e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(2); 1486-1491

Original Research Article

Analysis on Incidence and Etiology of Abdominal Surgical Site Infections among Emergency Postoperative Patients in Tertiary Medical College and Hospital

Jai Prakash Sinha[1*], Kunal[2]

[1]Assistant Professor, Department of Surgery, Jawaharlal Nehru Medical College & Hospital, Bhagalpur, Bihar

[2]Professor, Department of Surgery, Jawaharlal Nehru Medical College & Hospital, Bhagalpur, Bihar

Received: 25-11-2023 / Revised: 23-12-2023 / Accepted: 26-01-2024

Corresponding Author: Dr. Jai Prakash Sinha

Conflict of interest: Nil

Abstract:

Background: Surgical Site Infections (SSI) is a common post-operative consequence that occurs worldwide. On the other hand, published statistics on SSI patterns in developing nations such as India are quite scarce. The purpose of this study is to determine the prevalence of abdominal surgical site infections in emergency postoperative patients, as well as their etiological variables.

Methods: A total of 112 patients who were admitted to the Jawaharlal Nehru Medical College and Hospital's surgical department in Bhagalpur, Bihar, between October 2022 and September 2023 were included in this prospective study. With each patient's agreement, a series of enrollments was made, and preoperative, intraoperative, and postoperative data were gathered. The pus and wound discharge were gathered and sent for sensitivity testing and culture. Version 20.0 of the SPSS software was used for the statistical analysis, and a P-value of less than 0.05 was considered statistically significant.

Results: 15.2% was the total incidence of SSI. More men (64.7%) than women (35.3%) are impacted. Most SSI cases (41.2%) were associated with appendectomy cases and underweight patients (47.1%). Between the second and seventh post-operative day, all SSIs are discovered. The majority of wounds are unclean, contaminated, and clean-contaminated. The risk of SSI rises when a surgical procedure takes longer than three hours. The most common organism was E. Coli (82.4%), which was followed by Staphylococcus aureus (5.8%) and Klebsiella pneumoniae (11.8%). Maximum sensitivity patterns were observed for amikacin (100%), levofloxacin (93.2%), and doxifloxacin (92.3%), whereas high resistance (100%) was observed for routinely used medications like ceftriaxone and cefuroxime.

Conclusion: In this tertiary hospital, the prevalence of SSI is really high. The main organism in charge is E. Coli. In our institution, the most effective drugs against the microorganisms that cause SSI are amikacin, levofloxacin, and moxifloxacin.

Keywords: Surgical site infection, Appendectomy, E coli.

Introduction

Surgical Site Infections (SSI) are among the most often reported hospital-acquired infections (HAIs); they are infections that follow invasive surgical operations. After a surgical intervention, SSI is a particular type of HAI that appears in relation to the surgical site. [1,2,3] As of right now, infections that appear 30 days after surgery if there is no implant, or a year later if there is an implant, are included in the definition of SSI. [4]

SSI can have a number of detrimental effects, such as increased rates of morbidity and mortality, longer hospital stays, a rise in readmissions, the necessity for a reoperation, and higher healthcare costs. [5,6] Several international research have demonstrated the correlation between various surgical specializations and increased expenses after SSI. [7–9].

In the United States of America, surgical site infections (SSIs) account for a substantial number of complications; they affect between 300,000 and 500,000 surgical procedures each year and occur in between 2 to 5% of surgical patients. The healthcare system has a cost burden of about $1.6 billion due to SSI. [10,11] Moreover, the most common surgical complication in both industrialized and poor nations is SSI. [12] Healthcare-Associated Infections (HAI) are predicted to affect about 1.4 million people globally at any given time.

Although the prevalence of HAI varies greatly between nations and surgical procedures, it is conservatively expected to occur in at least 2% of surgeries. [10] The incidence of social security illness (SSI) can be up to four times higher in low- and middle-income countries (LMIC) than in high-income nations. [11] Notably, research has shown that the incidence of SSI in developing nations is higher than in affluent nations, ranging from 11% to 18%. [10,12]

According to a recent prospective study carried out in a developing nation, the total incidence of SSI was 10.9%.Thirteen the scarcity of published studies on the microbiological organisms implicated in SSI, their drug profiles, and risk factors has negatively impacted the management and prevention of these infections.

