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Microbiological Profile Of Surgical Site Infections And Associated Risk Factors In A Government Tertiary Care Hospital In Western UP

[1]Dr. Praveen Kumar, [2]Dr. Amit Singh, [3]Dr. Rajesh K Verma, [4]Dr. Dharmendra P Singh, [5]Dr. Satender Saraswat, [6]Dr. Bhanu P Singh, [7]Dr. Neha Khurana, [8]Dr. Sapna Dalal

[1,2,3,4,5,7]MD Microbiology, [6,8]MD Community Medicine,
[1]Microbiologist, [2,4]Professor, [3]Professor and Head, [4]Senior Resident, [6,7,8]Assistant Professor,
[2,3,4,5,7]Department of Microbiology, [6,8]Department of Community Medicine,
[2,3,4]UPUMS, Saifai, Etawah
[5]SN Medical College, Agra
[6,7,8]Adesh Medical College and Hospital, Shahabad

***Corresponding Author:**
Dr. Neha Khurana
Assistant Professor, Department of Microbiology, Adesh Medical College and Hospital, Shahabad

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Abstract

Context: Surgical site infections are the third most common type of nosocomial infection that complicates 300000-500000 surgeries per year in the USA alone making it a public health problem.

Aim: To study the incidence of SSI in surgical wards of our institute and to identify the risk factors associated with the development of SSIs.

Material and Methods: This study was carried out from November 2019 to June 2021 with 105 patients who underwent surgery in the Department of General Surgery of our institute. A predesigned proforma was used to collect the sociodemographic and clinical data. Surgical sites were examined and graded. Under aseptic precautions sample was taken from the infected surgical site for bacteriological culture. Data was analyzed using SPSS 23 Software.

Result: Among 105 patients, 31 developed surgical site infection. Among 31 positive cases, 11 were female and 20 males. It was found to be more common among aged males who are overweight, anaemics, diabetics, hypertensive, patients with longer preoperative waiting time and have undergone blood transfusions.

Conclusion: The incidence of SSI was 29.52%. Age, gender, BMI, Co-morbid conditions like Anemia, Hypertension and Diabetes mellitus, Blood transfusion, and pre operative waiting period were risk factors for SSI. *E. coli* was the most common isolated organism followed by *Staphylococcus* spp.

Keywords: SSI, Surgery, BMI, SMOKING

Introduction

Among various nosocomial infections, surgical site infection (SSI) is directly related to surgical procedure and accounts for approximately a quarter of all nosocomial infections.[1] It complicates around 300000-500000 surgeries per year in the USA alone and are believed to result in 5-10 billion of excess health expenditures and increased hospital stay[2,3]

The occurrence of SSI largely depends upon the contamination of wound site, pathogenicity of the microorganisms balanced against the host's immune response[4-6]. The organisms triggering SSI can be endogenous or exogenous but are usually derived from the endogenous environment, that is the patient skin or opened viscus. Surgical instrument or theatre environment contaminates the site during operation

which are the exogenous causes[7,8]. Surgical wound infections may occur shortly after surgery or several days post-operatively and the site of infection may be limited to the suture line or may extend into the operative site [9].

A positive culture from the surgical site does not necessarily indicate infection. Also, many wounds are colonized by bacteria, whether infected or not. Infected wounds may not yield pathogens by culture, owing to the fastidious nature of some pathogens, or if the patients are on antimicrobial therapy[10].

SSI rates have become a universal measure of quality in hospital based surgical practice since they are probably the most preventable of all nosocomial infections. Therefore, many countries have made it mandatory to report SSI rates. The burden SSIs is significantly underestimated because of most hospital truncate SSI surveillance at the time the patient leaves hospital, which is problematic because many infections emerge following discharge[11].

In this context it becomes important to determine the prevalence of SSIs, assess the magnitude of the problem and provide a rationale to set priorities in infection control in the hospitals.

This study was done to estimate the incidence of surgical site infection in general surgeries at a rural tertiary care hospital while identifying risk factors and prevalent microorganisms.

Material and Methods

This was a prospective study; information was gathered, including clinical data, sociodemographic characteristics, underlying medical conditions, clinical symptoms and presence of risk factors for SSI in 105 general surgery patients between November 2019 to June 2021 from the patients admitted in the Department of General Surgery of our institution.

