Original Research Article

Clinical study of various risk factors associated with surgical site infection at a tertiary hospital

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Abstract

Background: For surgical patients, surgical site infections (SSI) are the most common nosocomial infection, frequently cause morbidity and mortality among inpatients of hospitals and they have been shown to be the leading cause of operation-related adverse events. Present study was aimed to study various risk factors of surgical site infections at a tertiary hospital. **Material and Methods:** Present study was hospital based, prospective, observational study, conducted in patients 18-70 years age, of either gender, underwent non-traumatic exploratory laparotomy, had surgical site infections following laparotomy. **Results:** During study period, among 1332 laparotomies, 81 ppatients had surgical site infections, thus incidence of SSI was 6.08 %. Majority cases were from 41-50 years age group (28.4 %), male (64.2 %). Common co-morbidities noted were diabetes (43.21 %) followed by BMI 25-30 kg/m^2 (41.98 %), dyslipidaemia (33.33 %), smoking (28.4 %) and hypertension (25.03 %). Most patients had ASA score 2 (50.62 %) and duration of surgery > 2 hours (53.09 %). SSI was most common in Exploratory laparotomy with appendicectomy and peritoneal lavage (28.4 %) followed by open appendicectomy (14.81 %), adhesiolysis/resection anastomosis and peritoneal lavage (11.11 % each). Majority of wounds were Clean (45.68 %) followed by Clean contaminated (29.63 %), Contaminated (16.05 %) and Dirty or infected (8.64 %). In present study, Superficial SSI (65.43 %) was most common followed by Deep SSI (28.4 %) and Organ space SSI (6.17 %). Most common organism isolated was E. coli (19.75 %) followed by Pseudomonas (16.05 %) and Streptococcus (13.58 %). No growth was noted in 33 cases (40.74 %). **Conclusion:** Surgical site infection is a preventable morbidity. BMI > 25, co-morbidities such as diabetes, smoking, dyslipidaemia, surgery > 2 hours, appendicectomy were few high-risk factors noted for surgical site infections.

Keywords: Surgical site infection, diabetes, smoking, dyslipidaemia, abdominal surgeries.

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INTRODUCTION

For surgical patients, surgical site infections (SSI) are the most common nosocomial infection, frequently cause morbidity and mortality among inpatients of hospitals and they have been shown to be the leading cause of operation-related adverse events.[1,2] The rate of SSI is higher in the developing world than that in developed countries. The post-discharge surveillance of SSI in elective clean and clean-contaminated surgical procedures was carried out during 2019 and 15% incidence was reported in LMICs.[3] Patients of SSIs are closely linked with increased length of stay, delayed wound healing, pain, discomfort, long-lasting disability, and even death.[4] Numerous risk factors are involved in SSI with a complex relationship as; surgery, patients, microbial, and environment related factors.[5] There are many factors that affect the susceptibility of any wound to infection. These factors include pre-existing illness, length of operation, wound class, and wound contamination. Other factors are extremes of ages, malignancy, metabolic diseases,

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malnutrition, immunosuppression, cigarette smoking, remote site infection, emergency procedures, and long duration of preoperative hospitalization.[6]

As SSIs continue to pose challenges in healthcare management, detailed and specific identification of the factors that may place individual patients at greater risk of infection, and identification of the gaps in currently-available prevention options could help to minimize morbidity, mortality and healthcare costs associated with SSI. Present study was aimed to study various risk factors of surgical site infections at a tertiary hospital.

MATERIAL AND METHODS

Present study was hospital based, prospective, observational study, conducted in department of general surgery, at Tieten Medicity, Thane, India. Study duration was of 2 years (January 2020 to December 2021). Study approval was obtained from institutional ethical committee. Patients with surgical site infections following non-traumatic exploratory laparotomy during study period were considered for this study.

Inclusion criteria: Patients 18-70 years age, of either gender, underwent non-traumatic exploratory laparotomy, had surgical site infections following laparotomy, willing to participate in present study

Exclusion criteria: Patients undergoing exploratory laparotomy for traumatic causes. Patients receiving steroids, Chemotherapy/radiotherapy, immunosuppressant drugs. Patients presenting with pre-existing skin infections. Patients operated outside the hospital.

Study was explained to patients in local language and written consent was taken for participation and study. Socio-demographic details, associated co morbidities like diabetes/hypertension/ bronchial asthma/ thyroid disorders/renal disease or any immunosuppressive disorders, clinical details, prophylactic antibiotic use, blood transfusion, preoperative hospital stay, ASA score, nature of surgery, type of anaesthesia, duration of surgery, intraoperative findings, post-operative course, present examination findings, routine investigations (CBC, blood sugar, wound swab culture and sensitivity, LFT, RFT) were noted.

