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Original Research Article

Incidence and Risk Factors of Surgical Site Infections in Abdominal Surgeries: A Retrospective Evaluation

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Abstract

Background: The incidence rate of surgical site infections (SSIs) varies between 14% and 16%, positioning them as the 3rd most frequently reported nosocomial infection. The incidence of surgical site infections in elective operations in India varied between 3.83% and 39%, whereas in emergency procedures, it ranged from 12.41% to 26.4%.

Aim: The aim of this research was to assess the risk factors and incidence of surgical site infection in patients who are undergoing abdominal surgeries.

Methods: A retrospective study was conducted at the 'Department of General Surgery, Patna Medical College and Hospital, Patna, Bihar, India', to include all patients who underwent abdominal surgery. Thorough investigations were conducted, and patient demographics and pertinent risk factors were recorded.

Results: The research included 80 subjects, with an infection frequency of 38.75%. This rate is almost equivalent to that seen in prior studies conducted in India. The study conducted in the Western world has shown a decreased infection rate.

Conclusions: SSIs seem to be a prevalent cause of perioperative morbidity and death, resulting in prolonged hospital stays and elevated treatment costs. Effective planning and management of case-by-case situations may reduce the occurrence of SSIs and alleviate the strain on the healthcare system.

Keywords: Laparoscopy, Respiratory tract infection, Surgical site infection, Surgical antibiotic prophylaxis, Urinary tract infection

Introduction

Surgical site infection is a nosocomial infection that appears at or near a surgical incision or wound after a surgical procedure. Surgical site infections (SSIs) are the most common and well-researched healthcare-associated disease, accounting for up to one-third of surgical patients in low- and middle-income countries [1,2]. Surgical site infections are less common in developed countries like Turkey (4.1 percent), China (4.5 percent), and India (5.0 percent) than in developing countries like the United States (1.9%), France (1.0%), and Italy (2.6%). India is categorized as a low- and middle-income nation (LMIC) and has been shown to have much higher incidence of surgical site infections (SSI), with reported rates ranging from 4% to 30%, as per research [3]. The National Nosocomial Infections Surveillance System (NNIS) reports that surgical site infections (SSIs) account for 14–16% of all nosocomial infections in India, making them the third most common kind of infection. Proteus mirabilis, Pseudomonas aeruginosa, Escherichia coli, Methicillin-resistant Staphylococcus aureus (MRSA), and Staphylococcus aureus were the most often found causative pathogens [4,5]. Infection rates differ among surgical techniques, such as laparoscopy (10%), umbilical hernia repair (2%–5%), and colon surgery without antibiotic prophylaxis (30%–60%). Global research has demonstrated that the incidence of surgical site infections is significantly correlated with a variety of factors, such as the patient's "American Society of Anesthesiologists classification", the administration of pre-operative antibiotics [6].

Surgical antibiotic prophylaxis (SAP) is the practice of giving an efficient antimicrobial medication before being exposed to contaminated areas during surgery in order to avoid infections and the problems they might cause. Some of the established risk factors for SSI, such as environments, surgeons, and patients, may be minimized. Certain other factors, such old age and diabetes, are unavoidable intrinsic dangers for patients. Germs may still enter a wound via the patient's skin, the operating room, surgical staff, or equipment even after thorough cleaning and antisepsis [7,8].

The rate of surgical site infections can be significantly reduced by administering systemic antibiotics as prophylaxis prior to surgery. This is due to the fact that prophylactic antibiotics administered after 120 minutes post-incision have been associated with an elevated risk of SSIs [9]. Medical issues, such as the kind of surgical incision, infection risk, possible pathogens, and antibiotic prophylactic efficacy, must be taken into account while selecting and implementing SAP [10,11]. The optimal period of antimicrobial medication for avoiding surgical site infections (SSI) remains undetermined; nevertheless, accumulating data suggests that postoperative antimicrobial treatment is often unnecessary for the majority of surgeries [12]. SSIs elevate mortality and morbidity rates, incur higher expenditures owing to extended hospitalization, need supplementary diagnostic testing and therapeutic antimicrobial interventions, and sometimes, extra surgical procedures. The current research aimed to assess the frequency and risk factors for surgical site infections in patients following abdominal operations.

