ORIGINAL RESEARCH ARTICLE

Surgical Site Infections in Elective Abdominal Surgery and their Prevention in a Tertiary Care Centre of Rohilkhand Region

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A B S T R A C T

Introduction: Infections that occur in a postsurgical wound are referred to as Surgical Site Infections (SSIs) which results in patient discomfort, prolonged hospital stay and increased cost. The present study was planned to determine the risk factors and incidence of abdominal surgical site infections and to formulate measures to prevent them.

Material and Methods: A prospective, open label clinical study of 24 months duration was conducted on 100 admitted cases in the post graduate Department of Surgery, Rohilkhand Medical College, Bareilly to determine the incidence and risk factors associated with the abdominal surgical site infections in elective abdominal surgery.

Results: The incidence of surgical site infection was 7% in present study. Open surgery have a significantly higher risk of SSI (4/30; 13.3%) as compared to other procedures (3/70; 4.3%) (RR=3.09). Laparoscopic procedures have been reported to have minimal SSI rate. Smoking was found to be significantly associated with a higher risk of SSI (RR=9.37). Significant association of time lag between shaving and surgery with SSI (RR=2.67). Relative risk of SSI (3.4) in patients above 50 years of age and ASA Grade>II. In majority of cases (85.71%) SSI was recorded on third post-operative day. *Staphylococcus aureus* was the most common isolate (42.86%) followed by *Pseudomonas* (28.57%), *E. coli* and *Staphylococcus epidermidis*.

Conclusion: Open procedures, Smoking, Pre-op Hospital stay >1 day and ASA grade>II were found to be significantly associated with SSI. Mean duration of hospital stay of SSI patients was longer.

Key words: Surgical Site Infection, Infection in Elective Abdominal Surgery, SSI, Surgical Site Infection

INTRODUCTION

Infections that occur in a postsurgical wound are referred to as Surgical Site Infections (SSIs). Surgical site infections are one of the most important causes of Health Care Associated Infections (HCAIs)[1]. Surgical site infections (SSI) results in patient discomfort, prolonged length of hospital stay and increased cost[2,3]. Care for patients with SSI was estimated to cost on average an additional 3422 US$ per patient[4]. The skill and experience of surgeon directly affects the degree of contamination of the surgical site through breaks in technique or inadvertent entry in to a viscous[5]. Other factors of hospital set up which might also affect the rate of surgical site infections are prolonged pre-operative hospital stay[4,5], operating room environment[6], inadequate sterilization of surgical instruments[7,8], flash sterilization[9,10], surgical attire[11-12] and co morbid conditions like poor nutritional status[13,14], diabetes[6,15,16] and obesity[17] were the significant risk factors for surgical site infections. Personal habits like smoking[18-19] also contributed towards risk of surgical site infections.

Surgical site infections are burden on society and needs to be prevented, therefore, the present study was planned to study the incidence of abdominal surgical site infections in our set up and to assess the risk factors and suggest the measures to prevent the wound infection after elective abdominal surgery.

CDC Definition of Surgical Site Infection

(US Center for Disease Control and Prevention)

- *Superficial incisional*, affecting the skin and subcutaneous tissue
- *Deep incisional*, affecting the fascial and muscle layers.
- *Organ or space infection*, which involves any part of the anatomy other than the incision that is opened or manipulated during the surgical procedure.

Study aimed to determine the incidence of abdominal surgical site infections in elective abdominal surgery, to assess the risk factors associated with the abdominal surgical site infections in elective abdominal surgery and to formulate measures to prevent post-operative wound infection after elective abdominal surgery.

MATERIAL AND METHODS

The present prospective study was conducted in the post graduate Department of Surgery, Rohilkhand Medical College, Bareilly, from September 2014 to August 2016. Ethical clearence was obtained before the start of study.

Inclusion criteria

- All the patients undergoing elective abdominal surgery

were included.

Exclusion criteria

- Patients presenting with pre-existing skin infections were excluded.
- Patients operated outside the hospital were excluded.
- Emergency abdominal surgeries were excluded.

Antibiotic selection

Third generation Cephalosporins and Metronidazole were used for all the patients and were changed according to CDC Guidelines.

Pre-operative preparation

Shaving of the operative area was done over operating table before surgery. All patients were advised to take shower on the day of surgery with soap. All patients received Injection Ceftriaxone 1 gram and Injection Metronidazole 500 milligram intravenous one hour before the incision. CDC Guidelines were followed if changes were required.