Material and Methods

A total of 112 patients who were admitted to the surgery department of the Jawaharlal Nehru Medical College and Hospital in Bhagalpur, Bihar, between October 2022 and September 2023 were included in this prospective study.

Patients who underwent elective or emergency surgery and experienced wound infections over the study's designated term were the study's primary focus. Patients who had further surgeries within the month before the study's start date were not included. To determine the incidence of SSI, all information was obtained from hospital records using a systematic data collection form.

For every case, a thorough history of the patient was acquired, including information about comorbidities, blood transfusions, antibiotic therapy, and hospital stays prior to surgery. There were four categories for the surgical procedures: clean, clean-contaminated, contaminated, and dirty. Relevant information was also gathered about the kind and length of surgery, the use of prophylactic antibiotic medicines, and related risk factors (such as diabetes and obesity). The Centers for Disease Control and Prevention (CDC) classification system, which covers superficial infections, deep infections, and infections involving organs or spaces, was used to assess wound infections.

Standard laboratory procedures were followed for specimen collection, and wound swabs and/or pus aspirates were taken from the surgical sites that were clinically infected. When the swabs or aspirates arrived at the microbiology lab, they were streaked from the principal inoculums and rolled onto 5% Sheep Blood agar (BA) and MacConkey agar. After that, the agar plates were incubated aerobically for 24 to 48 hours at 37 °C. The identification of bacteria was done in compliance with accepted practices. [14]

The standard disc diffusion method was used to test for antibiotic susceptibility, adhering to the recommendations established by the Clinical and Laboratory Standards Institute (CLSI). The protocols followed the CLSI requirements to the letter. [15] The bacterial isolations were categorized as sensitive, moderate, or resistant after the zone diameters were measured. A data sheet contained comprehensive laboratory data, such as antibiotic susceptibility, bacterial identification, culture results, and gram stain results.

The Statistical Package for the Social Sciences (SPSS), version 21.0 for Windows (SPSS, Inc., Chicago, IL), was used for all statistical analyses. The study respondents' demographic features were described using descriptive statistics, specifically counts and percentages. For quantitative variables, proportions were used to compare the data, while the mean and standard deviation were determined for qualitative variables. Chi-square ($\chi 2$) and Fisher's exact tests were used in bivariate analysis to evaluate the link between putative risk factors and SSI. Less than 0.05 was the threshold for statistical significance.

Results

17 patients (6 female and 11 male) had developed SSI out of the total 112 patients of whom 27 were female and 85 were male.

Table 1: Patients details

Characteristics		SSIs	
		No	**Yes**
Gender	Female	21	6(35.3%)
	Male	74	11(64.7%)
	Total	95	17
Age group	13-35 yrs	59	5(29.4%)
	36-75	36	12(70.6%)

Table 2: SSI study patients (n=17)

SSI study patients	No. of patients	Percentage
Types of SSI		
• Superficial	7	41.2%
• Organ/Space	5	29.4%

• Deep	5	29.4%
Symptoms on • Day 2-7 • Organism isolated • E.coli • S. Aureus • Klebsiella	 17 17 14 1 2	 100% 100% 82.4% 5.9% 11.8%

Age (p = 0.027), BMI (p = 0.034), surgical time (p = 0.001), postoperative oxygen inhalation (p = 0.056), and wound class (p = 0.017) were all linked to SSIs at bivariate logistic regression and independent sample t test. 47.1% of underweight individuals (BMI <18.5) had the highest SSI (8/17) rate. In cases connected to appendectomy (7/17) 41.18% and laparotomy for traumatic small or large intestinal perforation (3/17) 17.6%, the majority of SSI occurred.

Compared to other single procedures, patients receiving surgery for a duodenal ulcer perforation had the lowest SSI (1 out of 16 cases). Two (66.7%) of the three individuals with a history of prior abdominal surgery went on to develop SSI.

For urgent surgeries (those done within 12 to 24 hours of admission), the majority of SSI was 58.8% (10/17). A solo practicing trainee surgeon had a higher SSI (9/17) 52.9%. The following factors were not linked to SSI: gender, comorbidities, smoking history, operation type, ASA class, and usage of drain (Table 3 and 4). The wound class (p = 0.050) and surgical length (p = 0.013) were the only variables included in the final model.