1. Methods

2.1. Study design, location, and duration

This retrospective study conducted in a hospital setting. The research included all patients receiving abdominal operations, including both elective and emergency procedures, at the 'Department of General Surgery, Patna Medical College and Hospital, Patna, Bihar, India from Feb 2020 to December 2020

2.2. Sample size

The sample size was calculated using a 95% confidence interval and a 5% absolute error margin to validate an estimated 16% incidence of surgical site infections. The sample size was determined using the percentage estimate method:

$$n = Z\left(1-\frac{a}{2}\right)^2 * \frac{P(1-P)}{E^2}$$

Where Za/2, which was equivalent to 1.96 at a 95% confidence range, was the standard normal deviation. P stands for the anticipated percentage of surgical site infections in the abdomen (16% according to Patel's research). The maximum permitted error, or E, was 5%. Thirty-one of the eighty patients having abdominal surgery were found to have a "surgical site infection".

2.3. Inclusion and exclusion criteria

All patients who reported to the general surgery department in need of abdominal surgeries regardless of their age or gender were included in the trial, given written informed permission to participate, and were treated as either trauma cases or outpatient departments. Individuals with prior wound infections and those who had undergone operations other than abdominal ones were not included.

2.4. Data collection

Patients were told about the research, its goal, and its methodology prior to giving their informed permission. After the ethics committee gave its clearance, the following data was gathered:

➢ **Patient particulars:**
Name, gender, age, residence, registration number, contact number, and admission date.

➢ **Patient history:**
Describe the primary symptoms, the history of the present medical conditions, past medical history, family history, and corticosteroid use.

➢ **Preoperative preparation:**
Several tests and examinations were carried out, such as blood sugar, CBC, liver and kidney function tests, serum electrolytes, ECG, chest and abdominal ultrasound, and other procedures.

➢ **Operative details:**
Details on the surgery, including the kind of treatment (emergency or elective), drain placement, and wound contamination.

➢ **Post-operative details:**
Utilization of antibiotics, dressing changes, wound cultures, and swab cultures, antibiotic susceptibility.

➢ **Outcome measures:**
The variables that were examined were fever, lesion exudate type, and color. The exudate from the incision depth was cultured for microbiology.

2.5. Laboratory procedures

In the microbiology division, swabs were inoculated into nutrient broth, MacConkey agar plates, and blood agar plates. The infected material was incubated aerobically at 37°C for 24 to 48 hours. The nutrient solution was sub-cultured in the event that organisms were not produced on the initial dishes. Bacteria were classified according to their cultural and morphological attributes. The processing procedures that were then provided as an example were implemented:

- Materials were injected into different growth media for both aerobic and anaerobic organisms, and biochemical tests, antibiotic susceptibility testing, and preliminary identification were performed.
- Patients underwent a month-long follow-up.
- Direct microscopic analysis of a smear stained with gram stain.

2.6. Data analysis

The statistical analysis was performed by using SPSS software, especially version 27. For data that follows a parametric distribution, the mean values between the two groups were compared using the student's t-test. The Chi-square test was used to examine categorical data. A P-value < 0.05 indicates the statistical significance of the outcome.

2. Results

This study included total of 80 cases, 31 patients (38.75%) had abdominal surgery site infections, indicating a notably high infection incidence rate within the examined patient group.

Table 1: Incidence of total surgical site infection.

Total cases	No, of cases infected	%
80	31	38.75%

The incidence of infection rises with age, peaking at 70% among those over 60 years old. BMI is a crucial factor, as individuals with a BMI of 21-24 exhibit a markedly high infection rate of 93.33%, whilst those with a BMI of 30 or over have a reduced incidence of 16.67%. Infection rates differ by wound classification, with contaminated wounds (50%) and filthy wounds (45.45%) exhibiting greater infection rates than clean wounds (36%) and clean contaminated wounds (15.79%). Emergency procedures had a significantly elevated infection rate of 40.48% in contrast to elective surgeries, which had an infection rate of 10.53%.

Table 2: Demographics, clinical, and surgical features.