Aseptic precautions in the operation theatre

All routine aseptic precautions were taken like using autoclaved gowns, drapes, sterile gloves and instruments. Standard surgical scrub followed by the protocol adopted by our Hospital were followed before performing the operation.

Operative protocol

The operative area was cleaned with spirit and painted with 5% povidone iodine. The principles of surgery were followed in all cases such as minimum tissue handling and maintenance of adequate hemostasis. Drains were used whenever necessary. Skin closure with suture material or skin staples was done. Neosporin ointment was used for local application and wound was covered with adhesive dressing.

Post operative care

Injectable Cephalosporins (3rd generation) and Metronidazole were continued in the post-operative period for 48 hours. Then the patient received oral antibiotics till stitch removal. For the patients with surgical site infection, the plan of antibiotic coverage changed according to culture and sensitivity report. The wound was inspected for any evidence of infection starting from 48 hours after surgery day till 8th post-operative day. Patients were followed up till discharge. The criteria for SSI were based on CDC's definition of SSI. For the patient who satisfied any of the criteria for SSI, wound swab was sent to the clinical microbiology laboratory for Gram stain and routine culture methods. No culture was obtained for anaerobes, viruses or fungi.

The patients were studied only for superficial incisional SSI. The wounds were further classified into clean, clean contaminated, contaminated and dirty, based on above criteria. The incidence rate was calculated for each wound separately.

The standardized set of criteria developed by CDC National Nosocomial Infection Surveillance System for Superficial incisional SSI was used.

RESULTS

The present study was carried out with an aim to determine the incidence of abdominal surgical site infections in elective abdominal surgery and to assess the risk factors associated with the abdominal surgical site infections in elective abdominal surgery in order to formulate measures to prevent post-operative wound infection after elective abdominal surgery.

For this purpose a total of 100 patients falling in sampling frame were included in the assessment and were subsequently monitored for development of surgical site infection during their hospital stay.

Out of 100 patients SSI was noted in 7 cases (n=7). There was no significant gender variation as 4 male and 3 females patients developed SSI. The incidence of SSI was found to be significantly higher in elderly as 3 patients above 60 years of age developed SSI (figure-1). There was considerable variation among procedures performed with Laparoscopic procedures having no SSI to nephrolithotomy in which 3 developed SSI. The incidence of SSI was significantly higher in obese patients (n=5) who required regular antiseptic dressings for prolonged periods. Only 1 out of 7 patients was a non-smoker, rest all (n=6) were chronic smokers with more than 10 years of smoking history. We observed that patients who stayed for more than 2 days preoperatively in the hospital developed more SSI (n=6). Patients who were categorised to be in ASA grade 2 had high incidence of SSI (n=6). Patients who had an operative time of more than 1 hour (n=5) had more incidence as compared to those who required less than 1 hour (figure-2).

Only 1 patient presented with mild discharge on postoperative day 1 rest all (n=6) were diagnosed to have SSI on day 3. Based on the pus culture report the commonest isolated organism was *Staphylococcus aureus followed* by *Pseudomonas, Staphylococcus epidermidis,* and *E. coli.* All patients who developed SSI required more post-operative hospital stay (>4 days) (table-1, figure-3).

SN	Pathogen	No. of cases	Percentage
1.	E. coli	1	14.29
2.	Staphylococcus aureus	3	42.86
3.	Pseudomonas	2	28.57
4.	Staphylococcus epidermidis	1	14.29

Table-1: Distribution of SSI Cases according to Pathogen Isolated (n=7)