Table 3: Total No. 112 independent sample t test

General Characteristics of study patients	Without SSI 95 (84.4%)	SSI cases 17 (15.2%)	Total 112 (100%)	p-value
Age • Mean age in years; mean±SD • Median age in years	 35±18 32	 46±15 50	 36±18 33	 0.027^{S}
Gender • Female • Male	 21(18.8%) 74(66.1%)	 6(5.4%) 11(9.8%)	 27(24.1%) 85(75.9%)	 0.242^{ns}
BMI (kg/m2); mean±SD	21.93±3.70	24.03±3.87	22.25±3.78	0.034^{s}
Positive smoking history	36(32.1%)	7(6.3%)	43(38.4%)	0.798^{ns}
Co-morbidities • Anemia • Diabetes • Hypertension • Tuberculosis • Cancer	 32(28.6%) 11(9.8%) 13(11.6%) 3(2.7%) 4(3.6%)	 6(5.4%) 4(3.6%) 4(3.6%) 0(0%) 1(0.9%)	 38(33.9%) 15(13.4%) 17(15.2%) 3(2.7%) 5(4.5%)	 0.897^{ns} 0.183 ^{ns} 0.297 ^{ns} 0.458 ^{ns} 0.759 ^{ns}

15.2% (17/112) of surgical site infections occurred overall. The age group of 36 to 75 years old had the highest SSI incidence (70.6%). With a mean age of 36.84 years ±17.97 (13–75) years, the patient population included 11 (64.7%) males and 6 (35.3%) females among the 85 males and 27 females with SSI. Between the second and seventh post-operative days, SSI had developed in all 17 patients. Of the total SSI cases, 41.2% (7 cases) were superficial, and 29.4% (5 instances) were deep and organ space SSI. This study SSI was caused by three distinct organisms. These are Staphylococcus aureus (1 case) 5.8%, Klebsiella pneumoniae (2 cases) 11.8%, and E. Coli (14 cases) 82.4%.

Table 4: Bivariate analysis of risk factors for development of SSIs

Operative details	Without SSI 95 (84.4%)	SSI cases 17 (15.2%)	Total 112 (100%)	p-value
Type of operation • Emergency • Urgent	 37(33.0%) 58(51.8%)	 7(6.3%) 10(8.9%)	 44(39.3%) 68(60.7%)	 0.862^{ns}
Done by • Senior Surgeon • Trainee	 53(47.3%) 42(37.5%)	 8(7.1%) 9(7.7%)	 61(54.5%) 51(45.5%)	 0.506^{ns}
ASA class • Class 1	 71(63.4%)	 9(8.0%)	 80(71.4%)	 0.171^{ns}

• Class 2 • Class 3	22(19.6%) 2(1.8%)	7(6.3%) 1(0.9%)	29(25.9%) 3(2.7%)	
Operative duration • <30 min • 30 min to <1hr • 1 hr to <2hr • 2 hr to <3hr • 3 hr to <4hr	 5(4.5%) 40(35.7%) 27(24.1%) 19(17.0%) 4(3.6%) 56(50.0%)	 0(0.0%) 5(4.5%) 4(3.6%) 2(1.8%) 6(5.4%) 13(11.6%)	 5(4.5%) 45(40.2%) 31(27.7%) 21(18.8%) 10(8.9%) 69(61.6%)	 0.001[s]
Drain used wound type • Clean wound • Clean-contaminated • Contaminated • Dirty/Infected	 1(0.9%) 41(36.6%) 21(18.8%) 32(28.6%)	 0(0.0%) 6(5.4%) 6(5.4%) 5(4.5%)	 1(0.9%) 47(41.96%) 27(24.1%) 37	 0.171[ns]
Post-operative informations • Oxygen inhalation	 55(49.1%)	 14(12.5%)	 69(61.6%)	 0.056[ns]

The following antibiotics had the highest levels of sensitivity: gentamicin (68.8%), azithromycin (81.3%), levofloxacin (93.2%), moxifloxacin (92.3%), and amikacin (100%).