	N=80	Infected	%
Age (years)			
18-25	10	3	30.00%
26-35	40	10	25.00%
36-60	10	4	40.00%
>60	20	14	70.00%
BMI			
≤20	20	5	25.00%
21-24	30	28	93.33%
25-29	12	5	41.67%
≥30	18	3	16.67%
Type of wound			
Clean	25	9	36.00%
Clean contaminated	19	3	15.79%
Contaminated	14	7	50.00%
Dirty	22	10	45.45%
Type of operation			
Emergency	42	17	40.48%
Elective	38	4	10.53%

The impact of several risk variables on the occurrence of surgical site infections. Preoperative hospitalization had the greatest infection prevalence (80%), followed by preoperative shaving duration (63.64%), preoperative respiratory tract infections (58.33%), and drain insertion (66.67%). Anemia had a 44.44% infection rate, but diabetes mellitus and hypoproteinemia showed lower rates of 33.33% and 25.00%, respectively. Extended surgical length correlated with an elevated infection prevalence (55.56%), with infections being more prevalent in instances with preoperative urinary tract infections (62.50%) and certain surgical techniques (50.00%).

Table 3: Risk factors of surgical site infection.

Risk factors	N	Infected	%
Anemia	18	8	44.44%
Hypoproteinemia	4	1	25.00%
DM	3	1	33.33%
Preop-RTI	12	7	58.33%

Duration of surgery (hrs.)	9	5	55.56%
Prehospitalization (days)	5	4	80.00%
Preop shaving time (hrs.)	11	7	63.64%
Drain placement	6	4	66.67%
Type of surgical approach	4	2	50.00%
Preop-UTI	8	5	62.50%

Data from many research about surgical site infections in various countries. Mahesh et al. (1980) observed a low infection incidence of 4.7% among 62,939 patients in Canada. . In contrast, studies from India show higher infection rates. Sankar et al. (2023) reported a 12.6% infection rate among 1,362 cases, Umesh et al. (2008) found a significantly higher rate of 30.7% in 114 cases, and Patel et al. (2012) recorded a 16% infection rate in 200 cases.

Table 4: Different studies conducted on surgical site infection.

Author	Country	Year	Total cases	Infection rate (%)
Mahesh et al.[13]	Canada	1980	62939	4.7
Sankar et al.[14]	India	2023	1,362	12.6
Umesh et al.[15]	India	2008	114	30.7
Patel et al. [16]	India	2012	200	16

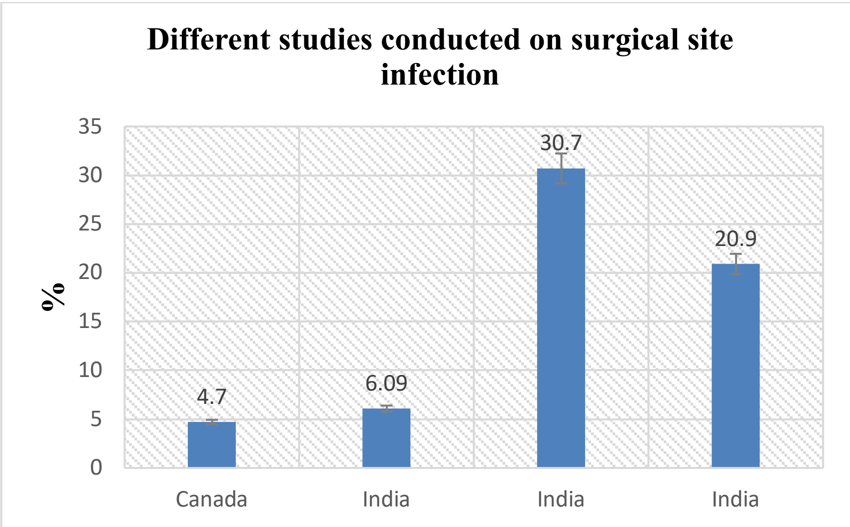

Figure 1. Different studies conducted on surgical site infection.

Discussion

The present study included a total of 80 individuals having major abdominal surgery. The surgical site infection (SSI) incidence in this study was approximately 38.75%, which is slightly higher than the data from earlier Indian studies conducted by Shahane et al. [17] (6%) and Sharan et al. [18] (7%). A number of other Indian studies, such as Patel et al., have reported higher rates of surgical site infections [19] at 12.68% and Mekhla et al. [20] at 39%. The increase in incidence was attributable to the inclusion of just emergency procedures and the rural context. Prior studies, such as those by Chada et al. [21], have shown a reduced incidence of surgical site infections (SSI) at 3.83%, attributable to the inclusion of exclusively clean or clean-contaminated procedures.