Figure-1: SSI in a patient on day 5

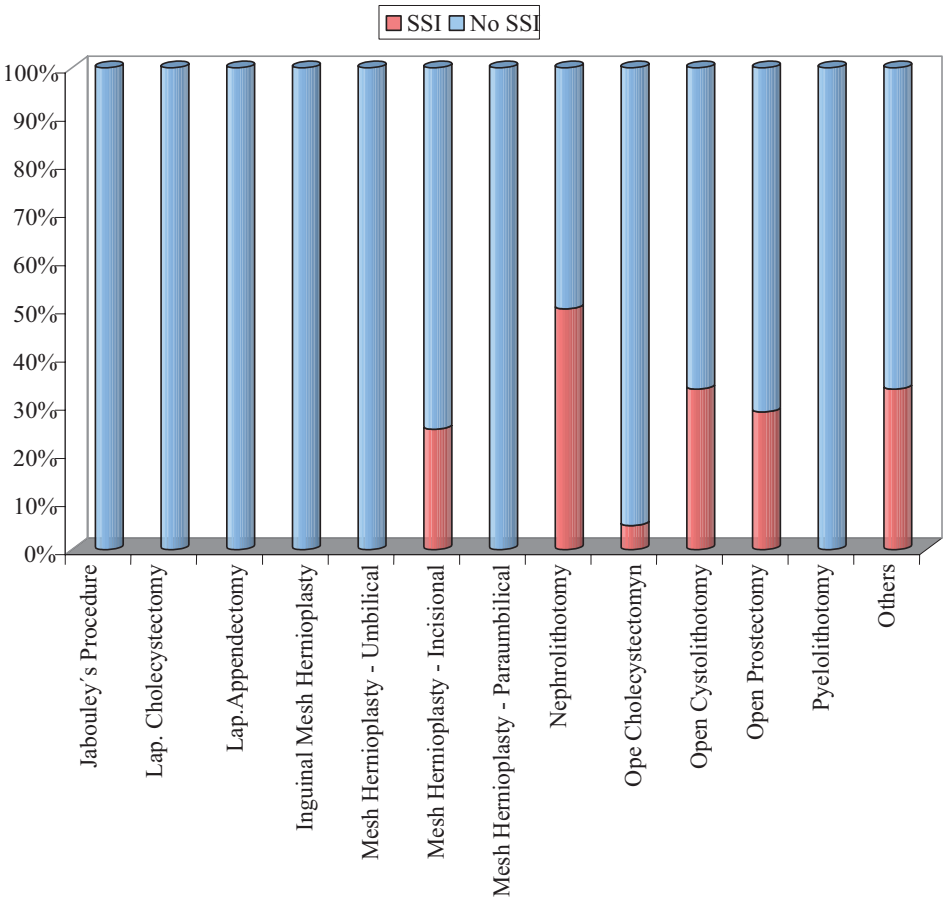

Figure-2: Type of Procedure

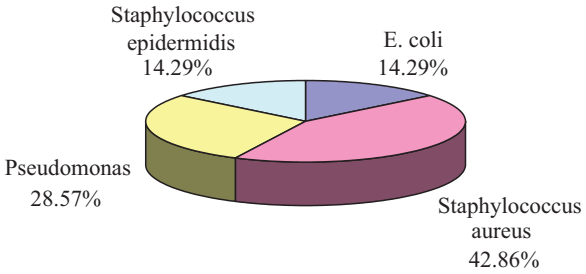

Figure-3: Types of Organisms isolated

DISCUSSION

Surgical site infection is one of the most intriguing post-surgical complication that has the capability to revert back the outcome of a surgery. It has great financial consequences too. Surgical site infection is one of the biggest reasons for increased hospital stay and substantial cost overflows[1]. It is a strong predictor of treatment success and failure in different types of surgical procedures[2,3].

In present study we made an attempt to determine the incidence of abdominal surgical site infections in cases of elective abdominal surgery and to assess the risk factors associated with the abdominal surgical site infections in elective abdominal surgery procedures.

The incidence of surgical site infection was 7% in present study. For different studies exclusively reporting the SSI in elective surgeries, the infection rate varies from 4.7% to 20%[26]. Among, studies from India[26-29], surgical site infection rate varies from 5%[27] to 28%[26]. There was only one study[26] that reported a phenomenally high SSI rate of 20% in elective abdominal surgeries.

In present study, open procedures (open cholecystectomy, open cystolithotomy, open prostectomy) showed to have a significantly higher risk of SSI (4/30; 13.3%) as compared to other procedures (3/70; 4.3%) (RR=3.09). Among other procedures, in 27 laparoscopic procedures, no case of infection was reported. Laparoscopic procedures have been reported to have minimal SSI rate. In different case series reviewed by us, the series showing minimal infection rate had included laparoscopic procedures only (Tang et al.[30],4.3%). Laparoscopic procedures owing to being minimal invasive expose a lesser surgical site and thus the vulnerable area for infection is relatively smaller and hence the infection rate is lower. In another study by Hübner et al. (2011)[31] too, the protective effect of laparoscopic surgery was reported vehemently. In present study, smoking was found to be significantly associated with a higher risk of SSI (RR=9.37). Smoking has always been cited as a contributory factor towards risk of surgical site infections[28-31]. In present study, surgical site infection was found to be significantly associated with a longer duration of pre-operative hospital stay. Pre-operative hospital stay makes the patient exposed to risk of various nosocomial infections. A number of other reports have also reported preoperative hospital stay to be a determinant of rate of SSI[8,13,14] and findings of present study endorsed this finding. In different studies reviewed by us, Razavi et al.[32] also suggested that reduction of preoperative hospital stay might play a role in reducing the SSI rate. Pedroso-Fernandez et al.