The following antibiotics shown high resistance: ciprofloxacin (47.1%), cefuroxime (100%), ceftriaxone (100%), and ceftazidime (83.4%). In contrast to its great sensitivity to amikacin, azithromycin, levofloxacin, moxifloxacin, nitrofurantoin, and gentamicin, E. Coli exhibited the strongest resistance to cefuroxime, ceftriaxone, and ceftazidime.

Klebsiella had the most sensitivity to amikacin, gentamicin, and levofloxacin and the highest resistance to ceftriaxone, cefuroxime, ciprofloxacin, azithromycin, and doxycycline. S Aureus exhibited the highest amikacin sensitivity and cefuroxime resistance.

Table 5: SSI n (17) – Fisher's exact test

Sensitivity pattern		E.coli	S. aureus	Klebsiella sp.	Total n(%)	p-value
Cefuroxime	Sensitive n(%) Resistant n(%)	0(0.0%) 2(100%)	0(0.0%) 1(100%)	0(0.0%) 1(100%)	0(0.0%) 4(100%)	-
Ceftazidime	Sensitive n(%) Resistant n(%)	1(8.3%) 10(83.4%)	0(0.0%) 0(0.0%)	0(0.0%) 0(0.0%)	1(8.3%) 10(83.4%)	-
Ceftriaxone	Sensitive n(%) Resistant n(%)	0(0.0%) 13(100%)	0(0.0%) 1(100%)	0(0.0%) 1(100%)	0(0.0%) 15(100%)	-
Ciprofloxacin	Sensitive n(%) Resistant n(%)	4(28.6%) 6(42.9%)	1(100%) 0(0.0%)	0(0.0%) 2(100%)	5(19.4%) 8(47.1%)	0.357[ns]
Amikacin	Sensitive n(%) Resistant n(%)	1(100%) 0(0.0%)	2(100%) 0(0.0%)	1(100%) 0(0.0%)	4(100%) 0(0.0%)	-
Gentamicin	Sensitive n(%) Resistant n(%)	8(61.5%) 5(38.5%)	2(100%) 0(0.0%)	1(100%) 0(0.0%)	11(68.8%) 5(31.3%)	0.432[ns]
Moxifloxacin	Sensitive n(%) Resistant n(%)	11(78.6%) 1(7.1%)	1(100%) 0(0.0%)	0(0.0%) 0(0.0%)	12(80.0%) 1(6.7%)	1.000[ns]
Azithromycin	Sensitive n(%) Resistant n(%)	12(85.7%) 2(14.3%)	1(100%) 0(0.0%)	0(0.0%) 1(100%)	13(81.3%) 3(18.8%)	0.350[ns]
Levofloxacin	Sensitive n(%) Resistant n(%)	11(84.6%) 1(7.7%)	1(50.0%) 0(0.0%)	2(100%) 0(0.0%)	14(87.4%) 1(6.3%)	1.000[ns]
Nitrofurantoin	Sensitive n(%) Resistant n(%)	9(75.0%) 2(16.7%)	1(50.0%) 0(0.0%)	1(50.0%) 1(50.0%)	11(73.3%) 3(20.0%)	0.637[ns]

Discussion

Sterilization techniques, barriers, surgical approaches, and the availability of antibiotic prophylaxis have all advanced, but surgical site infections (SSIs) continue to be a major global source of morbidity, extended hospital stays, unscheduled readmissions, and mortality. The prevalence of social security illness varies greatly between hospitals and between geographical areas. In the USA, there are about 157,500 SSI cases (or 3.03%) annually. Over a ten-year period, SSI rates evaluated in a Canadian hospital came out to be a mere 4.7%. [16]

SSI rates ranged from 6.09% to 38.7% according to several Indian studies. [17] The frequency of surgical site infections (SSI) in Chinese hospitals ranges from 13.0% to 18.0%.18 The incidence of SSI was high in most African investigations, averaging 16.4%. [19]

Between 5.13% and 14.13% of participants in two distinct Bangladeshi studies met the criteria for SSI prevalence. [20,21] 15.2% was the total SSI prevalence in our study. The differences in incidence rates between our study and other literature could be attributed to post-discharge surveillance, various surveillance systems, or potential underreporting of SSI. [16] The high frequency of surgical site infections (SSIs) may be partly attributed to the absence of advancements in infection control in our nation. Examples of these advancements include the use of positive pressure, hourly exchanges of filtered air, air conditioning systems with HEPA filters, etc. in theaters to lower bacterial loads. The disparity in infection rates between industrialized and poor countries can be attributed to the high standards of healthcare maintained in the former. [22] SSI increases the cost of hospitalization and also led to development of antimicrobial resistance. [17]