Wound infection was diagnosed if any one of these criteria was fulfilled: Serous or nonpurulent discharge from the wound, pus discharge from the wound, serious or nonpurulent discharge from the wound with the sign of inflammation and when wound was deliberately opened by the surgeon due to the localized collection.

Wound swab was sent to microbiology department for culture + sensitivity and after the swab culture and sensitivity report was available, the antibiotic was changed, if required. Follow up was kept till clearance of SSI.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Statistical analysis was done using descriptive statistics.

RESULTS

During study period, among 1332 laparotomies, 81 patients had surgical site infections, thus incidence of SSI was 6.08 %. Majority cases were from 41-50 years age group (28.4 %), followed by 51-60 years age group (20.99 %). Mean age of study patients was 50.4 ± 8.24. Male (64.2 %) outnumbered female (35.8 %) cases. Common co-morbidities noted were diabetes (43.21 %) followed by BMI 25-30 kg/m^2 (41.98 %), dyslipidaemia (33.33 %), smoking (28.4 %) and hypertension (25.03 %). Most patients had ASA score 2 (50.62 %) and duration of surgery > 2 hours (53.09 %).

Table 1: General Characteristic

Characteristic	No. of patients (n=81)	Percentage
Age group (years)		
≤30	12	14.81%
31-40	14	17.28%
41-50	23	28.40%
51-60	17	20.99%
61-70	15	18.52%
Gender		
Male	52	64.20%
Female	29	35.80%
Co-morbidities		
Diabetes	35	43.21%
BMI >25 kg/m^2	34	41.98%
Dyslipidaemia	27	33.33%
Smoking	23	28.40%
Hypertension	21	25.93%
Chronic obstructive pulmonary disease	17	20.99%

Coronary artery disease	6	7.41%
ASA grade		0.00%
I	11	13.58%
II	41	50.62%
III or more	29	35.80%
Duration of operation (Hours)		
<1 hr	15	18.52%
1-2 hr	23	28.40%
>2 hr	43	53.09%

In present study, SSI was most common in Exploratory laparotomy with appendicectomy and peritoneal lavage (28.4 %) followed by open appendicectomy (14.81 %), adhesiolysis/resection anastomosis and peritoneal lavage (11.11 % each).

Table 2: Type of Surgery

Surgery	No. of patients (n=81)	Percentage
Appendicectomy and peritoneal lavage	23	28.40%
Open appendicectomy	12	14.81%
Adhesiolysis/Resection Anastomosis	9	11.11%
Peritoneal lavage	9	11.11%
Hernia repair	8	9.88%
Ileal repair/ileostomy	6	7.41%
Exploratory laparotomy with omental patch repair	5	6.17%
RA repair of sigmoid volvulus	4	4.94%
Duodenal ulcer perforation repair	2	2.47%
Liver abscess drainage and peritoneal lavage	2	2.47%
Repair of intussusception	1	1.23%

In SSI patients, surgical wounds were labelled as clean, clean contaminated and contaminated, majority of wounds were Clean (45.68 %) followed by Clean contaminated (29.63 %), Contaminated (16.05 %) and Dirty or infected (8.64 %). In present study, Superficial SSI (65.43 %) was most common followed by Deep SSI (28.4 %) and Organ space SSI (6.17%).

Table 3: SSI related characteristics

Characteristic	No. of patients (n=81)	Percentage
Type of wound[7]		
Clean	37	45.68%
Clean contaminated	24	29.63%
Contaminated	13	16.05%
Dirty or infected	7	8.64%
Type of SSI[7]	81	
Superficial SSI	53	65.43%
Deep SSI	23	28.40%
Organ space SSI	5	6.17%

In present study, most common organism isolated was E. coli (19.75 %) followed by Pseudomonas (16.05 %), Streptococcus (13.58 %), Klebsiella (9.88 %), MRSA (7.41 %), Acinetobacter (4.94 %), Helicobacter (2.47 %) and Providentia (1.23 %). No growth was noted in 33 cases (40.74 %).

