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Surgical site infections - A threat to the health-care system: An observational study from a tertiary care hospital of Bihar

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ABSTRACT

Background: A surgical site infection (SSI) is any infection occurring after a medical intervention. It is the most common nosocomial infection in low- and middle-income countries. It has raised both mortality and morbidity. Resistance to antibiotics due to irrational use has further added to the severity of the problem. **Aims and Objectives:** The current study was designed with the aim of determining the incidence of SSIs among patients operated on a tertiary care hospital, along with their antibiogram. **Materials and Methods:** An observational study with a cross-sectional design was conducted on 150 patients with suspected SSI were included in this study over a period of 1 year, from August 2021 to July 2022. An adult patient with pus, serous, or seropurulent discharge from the surgical wound was included in the study. Information was obtained using a pre-designed and pre-tested schedule. Identification of the colony was done by gram staining and inoculation on 5% sheep blood agar and Mac Conkey agar plates. Antimicrobial sensitivity testing was done. The data was analyzed using Microsoft Excel. **Results:** A total of 152 patients were included in the study. The incidence of SSI was found to be 38.2%. The mean age of the participants was 47.7 ± 21.6 years. The maximum incidence of SSI was noted in the 5th decade of life. Among the 58 patients' samples, 65 aerobic bacterial colonies were isolated. Out of which *Staphylococcus aureus* and *Escherichia coli* were the commonest organisms. On performing an antibiogram, a higher degree of resistance was observed among Gram-negative organisms. **Conclusion:** SSI adds to the mortality as well as the morbidity of the patients. Not only this, but it also adds to the expenses. A more stringent surveillance system and reinforcement of the guidelines was the need of the hour to overcome this problem of hospital-acquired infections.

Key words: Antibiogram; Antibiotic resistance; Antimicrobial sensitivity testing; Hospital acquired infection; Surgical site infection

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INTRODUCTION

Surgical site infection (SSI) has been defined as any infection occurring in 30 days postoperatively or within 1 year for procedures where an implant has been placed, provided these infections could be attributed to the surgery and deep soft tissue like muscle and fascia around the incision are involved or any other part of the anatomy that has been manipulated during the procedure.[1] Among all hospital-acquired infections (HAIs), SSIs are the most common type seen among patients in low- and middle-income countries. Almost up to one-third of patients undergoing any form of surgical intervention suffer from these infections. Although the overall prevalence of SSI is lesser in developed nations, it remains the second most common type of HAI.[2] Although the pooled global incidence showed that one in every 10 patients suffers from SSI, the national incidence can go as high as 38%, according to reports from various researchers.[3-6] The National Nosocomial Infections Surveillance reports that SSIs are the third-most frequently encountered HAI in India.[7]

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SSIs take a toll on the mortality and morbidity of patients; apart from that, they pose exorbitant monetary losses to both the individual and the health-care system, along with prolonged hospitalization.[8,9] Studies suggest that the cost of medical care can go up to sixfold if patients suffer from such infections.[8,9] Other impacts include re-operation, re-admission, limitation of quality of life, and social catastrophe.[10] It also serves as an indicator of the quality of the health care provided by the health system. The pathophysiology of SSI is multifactorial and envisages both endogenous and exogenous contamination.[3] Various risk factors have been identified that include old age, a higher body mass index (BMI), poor nutritional status, a longer preoperative duration of hospitalization, steps during patient preparation for the procedure, and the duration of surgery. These factors impact the outcome of surgery, and ill preparation favors the SSI. Bacteriological studies have seen an increasing prevalence of Gram-negative organisms as causative agents for serious forms of SSI. Resistance to antibiotics due to irrational use has further added to the severity of the problem.[11,12]

With this background, the current study was planned and conducted with the aim of determining the incidence of SSIs among patients operated on a tertiary care hospital along with their antibiogram.

Aims and objectives

The current study was designed with the aim of determining the incidence of SSIs among patients operated on a tertiary care hospital, along with their antibiogram.

MATERIALS AND METHODS

This study was planned and undertaken by the Department of Microbiology in association with the Department of Surgery and Microbiology at Jawaharlal Nehru Medical College, Bhagalpur, Bihar. A total of 150 patients with suspected SSI were included in this study for 1 year, from August 2021 to July 2022. Prior approval from the Institutional Ethics Committee was obtained. Duly signed informed consent forms were collected from each patient before participation. For patients who were unable to give consent, the same was obtained from the available family member.

Selection of study participants

All the patients who underwent any form of surgery in any of the surgical departments of the medical college during the study period were enrolled in the study after consideration of exclusion and inclusion criteria.

