

## Original Research Article

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# A study of surgical site infections in a tertiary care hospital

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## ABSTRACT

**Background:** Health care-associated infections remain as an important public health concern. Surgical site infections (SSIs) are known to be one of the most common causes of nosocomial infections worldwide.

**Methods:** A prospective observational study was conducted across 12 months (May 2018-April 2019) in a tertiary care hospital. The present study includes 223 patients who were undergoing clean and clean contaminated surgery in the hospital. Contaminated and dirty surgeries were excluded. The demographic data of the patient, diagnostic criteria used, associated risk factors, use of prophylactic antimicrobial agents, the type and duration of surgery, clinical evaluation of wound and laboratory data was collected. All the pus samples or wound swabs of clinically suspects of SSI cases received in the Department of Microbiology were inoculated and interpreted according to Centre for Disease Control and Infection guidelines.

**Results:** The study included 223 patients who underwent surgery in the hospital. Amongst them 9 (4%) developed SSI. The incidence of SSI was 4.03%. There was a direct relationship observed between the occurrence of SSI and certain co-morbid conditions such as diabetes. It was also observed that prolonged surgeries above two hours and females were more predisposed to develop a surgical site infection.

**Conclusions:** SSIs being one of the most common causes of nosocomial infections. It was also the most important factor responsible for significant morbidity, mortality, unwanted prolonged hospitalization and additional cost of treatment in surgical patients which can be reduced by strictly following the guidelines of infection control along with judicious and rational use of antibiotics.

**Keywords:** Antibiotic susceptibility, Diabetes, Infection, Microbiology, Surgery, Wound

## INTRODUCTION

Health care-associated infections (HAIs) remain as an important public health concern. A surgical site infection is an infection that occurs after surgery in the part of the body where the surgery took place. Surgical site infections can sometimes be superficial infections involving the skin only. Other surgical site infections are more serious and can involve tissues under the skin, organs or implanted material.

World Health Organization (WHO) describes hospital acquired infections to be one of the major infectious diseases having a huge economic impact worldwide. These infections affect about 2 million people annually<sup>1</sup> resulting in 5-15% of them requiring hospitalization.<sup>1</sup> Surgical site infections (SSIs) are known to be one of the most common causes of nosocomial infections worldwide.<sup>2</sup>

A SSI contributes to substantial rate of mortality, significant morbidity, considerable prolongation in length

of hospitalization and added treatment expenses. Despite the technical advancements that have been practiced over the past few years in surgical and wound management system, wound infections are still viewed as the most widely recognized nosocomial infections, particularly in patients experiencing surgery. SSIs were estimated approx. 31% of all HAIs, which contributed 20% postsurgical readmissions as well. The situation is more severe in developing countries like India where resources are scarce and staff is always in short supply.<sup>3</sup>

As the control of postoperative complications is an essential component of total quality management, it becomes important to determine the prevalence of surgical site infections, assess the magnitude of the problem and provide a rationale to set priorities in infection control in the hospitals.<sup>4</sup> Attention to the microbiology of SSI has many additional benefits as it may inform the prognosis of individual patients, can allow clinicians to track trends in local antimicrobial resistance patterns, can provide insights into the pathogenesis of SSI and it can aid the prompt recognition of local SSI outbreaks and suggest locally relevant infection-control and SSI-prevention efforts.

The present study was conducted with an aim to study the prevalence of SSIs and various factors associated.

## METHODS

A prospective observational study was conducted from May 2018 to April 2019 in the Department of Microbiology at Bharati Vidyapeeth Medical College and Research Centre, Pune. In this study 223 patients of clean and clean contaminated surgeries from various surgical departments were included.

### **Inclusion criteria**

All the patients admitted to different surgical wards (including orthopedics, general surgery, pediatrics, urosurgery, obstetrics and gynecology and neurosurgery) of the hospital for elective or emergency surgeries of clean or clean contaminated procedures were included.

### **Exclusion criteria**

Contaminated or dirty (infected) surgeries as per the Centre for Disease Control and Infection (CDC) guidelines were excluded.

The demographic data of the patient, diagnostic criteria used, associated risk factors, use of prophylactic antimicrobial agents, the type and duration of surgery, clinical evaluation of wound and laboratory data was collected.