(2016)[33] also voiced a similar opinion.

In present study, SSI occurrence was recorded on day 3 after surgery in majority of cases (85.71%) and in all except one (85.71%), the wound was clean.

In present study, among SSI cases, *Staphylococcus aureus* was the most common isolate (42.86%) followed by *Pseudomonas* (28.57%). There was 1 (14.29%) case each with *E. coli* and *Staphylococcus epidermidis* respectively. The microbial profile of SSI reported in different studies has shown a variance. Sahu et al. (2009)[34] and Kakati et al. (2013)[29] in their study found *E. coli* to be most common isolate followed by *Staphylococcus aureus.* However, Maheshwari et al. (2013)[26] similar to our study found *S. aureus* to be the most common isolate. The difference in pathogen types might be attributable to changed environment in different studies.

Thus, the focus of attention for reduction of SSI in elective abdominal procedure shifts to the quality of post-operative care, hospital environment and factors other than those studied in the present study. Given the limited number of cases included in this study, further studies on a larger sample size are recommended.

CONCLUSION

The present study was carried out with an aim to assess the incidence of surgical site infection among patients undergoing abdominal surgery and to assess various risk factors associated with surgical site infection

The incidence of surgical site infection was 7% in present study. Open surgery have a significantly higher risk of SSI as compared to other procedures. Laparoscopic procedures have been reported to have minimal SSI rate. Smoking was found to be significantly associated with a higher risk of SSI. Significant association of time lag between shaving and surgery with SSI. Relative risk of SSI (3.4) in patients above 50 years of age and ASA Grade>II. In majority of cases (85.71%) SSI was recorded on third post operative day. *Staphylococcus aureus* was the most common isolate (42.86%) followed by *Pseudomonas* (28.57%), *E. coli.*

Therefore, Open procedures, Smoking, Pre-op Hospital stay >1 day and ASA grade>II were found to be significantly associated with SSI resulting in Mean duration of hospital stay of SSI patients was longer.

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REFERENCES

1. Smyth ET, McIlvenny G, Enstone JE, Emmerson AM, Humphreys H, Fitzpatrick F, Davies E, Newcombe RG, Spencer RC; Hospital Infection Society Prevalence Survey Steering Group. et al. Four Country Healthcare Associated Infection Prevalence Survey 2006: overview of the results. Journal of Hospital Infection. 2008;69(1):230–48.
2. Perencevich EN, Sands KE, Cosgrove SE, Guadagnoli E, Meara E, Platt R. Health and economic impact of surgical site infections diagnosed after hospital discharge. Emerg Infect Dis. 2003;9(2):196-203.
3. Dimick JB, Weeks WB, Karia RJ, Das S, Campbell DA Jr. Who pays for poor surgical quality? Building a business case for quality improvement. J Am Coll Surg, 2006; 202 (1): 933–937.
4. Anvikar AR, Deshmukh AB, Karyakarte RP, Damle AS, Patwardhan NS, Malik AK, Bichile LK, Bajaj JK, Baradkar VP, Kulkarni JD, Sachdeo SM. A one year prospective study of 3280 surgical wounds. Indian J Medical Microbiology 1999; 17(3):129-132.
5. Mishriki SF, Law DJ, Jeffery PJ. Factors affecting the incidence of postoperative wound infection. J Hosp Infect 1990;16 (3):223-30.
6. Ayliffe GA. Role of the environment of the operating suite in surgical wound infection. Rev Infect Dis 1991;13(Suppl 10):S800-4.
7. Centers for Disease Control. Postsurgical infections associated with nonsterile implantable devices. MMWR Morb Mortal Wkly Rep 1992;41(15):263.
8. Soto LE, Bobadilla M, Villalobos Y, Sifuentes J, Avelar J, Arrieta M, et al. Post-surgical nasal cellulitis outbreak due to Mycobacterium chelonae. J Hosp Infect 1991;19(2):99-106
9. American Society for Healthcare Central Service Personnel. Recommended practices for central service. Section one, continuous quality improvement. Chicago: American Hospital Association; 1993.
10. Association for the Advancement of Medical Instrumentation. Flash sterilization: steam sterilization of patient care items for immediate use (ANSI/AAMI ST37-1996). Arlington (VA): Association for the Advancement of Medical Instrumentation; 1996.
11. Dineen P. The role of impervious drapes and gowns preventing surgical infection. Clin Orthop 1973;96 (1):210-2.
12. Moylan JA, Fitzpatrick KT, Davenport KE. Reducing wound infections. Improved gown and drape barrier performance. Arch Surg 1987;122 (4):152-7
13. Casey J, Flinn WR, Yao JS, Fahey V, Pawlowski J, Bergan JJ. Correlation of immune and nutritional status with wound complications in patients undergoing vascular operations. Surgery 1983;93(6):822-7.
14. Weber TR. A prospective analysis of factors influencing outcome after fundoplication. J Pediatr Surg 1995;30(7):1061-3; discussion 1063-4.
15. Gordon SM, Serkey JM, Barr C, Cosgrove D, Potts W. The relationship between glycosylated hemoglobin (HgA1c) levels and postoperative infections in patients undergoing primary coronary artery bypass surgery (CABG) [abstract]. Infect Control Hosp Epidemiol 1997; 18(No. 5, Part 2):29(58).
16. Neumayer L, 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 (5): 1178–1187
17. Lilienfeld DE, Vlahov D, Tenney JH, McLaughlin JS. Obesity and diabetes as risk factors for postoperative wound infections after cardiac surgery. Am J Infect Control 1988;16 (1):3-6.
18. Jones JK, Triplett RG. The relationship of cigarette