All the patients included in the study were monitored at frequent intervals for development of SSI using clinical and microbiological criteria.

Sample processing: Under all aseptic precautions, pus from surgical wound site was collected in two sterile swab sticks and was transported the Bacteriology laboratory. One swab stick was used for making smear on clean, grease free glass slide. The smear was heat fixed and then stained by Gram's method and observed under oil immersion objective lens. The second swab sticks received in the laboratory was dipped in BHI broth for 4hour, then inoculated on Blood agar and MacConkey agar. After inoculation, the plates were incubated aerobically at 37^{o}C for 18-24 hours. The culture was read after 18-24 hours in well illuminated room for growth of microorganism. Identification of bacteria was done, based on colony characteristics, Gram's staining, biochemical tests such as catalase, coagulase, cytochrome oxidase, etc. Confirmation of species was done by automated microbiology identification and AST system like VITEK-2 COMPACT (Biomerieux, France).

Result

During the study period 105 patients underwent surgeries in the department of general surgery of our institute. Among the 105 patients, 31 developed surgical site infections giving cumulative incidence of 29.52%. Out of 31 positive cases, 20 were male & 11 were female. The age of study subjects ranged between 3 years to 78 years with majority belonging to 20 to 29 accounting for 28 cases. Out of these 28 patients only 7 (25%) developed SSI whereas 44.44% positivity was seen in the age group 60-69 years. There is a significant relation between the incidence of SSI and increased age. In the present study, high BMI (>25) was observed in 54.84% cases and was associated with increased incidence of SSI (p=0.0002). It was observed that the SSI rate was 22.22%, 32.73% and 35.71% respectively when operation was initiated <12 hr., 12-24 hr. and >24 hr of visiting the hospital.

In the present study, it was observed that factors like anaemia, hypertension and diabetes mellitus were associated with the increased rate of surgical site infection. Incidence of infection among blood transfused patients is 40.91%, whereas the patients who did not receive blood transfusion is 10.26%. Repair of Ileal perforation was the most frequent surgery performed.

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Table 1: Factors Associated With SSI

Factors	SSI Yes(%)	SSI No(%)	P-Value	Chi square
Age (Group)				
<10	1(20.00%)	5(80.00%)		
10-19	4(36.67%)	7(63.63%)		
20-29	7(25.00%)	21(75%)		
30-39	4(21.05%)	15(78.94%)		
40-49	5(33.33%)	10(66.67%)		
50-59	5(41.67%)	7(58.33%)		
60-69	4(44.44%)	5(55.55%)		
>70	1(16.67%)	5(83.33%)	0.428	7.00
Gender				
Male	20(28.57%)	50(71.43%)		
Female	11(29.52%)	24(68.57%)	0.762	0.09
BMI				
<25	14(18.92%)	60(81.08%)		
>25	17(54.84%)	14(45.16%)	0.0002	13.547
Co morbidity				
Anemia Yes	24(41.38%)	34(58.62%)	0.003	8.75
No	7(14.89%)	40(85.11%)		
Hypertension				
Yes	11(47.83%)	12(52.17%)	0.029	4.74
No	20(24.39)	62(75.61%)		

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DM				
Yes	6(33.33%)	12(66.67%)	0.697	0.152
No	25(28.74%)	62(71.26%)		
Blood transfusion				
	27(40.91%)	39(59.09%)	0.0008	11.069
No	4(10.26%)	35(89.74%)		
Smoking				
Yes	12(44.44%)	15(55.56%)	0.048	3.88
No	19(24.36%)	59(75.64%)		

Pre-op waiting				
<12h	8(22.22%)	28(77.78%)	0.483	1.451
12-24h	18(32.73%)	37(67.27%)		
>24h	5(35.71%)	9(64.29%)		
ASA Score				
I 9(16.98%)		44(83.02%)	0.0043 10.907	

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II	17(40.47%)	25(59.53%)	
III/IV	5(50%)	5(50%)	
Type of wound			
Clean	2(11.76%)	15(88.23%)	
Clean.contaminated	12(30.00%)	28(70.00%)	
Contaminated	17(35.42%)	31(64.58%)	