History of pre-existing diseases especially diabetes was noted. The patients were monitored in the post-operative period and various signs of SSI were noted. All the pus samples or wound swabs of clinically suspected of SSI cases received in the Department of Microbiology were immediately inoculated and streaked onto 5% sheep blood agar and MacConkey agar. Plates were incubated aerobically at 37°C for 24 hours. Isolated organisms will be processed and identified according to standard bacteriological techniques.<sup>5,6</sup> The antimicrobial susceptibility testing of the isolated organisms was done by Kirby Bauer's disc diffusion test/Vitek as per CLSI guidelines.<sup>7</sup>

The surgeries were classified into various categories and presented into Table 1.

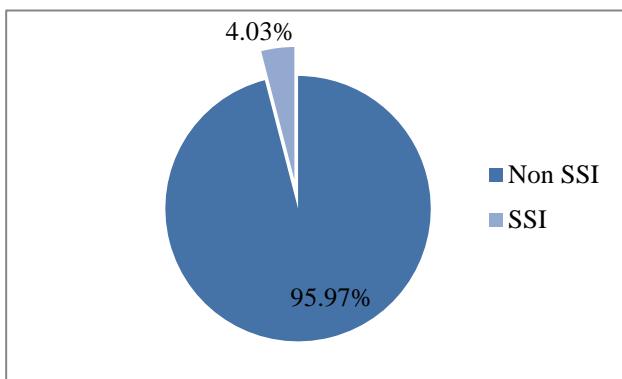
**Table 1: Classification of surgery.**

<b>Wound type</b>	<b>Definition/major characteristics</b>
<b>Clean</b>	An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tracts are not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow non penetrating (blunt) trauma should be included in this category if they meet the criteria.
<b>Clean-contaminated</b>	Operative wounds in which the respiratory, alimentary, genital or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.
<b>Contaminated</b>	Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (for example, open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered, including necrotic tissue without evidence of purulent drainage (for example, dry gangrene) are included in this category.
<b>Dirty or infected</b>	Includes old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation.

The data was entered in Microsoft Excel and analysed. The values are presented in number and percentages.

## RESULTS

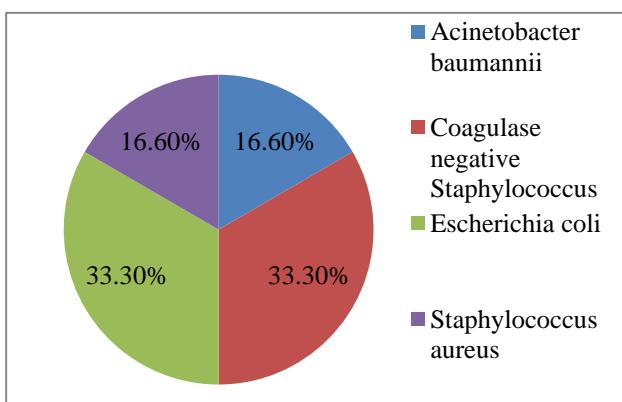
Of the total 223 patients who underwent surgery in the hospital, amongst them 9 (4%) developed SSI. The incidence of SSI was 4.03%.



**Figure 1: Incidence of SSIs.**

**Table 2: Factors associated with SSIs.**

Characteristics		SSI/Total	%
Gender	Male	1/115	0.86
	Female	8/108	7.40
Age (in years)	<12	0/11	0
	12-19	0/16	0
Duration of surgery (in hours)	20-29	1/53	1.8
	30-39	4/40	10
Operation category	40-49	3/47	6.3
	50-59	0/25	0
Associated risk factors	>60	1/31	3.2
	<2	5/128	3.9
	≥2	4/95	4.2
	Elective	7/205	3.4
	Emergency	2/18	11.10
	Diabetic	2/39	5.10
	Non-diabetic	7/184	3.80



**Figure 2: Causative organism for SSIs.**

Of the 223 patients in the study, 115 were males and 108 were females. There was female preponderance in SSI patients. Out of the 115 male patients 1 (0.86%) patient developed surgical site infection, while out of the 108 female patients 8 (7.4%) patients developed surgical site infection. The ages of patients ranged from 1 year to 96 years. Out of the 9 patients who developed SSI, 1 patient was in the age group of 20-29, 4 patients were in the age group of 30-39, 3 patients were in the age group of 40-49 and 1 patient was above 60 years of age. The incidence of SSI in elective surgery was 3.40%. The incidence of SSI in emergency surgeries was 11.10%. The duration of surgery ranged from 15 minutes to 5.8 hours. 4 patients with SSI had surgery lasting for 2 or more hours while 5 had surgery lasting for less than 2 hours. Rate of SSI in surgeries with duration below 2 hours was 3.90%, SSI rate in surgeries lasting more than 2 hours was 4.20%. There were 39 diabetic patients in this study. Out of these 39 diabetic patients 2 (5.1%) developed SSI. There were 184 non diabetic patients. Out of them 7 (3.88%) developed SSI. Out of the 9 cases of SSI, 3 showed no growth while 6 showed growth as shown in Table 2.