smoking to impaired intraoral wound healing: a review of evidence and implications for patient care. J Oral Maxillofac Surg 1992;50(3):237-9; discussion 239-40.
19. Jone SK, Tripleff RG: The relationship of cigarette smoking to impaired intra-oral wound healing: a review evidence and implication for patient care. J oral Maxillo Surg. 1992, 50 (3): 237-40.
20. Perencevich EN, Sands KE, Cosgrove SE, Guadagnoli E, Meara E, Platt R. Health and Economic Impact of Surgical Site Infections Diagnosed after Hospital Discharge. Emerging Infectious Diseases. 2003;9(2):196-203.
21. Maruo K, Berven SH. Outcome and treatment of postoperative spine surgical site infections: predictors of treatment success and failure. J Orthop Sci. 2014;19(3):398-404.
22. Nichols RL. Preventing Surgical Site Infections. Clinical Medicine and Research. 2004;2(2):115-118.
23. Maheshwari MK, Pandey S, Bhatnagar AK, Agrawal A. A prospective study of surgical site infection in elective and emergency abdominal surgery in CSSH, Meerut. JARBS. 2013; 5(4): 413-418.
24. Satyanarayana V., Prashanth H.V., Basavaraj Bhandare, Kavyashree AN. Study of Surgical Site Infections in Abdominal Surgeries. Journal of Clinical and Diagnostic Research. 2011;5(5): 935-939.
25. Chauhan H and Patel U. Effect of intra-abdominal absorbable sutures on surgical site infection. National Journal of Medical Research 2012; 2(3): 372-375.
26. Kakati B, Kumar A, Gupta P, Sachan PK, Thakuria B. Surgical site abdominal wound infections: Experience at a north Indian tertiary care hospital. JIACM 2013; 14(1): 13-9.
27. Tang R, Chen HH, Wang YL, Changchien CR, Chen JS, Hsu KC, Chiang JM, Wang JY. Risk Factors For Surgical Site Infection After Elective Resection of the Colon and Rectum: A Single-Center Prospective Study of 2,809 Consecutive Patient. Ann Surg. 2001 Aug; 234(2): 181–189.
28. Hübner M, Diana M, Zanetti G, Eisenring MC, Demartines N, Troillet N. Surgical Site Infections in Colon SurgeryThe Patient, the Procedure, the Hospital,and the Surgeon. Arch Surg. 2011;146(11):1240-5.
29. Razavi SM, Ibrahimpoor M, Kashani AS, Jafarian A. Abdominal surgical site infections: incidence and risk factors at an Iranian teaching hospital. BMC Surgery BMC series 2005; 5(2).
30. Pedroso-Fernandez Y, Aguirre-Jaime A, Ramos MJ, Hernández M, Cuervo M, Bravo A, Carrillo A. Prediction of surgical site infection after colorectal surgery. Am J Infect Control. 2016; 44(4): 450-454.
31. Sahu S, Shergill J, Sachan P, Gupta P. Superficial Incisional Surgical Site Infection In Elective Abdominal Surgeries - A Prospective Study. The Internet Journal of Surgery. 2009; 26(1): 1-7.

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