Fig 1: Rate Of Infection In Various Surgeries

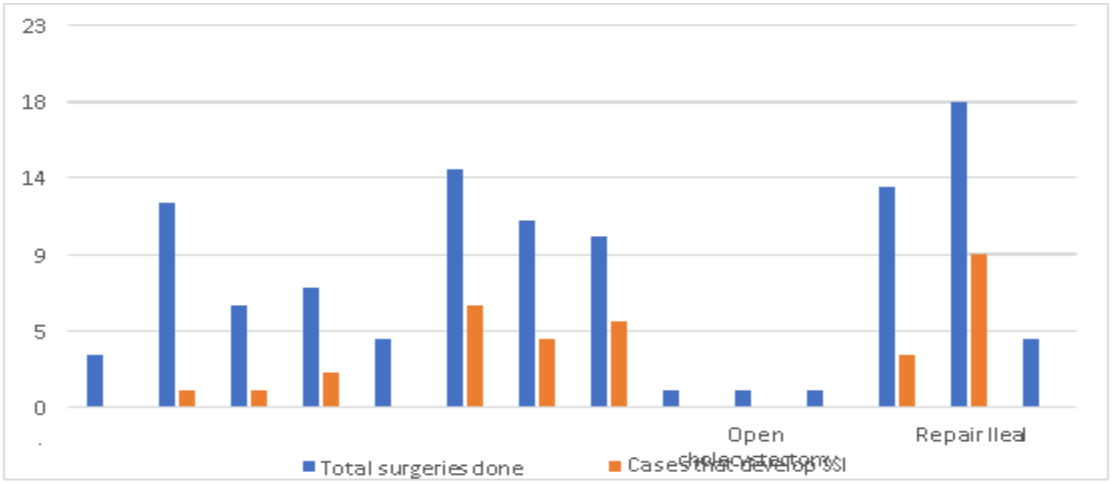
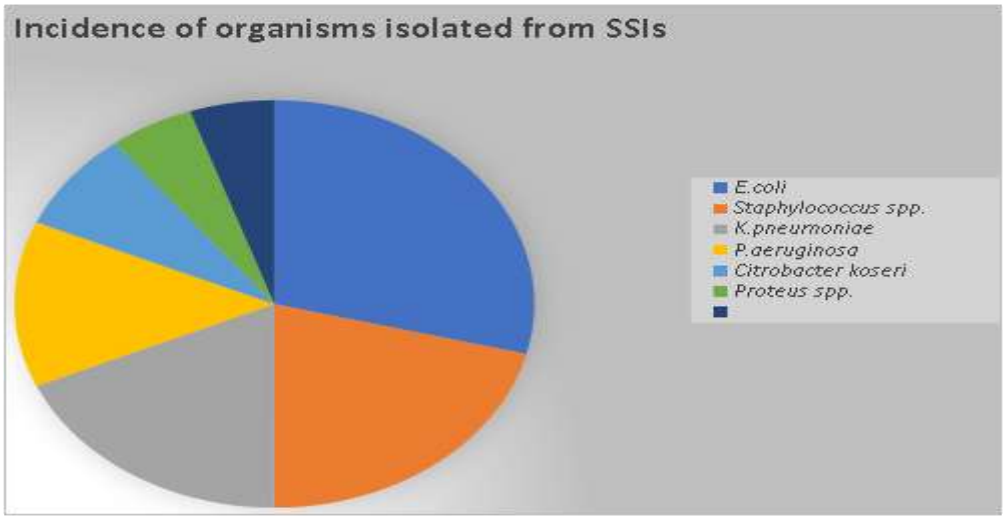


Fig 2: Incidence Of Organism Isolated From SSI



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In relation to different types of wounds, by the degree of contamination, it was observed that among 105 cases 17 were clean wounds; SSI developed only in 2 (11.76%) of these clean wounds. There were 40 clean contaminated cases, among them SSI occurred in 12 (30%); Whereas SSI developed in 17 (35.42%) among 48 contaminated wounds. In relation to ASA score, it was observed that grading of ASA score increases with increase SSI rate.

Monomicrobial etiology was associated with 77.41% cases and polymicrobial etiology was associated with 22.58% cases. Figure 2 shows that E.coli was the commonest organism isolated causing 28.94% cases of SSI followed by Staphylococcus spp. (21.05%).