Table 6: Organism isolated

Organism isolated*	No. of patients (n=81)	Percentage
No growth	33	40.74%
E. coli	16	19.75%
Pseudomonas	13	16.05%
Streptococcus	11	13.58%
Klebsiella	8	9.88%
MRSA	6	7.41%
Acinetobacter	4	4.94%
Helicobacter	2	2.47%
Providentia	1	1.23%

(polymicrobial infection noted in few cases)

DISCUSSION

There are various factors contributing to the risk of SSI occurrence and preventative measures require an integrative approach that focuses through the pre-, intra and postoperative care involving all the stakeholders. Numerous multimodal preventive intervention programs based on guidelines, surgical site care bundles, and surgical safety checklists have been established. Despite several advancements in procedures, the optimal reduction of SSIs remains a challenge.[8,9] The development of SSI is multifactorial, and it may be related to patient's risk factors such as age, comorbidities, smoking habit, obesity, malnutrition, immunosuppression, malignancies, and the class of contamination of the wound.[10] 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.[11]

The incidence of SSI in study by Prakash V *et al.*,[12] was 25.34% with 81.58% superficial SSI and 18.42% deep SSI. Laparotomy was the common procedure and 63.2% of cases were females and 41-60 years was the most common age group. Staphylococcus aureus, Klebsiella pneumoniae and Escherichia coli were the common pathogens and were sensitive to carbapenems, vancomycin and linezolid. Significant association was observed with presence of pre-morbid analysis, presence of drain, use of povidone iodine alone and development of SSI. Patel S M *et al.*,[13] noted that, SSI rate was 16% (32/200).The most common organism isolated was Escherichia coli (35.7%, 10/28). Increase in pre-operative hospital stay, ASA (American Society of Anesthesiology) score > 2, increase in surgical wound class, emergency surgeries, longer duration of surgery were associated with increased SSI rates. Amrutham R *et al.*,[14] noted that surgical site infections (SSIs) were most commonly found among males, aged, diabetics, anaemic, underweight and overweight, hypertensive, blood transfusion and patients with longer hospital stay. Surgical Site Infections were higher in emergency cases than elective surgeries. Staphylococcus aureus was the most common organism isolated from surgical site infections. Multidrug resistance organisms were predominant in surgical site infections. In study by Amit Agrawal[15], SSI incidence was 15.7 % (59/375). In elective surgeries, the SSI rate was 5.7% and in emergency surgeries, it was 28.6%. It was found that SSI increased with increasing age linearly. Other significant factors involved were increasing class of wound (dirty > clean wound class), increased preoperative stay, presence of remote site infection, increased duration of surgery and use of drains. E. coli was found to be the most common organism causing SSI in abdominal operations.

In a systematic review, Salahuddin M *et al.*,[16] studied 18 articles, occurrence rate of SSI ranges from 2% to 17.8%. 3 microorganisms commonly reported were Staphylococcus aureus, Klebsiella pneumonia, and E.Coli. High SSI incidence noted among emergency surgical procedures and lower among obstetrics and gynecology procedures. Longer preoperative duration of stays in hospital, decreased Hb and serum albumin level, comorbid conditions such as diabetes, hypertension are potential risk factors for the development of SSI. The occurrence rate of SSI among post-operative patients is very high, especially in developing countries. Korol E *et al.*,[17] conducted a systemic review and noted that median SSI incidence was 3.7%, ranging from 0.1% to 50.4%. Incidence of overall SSI and S. aureus SSI were both highest in tumor-related and transplant surgeries. Median time until SSI onset was 17.0 days, with longer time-to-onset for orthopedic and transplant surgeries. Risk factors consistently identified as associated with SSI included co-morbidities, advanced age, risk indices, patient frailty, and surgery complexity. Thirteen studies considered diabetes as a risk factor in multivariable analysis; 85% found a significant association with SSI, with odds ratios ranging from 1.5-24.3. Longer surgeries were associated with increased SSI risk, with a median odds ratio of 2.3 across 11 studies reporting significant results. Multiple risk factors and peri-operative characteristics can increase the likelihood of superficial surgical site infections. Important host factors include diabetic mellitus, hypoxemia, hypothermia, leucopenia, nicotine, long term use of steroids or immunosuppressive agents, malnutrition, nares contaminated with Staphylococcus aureus and poor skin hygiene.[18] Peri-operative / environmental factors are operative site shaving, breaks in operative sterile technique, early or delayed initiation of antimicrobial prophylaxis, inadequate intra-operative dosing of antimicrobial prophylaxis, infected or colonized surgical personnel, prolonged hypotension, poor operative room air quality, contaminated operating room instruments or environment and poor wound care postoperatively.[18,19] Correctly performed hand hygiene among health care workers (HCWs) is the most important action to interrupt the chain of transmission of pathogenic microorganisms between patients and therefore reducing HAI, including SSI.[20] With rising incidence rate of SSI, its end results will have a greater impact on patients as well as on healthcare systems. Prevention of SSI requires multipronged approach targeting both patient related and procedure related risk factors in pre- operative, intra-operative, and post-operative period.

CONCLUSION

Surgical site infection is a preventable morbidity. BMI > 25, co-morbidities such as diabetes, smoking, dyslipidaemia, surgery > 2 hours, appendicectomy were few high-risk factors noted for surgical site infections following elective/emergency abdominal surgeries. Pre-operative assessment, evaluation of high-risk factors, intraoperative care and postoperative monitoring is important to prevent SSI.