Inclusion criteria

1. Patients with an age >14 years and all genders
2. Patients with pus, serous, or seropurulent discharge from the wound, along with any signs of sepsis, were included.

Exclusion criteria

1. Patients who underwent laparoscopy were excluded
2. Patients who received pre-operative antibiotics for at least for 1 week were excluded
3. Re-operated patients or patients receiving immunosuppressive agents were also excluded from the study group
4. Patients failing to give consent or follow-up were excluded from the study.

Method of data collection

Baseline characteristics of the study population were recorded. It included age, gender, body mass index, diabetes status, anemia, hypoalbuminemia, smoking, and history of blood transfusion. A total of 150 patients with suspected SSI were included in the study. At the time of the induction of surgery, prophylactic antibiotic coverage was introduced if no signs or indications of sepsis were seen. In cases of contamination, antibiotics were continued in the post-operative phase. For each patient, two swabs were collected. Gram staining was performed using one swab. 5% sheep blood agar and Mac Conkey agar plates were inoculated and incubated at 37°C for 48 h. Based on characteristic features, colonies were identified. For some, standard biochemical tests were used.[13,14] Antimicrobial sensitivity testing was carried out by the modified Kirby Bauer disc diffusion method on Muller Hinton agar. Results were interpreted in accordance with Clinical Laboratory Standards Institute guidelines.[15]

The data were compiled and analyzed using a Microsoft Excel sheet. The result has been expressed in percentages. The incidence rate of SSI was calculated.

RESULTS

In the total study duration of 1 year, a total of 238 patients who had undergone major surgeries in the department of general surgery at the designated medical college were included in the study. After fitting all the selection criteria, 152 patients were included in the study.

Superficial SSI was detected in 58 patients, resulting in an incidence rate of 38.2%. The age of patients varies from 18 to 82 years, with a mean age of 47.7 ± 21.6 years. There was a female preponderance observed, with a male-to-female ratio of 0.76:1. Table 1 gives a detailed age and gender distribution of the study population. Among the study participants, 14 patients had known diabetes, 28 had

anemia, and 32 had hypoalbuminea. The SSI rate is hence calculated to be 24.1%, 48.3%, and 55.2%, respectively. On running the test of association, there was no significant association noted between the development of SSI and these conditions. Other risk factors known to be associated with the incidence of SSI are documented in Table 2.

Among the 58 patients' samples, 65 aerobic bacterial colonies were isolated. Of which, *Staphylococcus aureus* and *Escherichia coli* were the commonest organisms [Table 3]. All 65 bacterial isolates underwent antimicrobial susceptibility testing. Results are detailed in Table 4.

DISCUSSION

Although the recent past has seen tremendous advances in terms of infection control, SSIs continue to be an issue of concern for the medical fraternity. The majority of cases occur among hospitalized patients. The reports on the rate of incidence of SSIs varies from as high as 41.9% to as low as 2.5%.[16] The incidence of SSI in the current study was noted to be 38.2%. Reports from Indian researchers have been shown to have SSI rate from 6.1% to 38.7%.[16-19] This is much higher than the incidence reported from developing nations.[20] This may be because of poor infection control measures, poor general cleanliness, and overburdened health-care facilities. The presence of comorbidities among the study participants also played a key role.

Table 1: Distribution of cases of surgical site infection based on morphotypes and age groups

Age group	Morphocytes			Total
	Monomicrobial	Polymicrobial	Sterile	
18–30 years	1	0	7	8
31–40 years	11	1	21	33
41–50 years	16	5	31	52
51–60 years	10	3	19	32
>60 years	7	4	16	27
Total	45	13	94	152

Table 2: Status of various known risk factors of SSI among the study subjects

Risk factor	SSI		P-value
	Yes (58)	No (94)	
Body mass index (>30 kg/m^2)	41	46	>0.05
Diabetes (Yes)	10	6	>0.05
Smoking (Yes)	27	15	>0.05
Anemia (Yes)	31	17	>0.05
Preoperative hypoalbuminemia (Yes)	43	18	>0.05
Blood transfusion (Yes)	39	22	>0.05
Drains (Yes)	33	19	>0.05
Operative time (>2 h)	48	15	>0.05
Clean and contaminated wounds	19	72	>0.05

SSI: Surgical site infection

Table 3: Obtained bacterial isolates from cases of surgical site infections

Isolated organism	Number (%) n=65
Staphylococcus aureus	31 (47.7)
Escherichia coli	14 (21.5)
Pseudomonas aeruginosa	8 (12.3)
Citrobacter spp.	7 (10.8)
Acinetobacter spp.	3 (4.6)
Klebsiella spp.	1 (1.5)
Proteus spp.	1 (1.5)