The research found that as people age, their susceptibility to infection rises. The incidence increases gradually over time, reaching 70% in the 60–70 age range from 30.0% in the 18–25 age group. Previous studies by Cruse and Foord [16] came to a similar result. A few studies (Owen et al., 2012) discovered that the 36–50 year age group had a higher SSI rate [22]. In contrast to a research by Mejis et al. [23], which found an increased risk of SSI with rising BMI, individuals with a BMI more than 30 had a 16.67% infection rate. Obesity reduces blood supply to fatty tissues, hence the higher the BMI, the greater the risk of infection.

This research found that the infection rate for clean surgical wounds was 36%. The percentage of infection in clean contaminated wounds was 15.79%; the percentage of infection in contaminated wounds was 50%; and the percentage of infection in unclean wounds was 45.45%. Similar results were seen in further experiments. Syed et al. conducted a study at an Iranian teaching hospital, which revealed that the frequency of surgical site infections was approximately 13.6% in clean wounds, 26.7% in clean-contaminated wounds, 45.8% in contaminated wounds, and 14% in soiled wounds. In a similar study, Mahesh et al. calculated the SSI rates as follows: 11.53% for clean surgery, 23.33% for clean-contaminated, 38.10% for contaminated, and about 57.14% for unclean wounds [13]. Our research found that emergency procedures had an infection incidence of around 40.48%, whereas electives had an infection rate of 10.53%. In contrast to these findings, Mahesh et al [13] did a research and discovered that emergency procedures had a higher incidence of SSI than elective surgeries (21.05% vs 7.61%). Similarly, SSI rates for elective and emergency treatments were determined by Saravana Kumar et al. [4] to be 4.34% and 12.41%, respectively.

Patients with respiratory tract disorders had a higher SSI incidence of 58.33%, while diabetic patients had an infection rate of 33.33%. Other groups included anemic patients at 44.44%, those with urinary tract infections at 62.50%, and individuals with hypoproteinemia at 25.00%. This data indicates that comorbidity is a significant risk factor, likely due to immunosuppression, diminished healing factors, hyperglycemia, an unfavorable environment for wound healing, and previous illnesses. Mohan et al. discovered comparable findings, recognizing diabetes mellitus and smoking as significant risk factors for the development of surgical site infections [24].

The likelihood of hospitalization prior to surgery beyond 5 days was 80%. Prolonged preoperative hospitalization increases the risk of surgical site infections (SSI). The increased frequency of surgical site infections associated with longer preoperative hospital stays is explained by increased nosocomial strain colonization of patients. A protracted hospital stay before to surgery also suggests a serious condition and related comorbidities, delaying the patient's preparation for surgery. Comparable findings were reported in other research, including that of Mansour et al., which indicated an infection incidence of 18.6% for hospitalizations less than 15 days and 25.9% for those over 15 days. Saravanakumar et al. [4] describe a surgical site infection (SSI) frequency of 66.6% with drain and 33.3% without drain.

The infection rate associated with the utilization of drains was 66.67% in the current investigation. Similar findings were observed in other investigations that implemented drains. The placement of the drain is determined by the surgeon, but it serves as a portal for the organism. In contrast, Nivitha et al [24] conducted a study in which the infection rate was 16% when a drain was placed and 84% when no drain was used. According to our research, individuals who shave before surgery more than six hours beforehand have a higher risk of infection (63.64%), while patients who prepare within six hours have a higher risk of infection (55.56%). Pre-operative grooming leaves the surface exposed to infection, and the greater the period, the longer it takes the organism to establish itself, which is most likely the source of this finding. Brown et al [25] and Rojanapirom et al [26] conducted a trial that contrasted the shaving and non-shaving of hairs preoperatively. Patients who underwent hair removal exhibited an SSI of 9.6% during trail observations, while those who did not undergo hair removal had an SSI of 6%.

Conclusion

After a comprehensive clinical evaluation of the wound, it was found that the prevalence of "surgical site infection" was almost 38.75 percent. This was comparable to a greater number of investigations that were conducted in India, however research conducted in the West show a lower frequency of infection due to a variety of reasons, including poor socioeconomic status, low literacy rates, and insufficient infrastructure.

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