REFERENCES

1. Watanabe A, Kohnoe S, Shimabukuro R, Yamanaka T, Iso Y, Baba H, et al. Risk factors associated with surgical site infection in upper and lower gastrointestinal surgery. Surg Today2008;38:404-12.
2. Suljagić V, Jevtic M, Djordjevic B, Jovelic A. Surgical site infections in a tertiary health care center: Prospective cohort study. Surg Today 2010;40:763-71.
3. Curcio D, Cane A, Fernández F et al. (2019) Surgical site infection in elective clean and clean-contaminated surgeries in developing countries. International Journal of Infectious Diseases 80: 34–45.
4. Pittet D, Allegranzi B, Storr J et al. (2008) Infection control as a major World Health Organization priority for developing countries. Journal of Hospital Infection 68: 285–292.
5. Woldemicael AY, Bradley S, Pardy C et al. (2019) Surgical site infection in a tertiary neonatal surgery centre. European Journal of Pediatric Surgery 29: 260–265.
6. Satyanarayana V. et al. Study of Surgical Site Infections in Abdominal Surgeries. Journal of Clinical and Diagnostic Research; 2011, October, Vol-5(5): 935-9.
7. National Healthcare Safety Network (NHSN) Patient Safety Component Manual, Chapter: Surgical Site Infection (SSI) Event, https://www.cdc.gov/nhsn/pdfs/pscmanual/pcsmanual_current.pdf, assessed on 20 July 2020
8. World Health Organization. WHO Surgical Safety Checklist Implementation Manual (First Edition). Spring. 2008; September:1–28.
9. Schweizer M, Perencevich E, McDanel J, Carson J, Formanek M, Hafner J, et al. Effectiveness of a bundled intervention of decolonization and prophylaxis to decrease Gram positive surgical site infections after cardiac or orthopedic surgery: systematic review and meta-analysis. BMJ. 2013;346:f2743.
10. Tsujinaka T, Yamamoto K, Fujita J, Endo S, Kawada J, Nakahira S, Shimokawa T, Kobayashi S. Subcuticular sutures versus staples for skin closure after open gastrointestinal surgery: a phase 3, multicentre, open-label, randomised controlled trial. Lancet. 2013;382:1105–382.
11. Thombare D., Joshi D. A Study of Incidence and Risk Factors in Post Operative Abdominal Wound Infection in Tertiary Care Centre. MVP J. Med. Sci. 2019; 6(1):8-14.
12. Prakash V, Rachamalli RR, Kandati J, Satish S. A prospective study on risk factors for development of surgical site infections at a tertiary care hospital: a two years study. Int Surg J 2018;5:460-5.
13. Patel Sachin M1, Patel Mitesh H2, Patel Sangeeta D3, Soni Sumeeta T4, Kinariwala Dipa M3, Vegad Mahendra Surgical site infections: incidence and risk factors in a tertiary care hospital, western India, National Journal of Community Medicine Vol 3 Issue 2 April-June 2012
14. Amrutham R, Reddy MMB, Pyadala N. A prospective study of surgical site infections and related risk factors in a teaching hospital. Int Surg J 2017;4:237-41.
15. Amit Agrawal, R. P. Singh. "Surgical Site Infection in Abdominal Surgeries: A Clinical Study". Journal of Evolution of Medical and Dental Sciences 2014; Vol. 3, Issue 40, September 01; Page: 10188-10193,
16. Salahuddin M, Muddebihal F, Thirunavukkarasu A, Alanazi A A Z, Alrashdi A M S, Alrashidi A M, et al. Epidemiology and Risk Factors of Post Operative Site Infections in Surgical Patients: A Systematic Review. Arch. Pharm. Pract. 2022;13(1):31-6.
17. Korol E, Johnston K, Waser N, Sifakis F, Jafri HS, et al. (2013) A Systematic Review of Risk Factors Associated with Surgical Site Infections among Surgical Patients. PLoS ONE 8(12): e83743.
18. Amol Wagh, Gajjam Shrinivas. Risk Factors Responsible to Surgical Site Infections Following Emergency non – Traumatic Exploratory Laparotomy. New Indian J Surg. 2019;10(1):11-17.
19. Doharty, G.M, Way L.W. Current Surgical Diagnosis, 12th ed. Mcgraw Hill, USA; 2006.pp.106- 107.
20. Murni I, Duke T, Triasih R, Kinney S, Daley AJ, Soenarto Y. Prevention of nosocomial infections in developing countries, a systematic review. Paediatr Int Child Health 2013;33:61-78.

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