The duration of surgery and the CDC wound class were found to be risk factors for SSI. There is a statistically significant correlation between the length of operation and SSI. According to this study, there is a higher likelihood of SSI development ($p<0.001$) when surgery lasts more than three hours. This might be the result of increased pathogen exposure at the site of the incision or increased potential for aseptic technique violations. Additionally, SSI and the 24 CDC wound class were significantly related. Compared to clean wounds, surgeries that are dirty/infected, contaminated, and clean-contaminated have a higher risk of acquiring surgical site infection (SSI).

SSI incidence was highest (70.6%) among patients aged 36 to 75 years, whereas the lowest infection rate (29.4%) was seen in the age group of 13 to 35 years, taking into account patient characteristics. Numerous studies have shown that SSI incidence rises with age due to immune system deterioration. [17] Although the majority of the patients in our series (71.4%) are in ASA class 1, the ASA index for the patient's clinical status prior to surgery is a known risk factor for SSI [16].

Consequently, this became unimportant. According to the microbiological profile, E. Coli is the primary bacterium that causes SSI and is present in 82.4% of the cases. Identification of risk factors allows health care professionals to take actions that reduce complications resulting from infections and minimize SSI rates.

In order to mitigate the elevated rate of infections in developing nations, an appropriate surveillance system is necessary for the administration of antibiotics and the execution of infection control protocols. Simple steps like restricting the number of workers in the operating room and their restricted movements can help reduce the amount of airborne particles in the operating room and hence the spread of bacteria. [24] Evidence-based prevention techniques can avert about 50% of SSIs. [18] The CDC released their most recent "Guideline for the Prevention of Surgical Site Infection" in 2017. [26] The prevention of surgical site infections (SSI) necessitates a multidisciplinary strategy involving people accountable for the architecture, organization, and operation of operating rooms. [24]

Conclusion

This tertiary hospital has a relatively high incidence of SSI (15.2%). Longer postoperative times and the CDC wound class (clean-contaminated, contaminated, or dirty/infected) were risk variables associated with surgical site infections. E. Coli has been found to be the main bacteria in pus cultures. Strong medications that are effective against the microorganisms that cause SSI in our hospital are amikacin, levofloxacin, and moxifloxacin. Strict adherence to the CDC's surgical site infection prevention guidelines is necessary to lower the prevalence of SSI in our hospital.

References

1. Amenu D, Belachew T, Araya F. Surgical site infection rate and risk factors among obstetric cases of Jimma University specialized hospital. Southwest Ethiopia Ethiop J Health Sci. 2011; 21(2):91–100.
2. Fadnis MP, Desai S, Kagal ABR. Original article surgical site infections: incidence and risk factors in a tertiary care hospital. Western. 2012; 3(2):152–61.
3. Chahoud J, Kanafani Z, Kanj SS. Surgical site infections following spine surgery: eliminating the controversies in the diagnosis. Front Med [Internet]. 2014:1–10.
4. Fan Y, Wei Z, Wang W, Tan L, Jiang H, Tian L, et al. The incidence and distribution of surgical site infection in mainland China: a meta-analysis of 84 prospective observational studies. Sci Rep. 2014; 4:1–8.
5. Andrew B, O'Keeffe TL. &Stana B. Oxford craniotomy infections database: a cost analysis of craniotomy infection. Br J Neurosurg. 2012; 26(2):265–9.
6. Hogle NJ, Cohen B, Hyman S, Larson E, Fowler DL. Incidence and risk factors for and the effect of a program to reduce the incidence of surgical site infection after cardiac surgery. Surg Infect (Larchmt) [Internet]. 2014; 15(3):299–304.
7. Pinkney TD, Calvert M, Bartlett DC, Gheorghe A, Redman V, Dowswell G, et al. Impact

