both the groups (p=0.172).

Among 29 SSI cases, 10 (34.5%) had diabetes while 19 (65.5%) did not have diabetes. In non SSI group, among 121 participants, 19 (15.7%) had diabetes while 102 (84.3%) did not have diabetes. There was significant difference in diabetes status between both the groups (p 0.021). Out of total 29 patients having diabetes, 10 (34.5%) had SSI. This shows that patient with diabetes has more risk of getting SSI post operatively.

Incidence of SSI among smokers was 30.8% while it was 16.9 among non-smoker patients. Among 29 SSI cases, 8 (27.6%) were smokers while 21 (72.4%) were non-smokers. In non SSI group, among 121 participants, 18 (14.9%) were smokers while 103 (85.1%) were non-smokers. Smokers had more chances of getting SSI post operatively but the difference between smokers and non-smokers was not found statistically significant (p 0.104).

Among 29 SSI cases, 14 (48.3%) had preoperative bath while 15 (51.7%) did not have preoperative bath. In non SSI group, among 121 participants, 93 (76.9%) had preoperative bath while only 28 (23.1%) did not have preoperative bath. Prevalence of SSI was found higher among patients who did not have preoperative bath. The difference between both the groups was found statistically significant (p 0.002). This shows that preoperative bath plays important role in prevention of SSI.

There exists a number of risk factors which predisposes to the development of SSI which can be divided into bacterial, patient and local factors. A combination of these factors predisposes to occurrence of SSI and thus it is not easy to establish association of specific factors as culprit for SSI. So, there is difference in rates of SSI in different studies.[10]

Median of pre-operative hemoglobin among SSI case was 11.9 g/dl while it was 12.2 g/dl among non SSI cases. There was no significant difference in pre-operative hemoglobin among both the groups.

Median of pre-operative albumin among SSI case was 30 g/l while it was 37 g/l among non SSI cases. Non SSI patients had higher level of pre-operative albumin in comparison to SSI patients. The difference in pre-operative albumin between both groups was found statistically significant (p 0.003).

Out of 107 elective surgery cases, 30 (28.0%) had appendectomy, 26 (24.3%) inguinal hernia surgery, 24 (22.4%) had umbilical hernia surgery while 19 (17.8%) had open cholecystectomy. The incidence of SSI for emergency cases was found to be 34.9% and that for elective procedures was 13.1%. Among 29 SSI cases, 15 (51.7%) had emergency surgery while 14 (48.3%) had elective surgery.

Out of 43 emergency surgery cases, 21 (48.8%) had open appendectomy, 7 (16.3%) had peptic perforation repair and intestinal obstruction surgery each, 4 (9.3%) had surgery for blunt abdominal trauma while 2 (4.7%) had surgery for enteric perforation. In non SSI group, among 121 participants, 28 (23.1%) had emergency surgery while 93 (76.9%) had elective surgery. Prevalence of SSI was seen more in emergency surgery patients. The difference was found statistically significant (p 0.002).

The overall infection in this study is 19.3% which equals the rate of SSI in developing countries and is higher than the SSI rate of developed countries. One of the reason behind this is the presence of systematic feedback system related to SSI which exists in developed countries, Secondly considering financial difficulties in developing countries and other factors like poorly trained staff responsible for infection control, disparency between size of ward and number of staff and inadequate participation from patients and relatives.[11]

Duration of the surgery was also found to affect the incidence of SSI with maximum occurrence in operations requiring more than 2 hours and least in operations requiring less than one and a half hour.[12] Doherty et al, had similar results with duration of surgery and SSI rate.[13]

Longer operative time reflects the complexity of the surgery. It would also increase the wound susceptibility to infection by increasing the exposure to potential contamination and decreasing the tissue concentration of antibiotic.[14] To overcome the decreased concentration of antibiotic that occurs with prolonged operations, re-administration of the antibiotics is recommended.[15]

Median of post-operative stay among SSI case was 17 days while it was 5 days among non SSI cases. SSI patients had higher post-operative stay in comparison to non SSI patients. This may be due to slow recovery due to SSI, may be due to emergency surgery or antibiotic resistance. The median difference in post-operative stay between both groups was found statistically significant. (p <0.001). These findings were similar to the data obtained from a Peruvian hospital where SSI increased the duration of hospital stay (14.0 Vs 6.1 days; p <0.001).[16]

CONCLUSION

The incidence of Surgical Site Infection (SSI) among cases underwent abdominal surgery was 19.3 %. In our institute where most patients come from low economic state, poor hygiene and nutrition status, with current preoperative protocol for SSI prevention SSI rate is comparable to that of most developing countries. The SSI rate in Emergency surgery was 34.9%, significantly higher than elective operation (13.1%).