Discussion

SSI is a significant marker for evaluating the care provided by a healthcare institution so it is important to know the incidence of SSI; knowing that necessary actions can be taken to decrease the burden. In this study, the overall infection rate of the surgical site was 29.52% which is in concordance to other studies in which it varies from 2.5% to 41.9%[1,12-15.] Among 31 positive cases, 20 (19%) were males and 11 (10.5%) were females. In the study conducted by Naveen *et al.* at Mysore, Karnataka[16] the incidence of SSI among male patients was 29%, while it was 10% among females, and this result was similar to our findings. In a study conducted at Aligarh, findings were observed with 18% incidence in male patients and 27% in female patients[11] this result is completely contradicted by our results.

In the present study, the age of the patients ranged from 3 years to 83 years. The mean age of the cases in our study was 35.5years. The maximum number of study participants belonged to the age group 20-29 years whereas the highest number (44.44%) of SSI patients belonged to the age group of 60–69 years followed by 50–59 years (41.67%). The rate of SSI increases with increase in age. This may be due to decreased immunity with older age. Our data is in concordance to other studies which also shows the same result[15,17-20].

In our study, a statistically significant relation was found between high BMI (>25) and incidence of SSI. Similar results were obtained in the study performed by Xue *et al.*, Ashby *et al.* and Giles *et al.* also demonstrated that higher BMI was a significant predictor of SSI[19-21]. This could be due to thick layers of subcutaneous fat in obese patients which increases the risk of formation of dead space upon wound closure. This could lead to increase in tissue necrosis and poor vascular perfusion that hinders the oxidative killing of bacteria by neutrophils and results in wound infection.[29]

With regard to the time between admission of the patient at the hospital to the time when surgery is performed, the rate of SSI increases with the time lapse. It was observed that the SSI rate was 22.22%, 32.73% and 35.71% when operation was initiated <12 hr., 12-24 hr. and >24 hr. later respectively. This finding is consistent with Naveen *et al*[16]. This may be due to prolonged preoperative hospital stay which causes to colonization with antimicrobial resistant microorganism and itself directly affects patient's susceptibility to infection, either by lowering host resistance or by providing increased opportunity for ultimate bacterial colonization[15].

In the present study, it was observed that factors like anaemia, hypertension and diabetes mellitus were associated with the increased rate of surgical site infection. Cause being the reduced immunocompetence, wound healing factors, hyperglycemia and preexisting infections.

In the present study, smoking was associated with the increased rate of SSIs as compared to non-smokers. Similar findings and association with SSIs also reveal in other studies[22,23]. Among smokers, numerous factors are responsible for the increased risk of postoperative complications. Nicotine, nitric oxide, and carbon monoxide directly alter the wound healing process. Smoking causes endothelial dysfunction, inflammation and progression of atherothrombotic disease. Moreover, smokers have evidence of an impaired systemic immune response with suppressed immunoglobulin levels, an altered CD4 to CD8 cell ratio, and reduced phagocytic activity.[24]

A dose response relationship was noted in the association between blood transfusion and surgical site infections in the present study. Majority of the transfusions were intra-operative. Most of the discussion in the literature surrounding the immunomodulatory effects of transfusion implicates donor leukocytes.[25,26] To this end, leukoreduction has thought to potentially be helpful.

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In relation to different types of wounds, by the degree of contamination, it was observed that infection rate increased with degree of wound contamination. These findings were consistent with Cruse and Frood study in 1980[27].

In relation to ASA score, it was observed that the ASA index for the patients' clinical states before surgery was statistically associated with SSIs. The chance of developing SSI increases with ASA score increase. These findings were consistent with the findings of study by Rodrigues de Carvalho RL *et al.*[28]. Some authors have shown that SSI rates are higher in patients who are more debilitated[25] or have systemic diseases, such as Diabetes Mellitus. Such poorly controlled factors lead to a worsening of the general clinical status of the patients, which implies a higher scoring on the ASA index, making it more susceptible to infections, including SSI.[28]

The microbiological profile found among the patients who developed SSI was similar to patients that underwent general surgeries, in which E.coli and *Staphylococcus spp.* was the main organisms responsible for the development of SSI.[11,29]

Conclusion

The incidence of SSI was 29.52%. Age, gender, BMI, Co-morbid conditions like Anemia, Hypertension and Diabetes mellitus, Blood transfusion, and pre operative waiting period were risk factors for SSI. *E. coli* was the most common isolated organism followed by *Staphylococcus* spp.

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