of wound edge protection devices on surgical site infection after laparotomy: multicentre randomized controlled trial (ROSSINI trial). BMJ [Internet]. 2013; 347(7919):1–13.
8. Kallala RF, Ibrahim MS, Sarmah S, Haddad FS, Vanhegan IS. Financial analysis of revision knee surgery based on NHS tariffs and hospital costs Does it pay to provide a revision service? Bone Jt J. 2015; 97–B (2):197–201.
9. Atkinson RA, Jones A, Ousey K, Stephenson J. Management and cost of surgical site infection in patients undergoing surgery for spinal metastasis. J Hosp Infect [Internet]. 2017; 95(2):148–53.
10. Pathak A, Mahadik K, Swami MB, Roy PK, Sharma M, Mahadik VK, et al. Incidence and risk factors for surgical site infections in obstetric and gynecological surgeries from a teaching hospital in rural India. Antimicrob Resist Infect Control. 2017; 6(1):1–8.
11. Danzmann L, Gastmeier P, Schwab F, Vonberg RP. Health care workers causing large nosocomial outbreaks: A systematic review. BMC Infect Dis. 2013; 13(1).
12. Chu K, Maine R, Trelles M. Cesarean section surgical site infections in sub-saharan Africa: a multi-country study from Medecins sans Frontieres. World J Surg. 2015; 39(2):350–5.
13. Mukagendaneza MJ, Munyaneza E, Muhawenayo E, Nyirasebura D, Abahuje E, Nyirigira J, Harelimana JD, Muvunyi TZ, Masaisa F, Byiringiro JC, Hategekimana T, Muvunyi CM. Incidence, root causes, and outcomes of surgical site infections in a tertiary care hospital in Rwanda: a prospective observational cohort study. Patient Saf Surg. 2019 Feb 18; 13:10.
14. Koneman EW, Allen SD, Janda WM, Schreckenberger PCWWJ. Color Atlas and Textbook of Diagnostic Microbiology. 5th ed. Philadelphia: Pa: Lippincott-Raven; 1997.
15. Wayne P. Performance Standards for Antimicrobial Susceptibility Testing: Twenty-Fifth Informational Supplement [Internet]. Clin Lab Stan Inst. 2015. M100-S25.
16. Cruse PJ, Foord R. The Epidemiology of Wound Infection. A 10-Year Prospective Study of 62,939 Wounds. Surg Clin North Am. 1980; 60(1):42031–2.
17. Narula H, Chikara G, Gupta P. A Prospective Study on Bacteriological Profile and Antibiogram of Postoperative Wound Infections in a Tertiary Care Hospital in Western Rajasthan. J Family Med Prim Care. 2020; 2020(4):1927–34.
18. Kim BD, Hsu WK, De Oliveira GS, Saha S, Kim JY. Operative duration as an independent risk factor for postoperative complications in single-level lumbar fusion: an analysis of 4588 surgical cases. Spine. 1976; 39(6):510–20.
19. Lubega A, Joel B, Lucy NJ. Incidence and Etiology of Surgical Site Infections among Emergency Postoperative Patients in Mbarara Regional Referral Hospital, South Western Uganda. Surg Res Pract. 2017; 2017:6365172.
20. Monjur F, Rizwan F, Ghosh NK. Surgical Site Infection Related Risk Factors and Usage of Antibiotics in Two Different Tertiary Care Hospitals of Dhaka City, Bangladesh. Asian J Pharm Clin Res. 2018; 11(7):184–8.
21. Sickder HK, Lertwathanawilat W, Sethabouppha H, Viseskul N. Prevalence of Surgical Site Infection in a Tertiary Level Hospital in Bangladesh. Int J Natural Soc Sci. 2019; 2017(3): 63–8.
22. Carvalho RLR, Campos CC, Franco LM, De C, Rocha ADM, Ercole FF. Incidence and Risk Factors for Surgical Site Infection in General Surgeries. Rev Lat Am Enfermagem. 2017; 4:2848.
23. Spagnolo AM, Ottria G, Amicizia D, Perdelli F, Cristina ML. Operating Theatre Quality and Prevention of Surgical Site Infections. J Prev Med Hyg. 2013; 54(3):131–7.
24. Carvalho RLR, Campos CC, Franco LM, De C, Rocha ADM, Ercole FF. Incidence and Risk Factors for Surgical Site Infection in General Surgeries. Rev Lat Am Enfermagem. 2017; 25(18):e2848.