Predominant isolates causing SSI were Coagulase negative *Staphylococcus* 2 out of 6 (33.33%) and *E. coli* 2 out of 6 (33.33%), followed by *Acinetobacter baumannii* and *Staphylococcus aureus* 1 in each (16.66%) as shown in Figure 2.

### Antibiotic susceptibility test of the isolated organisms

*Staphylococcus aureus* isolate was methicillin resistant *Staphylococcus aureus*. It was sensitive to vancomycin and linezolid. Two isolates of coagulase negative *Staphylococcus* were methicillin resistant. One isolate of *E. coli* was ESBL producer and other was non ESBL producer. *Acinetobacter* was sensitive to only colistin and tigecycline.

## DISCUSSION

Post-operative wound infection still remains one of the most important causes of morbidity and is one of the most common nosocomial infections.<sup>8</sup> Kumar et al in a similar study reported the incidence rate of SSI as high as 12.5% but in our study the incidence of SSI was only 4%.<sup>9</sup> Although infection rate varying from 20% to as high as 76.9% have been reported. Our rates are comparable to studies done in United Kingdom (3.1%) and Netherlands (4.3%).<sup>10,11</sup> With good infection control practices, our rates are much lower than other studies as mentioned above. Out of 115 male patients 1 (0.86%) patient developed surgical site infection, while out of 108 female patients 8 (7.4%) patients developed surgical site infection. In our study there was female preponderance in SSI patients because more number of infections was seen in obstetrics and gynecology surgeries. This was comparable to other studies.<sup>12</sup> The study also revealed that maximum infection (44.4%) were seen in the age group of 30-39. Maximum number of lower section caesarian section (3 cases) and total abdominal hysterectomy and bilateral salphingo oophorectomy- (3 cases) developing SSI might be the explanation for the above result.

In our study high incidence rate (11.1%) in emergency surgery as compared to elective surgery (3.4%) was noted. Other studies have reported similar results and even up to as high as 17.7%. Further studies showed that emergency operations significantly increased the rate of SSI. The effect of emergency surgery on the rate of SSI is likely to be due the fact that emergency procedures lack routine pre-op preparations which reduce the rate of SSI (e.g., control of diabetes) and most of emergency operations involve contaminated areas such as the bowel and the perianal region.<sup>13</sup>

In the present study, SSI rate in surgeries extending for more than 2 hours was 4.2%, and in surgeries lasting for less than 2 hours it was 3.9%. This is comparable to study done by Ansul et al. Prolonged duration of operation results in increased exposure of operation site to air, prolonged trauma, stress of prolonged anesthesia and sometimes blood loss. Regarding associated risk factors in our series, SSI was significantly higher in diabetic patients (5.1%) when compared to non-diabetics (3.8%). Neumeyer et al also found a higher incidence of SSI among diabetics.<sup>14</sup>

### Organisms causing SSI

Predominant isolates causing SSI were coagulase negative *Staphylococcus* (33.33%) and *E. coli* (33.33%), followed by *Acinetobacter baumannii* (16.60%) and *Staphylococcus aureus* (16.66%).

Ramesh et al reported *E. coli* (20.8%) as the most common organism isolated followed by *S. aureus* (16.1%) from SSI cases.<sup>15</sup> Whereas some studies also

revealed *Staphylococcus aureus* as the most common organism isolated from SSI.<sup>16</sup> The high incidence of gram-negative organisms in the post-operative wound infections can be attributed to be acquired from patient's normal endogenous micro flora. The antibiotic susceptibility of this isolated organism is quite similar even to the patients with non-surgical infections.

## CONCLUSION

SSIs being one of the most common causes of nosocomial infections worldwide pose an important public health concern. It is one the most important factor responsible for significant morbidity, mortality, unwanted prolonged hospitalization and additional cost of treatment in surgical patients. As the control of postoperative complications is an essential component of total quality management, it becomes important to determine the prevalence of surgical site infections, assess the magnitude of the problem and provide a rationale to set priorities in infection control in the hospitals.

### Recommendations

The recommendations of CDC and other national authorities should be followed strictly in hospitals and the operational surveillance system should be strengthened to combat the unwanted SSI all across the globe. The use of antibiotic in post-surgical patients should be targeted towards the prevailing organism in that community which will also help in reducing antibiotic induced bacterial resistance.

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