Most of the study participants in the current study were in their 5th decade of life, and there was a female dominance. This is because aging is associated with slower healing, more catabolism, and co-morbid states.[18] Socio-economic status could not be assessed due to the paucity of data, but studies in the past have reported that those from the lower economic section are more prone to develop SSI.[21] We could not find any association between SSI and BMI, while on the other hand, some studies have shown that patients with a higher BMI had more chances of developing SSI.[18,19] The history of the presence of co-morbidities has shown them to play a vital role in the development of SSI as they cause impairment in wound healing.[3,20,21,22] Similarly, smoking tobacco also leads to SSI as it hinders tissue oxygenation and impairs immunity.[23]Longer duration of surgery and placement of drains also attributes to the risk of developing SSI as there is tissue desiccation, longer exposure to pathogens, and a lesser tissue concentration of prophylactic antibiotics.[24]

Globally, the most common causative organism is *S. aureus*, a Gram-positive cocci that has been reported to constitute as high as 54.4% of the cases.[14] The present study also supports similar findings with a predominance of *S. aureus* (47.7%). Consistent reports have been published from other studies. This finding was also supported by other studies.[5,10,12,15,16] *S. aureus* infections have a predominant role among nosocomial infections and further create a grave consequence of being associated with the emergence of methicillin-resistant *S. aureus* strains. Rest 52.3% of the colonies were Gram-negative isolates, of which *E. coli* was the most common (21.5%), followed by *Pseudomonas aeruginosa* (12.3%) and *Citrobacter* spp. (10.8%). This is in tandem with other observations.[4,5,14] *P. aeruginosa* was the most frequently reported cause of SSI in some of the studies.[6,21] Multi-drug resistance is a global problem. In the current study, the antibiotic susceptibility test revealed that the majority of the isolates were resistant to antibiotics. For Gram-positive bacteria, the least level of resistance was noted for vancomycin, teicoplanin, linezolid, and amikacin. A higher degree of resistance was noted among the Gram-negative bacteria. These Gram-negative isolates

Table 4: Antimicrobial sensitivity testing pattern of bacterial isolates from samples obtained from patients of surgical site infection

Antibiotic	Percentage of sensitive colonies						
	Staphylococcus aureus (31)	*Escherichia coli* (14)	*Pseudomonas aeruginosa* (8)	*Citrobacter* spp. (7)	*Acinetobacter* spp. (3)	*Klebsiella* spp. (1)	*Proteus* spp. (1)
AMP	83.9	78.6	100	100	66.7	100	100
AMC	32.3	78.6	87.5	100	66.7	100	100
AMK	6.5	14.3	50	14.3	33.3	0	0
AZT	-	78.6	75	100	66.7	100	100
CFP	-	78.6	-	100	66.7	100	100
CFT	-	-	87.5	-	-	-	-
CTR	22.7	42.9	87.5	42.9	33.3	100	100
CFX	16.1	-	-	-	-	-	-
CIP	32.2	42.9	100	29.6	33.3	100	100
GEN	16.1	42.9	77.8	42.9	66.7	100	
LNZ	3.2	-	-	-	-	-	-
MRP	-	14.3	25	14.3	0	0	0
PIP	-	14.3	-	-	-	-	-
PTZ	-	-	25	14.3	33.3	100	0
TEC	0	-	-	-	-	-	-
VAN	3.2	-	-	-	-	-	-

had resistance up to 100%. Effective drugs for the isolates in this study were meropenem, piperacillin-tazobactam, and amikacin. Most resistance was noted for ampicillin, amoxicillin-clavulanate, and cefotaxime.

Limitations of the study

This study was a single centre study with a comparatively small sample size. Moreover, some of the risk factors of SSI could not be included due to paucity of resources. There was an associated attrition bias in the study.

CONCLUSION

Improved preoperative evaluation of the need for antibiotic coverage, hygienic practices, and induction training of health care providers are some of the measures that may help to reduce SSI incidence. The study also focused on some of the known risk factors for SSI. Including medical comorbidities was one of the strengths of the study. More studies on SSI are needed, as it incurs huge out-of-pocket expenditures for the health system. A more stringent SSI surveillance system settlement connecting all urban and rural setups is lacking in our system, unlike in developed nations. Private practitioners at the primary level may be added to the system. It may aid in early diagnosis and, hence, better management, as well as strengthen the health database.

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