Incidence of SSI was not associated with age and sex of the patients. It was also not associated with smoking status of the case. However, development of SSI was significantly higher in cases having diabetes mellitus, lower serum albumin and incidence of SSI not associated with lower hemoglobin levels. Pre-operative bathing was important protective factor. SSI rate was also higher in case of longer duration of surgery.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. European Centre for Disease Prevention and Control. Available at: http://ecdc.europa.eu/en/publications/Publications/120215_TED_SSI_protocol.pdf, Accessed 16 August 2016.
2. Kłodzińska E, Kupczyk W, Jackowski M, Buszewski B. Capillary electrophoresis in the diagnosis of surgical site infections. Electrophor. 2013;34(22-23):3206-13.
3. National Nosocomial Infections Surveillance (NNIS) System Report, data summary from January 1992 through June 2004. Am J Infect Control. 2004;32:470-85.
4. Fullen WD, Hunt J, Altemeier WA. Prophylactic antibiotics in penetrating wounds of the abdomen. J Trauma. 1972;12(4):282-9.
5. Leigh N, Hosokawa P, Itani K, El-Tamer M, Henderson WG, Khuri SF. Multivariable predictors of postoperative surgical site infection after general and vascular surgery: results from the patient safety in surgery study. J Am Coll Surg. 2007;204(6):1178-87.
6. Raka L, Krasniqi A, Hoxha F, Musa R, Mulliqi G, Krasniqi S, et al. Surgical site infection in an abdominal surgical ward at Kosovo teaching hospital. J Infect Develop Countries 2007:1(3):337-41.
7. Razavi SM, Ibrahimpoor M, Sabouri Kashani A, Jafarian A. Abdominal surgical site infections:

incidence and risk factors at an Iranian teaching hospital. BMC Surg. 2005;5:2.
8. Umesh S. Kamath, Fereirra AMA, Kulkarni MS, Motghare DD. A prospective study of surgical site infection in a teaching hospital in Goa. Ind J Surg. 2008:70:120-4.
9. Gomila A, Carratala J, Camprubi D, Shaw E, Badia JM, Cruz A, et al. Risk factors and outcomes of organ-space surgical site infections after elective colon and rectal surgery. Antimicrob Resist Infect Control. 2017;6:40.
10. Gibbons C, Bruce J, Carpenter J, Wilson A, Wilson J, Pearson A, et al. Identification of risk factors by systematic review and development of risk-adjusted models for surgical site infection. Health Technol Assessment (Winchester, England). 2011;15(30):1-56.
11. Emori TG, Culver DH, Horan TC, Jarvis WR, White JW, Olson DR, et al. National nosocomial infections surveillance system (NNIS): description of surveillance methods. Am J Infect Control. 1991;19(1):19-35.
12. Liliani SP, Jangale N, Chowdhary A, Daver GB. Surgical site infection in clean and clean contaminated cases. Ind J Med Microbiol. 2005;23(4):249-52.
13. Doherty GM. Complications in surgery. Ann Surg. 2006;244(5);837.
14. Leong G, Wilson J, Charlett A. Duration of operation as a risk factor for surgical site infection: comparison of English and US data. J Hosp Infect 2006;63:255-62.
15. Bratzler DW, Dellinger EP, Olsen KM, Perl TM, Auwaerter PG, Bolon MK, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Surg Infect. 2013;14(1):73-156.
16. Hernandez K, Ramos E, Seas C, Henostroza G, Gotuzzo E. Incidence of and risk factors for surgical-site infections in a Peruvian hospital. Infect Control Hospital Epidemiol. 2005;26(5):473-7.

Cite this article as: Save M, Khadilkar R, Shah P, Shiva R. A study of incidence and factors determining the occurrence of surgical site infection in abdominal surgeries. Int Surg J 2020;7:520-5.