

## **Surgical Site Infections: A Prospective Study in a Surgical Department of a Tertiary Care Center**

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### **Original Research Article**

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#### **Article History**

*Received: 28.09.2018*

*Accepted: 15.10.2018*

*Published: 30.10.2018*

#### **DOI:**

10.36347/sjams.2018.v06i10.045



**Abstract:** SSI is the index of the health care system of any hospital. With increasing incidence of hospital acquired infections and multidrug resistance, a meticulous and periodic surveillance of various hospital acquired infections particularly surgical site infections is called for. This study was undertaken because SSI is one of the topmost priorities among all the nosocomial infections. This prospective study was conducted in the Department of General Surgery, GCS Medical College and Research Centre, Ahmedabad over a period starting from July 2016 to December 2017. We studied all surgical cases operated with primary closure in our unit for surgical site infections. Any case operated outside our hospital or not closed primarily was excluded from the study. A total of 1026 cases were operated in our surgical unit, out of that 712 cases which were fulfilling the criteria were included in this study. Out of total 712 surgical cases studied over a period of 18 months, the surgical site infection rate was found to be 8.15%. Clean surgeries showed minimum risk of infection. Escherichia coli, Klebsiella pneumoniae and Pseudomonas aeruginosa were the common pathogens. It is the need of hour to address the issue of surgical site infections and take stringent measures to curb them.

**Keywords:** SSI, clean surgery, nosocomial.

### **INTRODUCTION**

Nosocomial infections or healthcare associated infections occur in patients under medical care. Frequently prevalent infections include central line-associated bloodstream infections, catheter-associated urinary tract infections, surgical site infections and ventilator-associated pneumonia [1].

Surgical site infections (SSI) are one of the most common nosocomial infections and they have been shown to be the leading cause of operation-related adverse events [2]. SSI frequently cause morbidity and rarely mortality among the patients in hospitals. Several studies have demonstrated an increased length of hospital stay and financial burden for patients with SSI compared with non-infected patients having similar surgical procedures [3]. The incidence varies from hospital to hospital and across different countries too.

According to the United States centers for disease control and prevention, the criteria for diagnosis of SSI are as following:

Infection less than 30 days after surgery plus one of the following:

- Purulent discharge
- Diagnosis of superficial SSI by surgeon
- Symptoms of erythema, pain and local edema.

In case of implant surgery SSI includes deep space infections upto 1 year post operatively [4].

Total quality management in hospitals is gaining emphasis these days. Control of postoperative complications is an essential and integrated component of total quality management [5]. In this context it becomes important to determine the incidence of surgical site infections, assess the magnitude of the problem and provide a protocol to set priorities in infection control in the hospitals. Hence the present study had been undertaken.

**AIM AND OBJECTIVES**

To study the incidence of SSI and to identify the risk factors for the development of SSI in the surgical ward of GCS Medical College, Hospital & Research Centre.

**MATERIALS AND METHODS**

A total of 1026 cases were operated in our surgical unit, Department of General Surgery, GCS Medical College Research Centre, time period ranging from June 2016 to December 2017, out of that 712 cases which were fulfilling the criteria and followed regularly were included in this study.

**Inclusion criteria**

- All surgeries operated and closed primarily in our department at our institute over the given time period.

**Exclusion criteria**

- The patients operated elsewhere and then admitted for further management in our institute.
- The surgeries where wound couldnot be closed primarily.

- Patients who did not give the consent for the study.

Following the surgical procedure, patient was examined for any systemic signs of infection like fever; malaise etc. and the surgical sites were examined for erythema, edema or purulent discharge if any. Once clinical diagnosis of SSI was made, culture was sent. Antibiogram was sought in cases of positive culture sensitivity reports to evaluate the sensitivity pattern of organisms. Demographic characteristics like age and sex were noted. Variables like co-morbid conditions, prophylactic antibiotic use etc were studied in the infected and non-infected groups. The risk factors were analyzed using the Chi-square analysis at *p* value less than 0.05. Patients who did not comply or could not be followed up were excluded from the study.

**RESULTS**

During the study period of 18 months stated above, out of 712 patients who were fulfilling the criteria and enrolled in the study after written informed consent, 58 developed surgical site infections giving a cumulative incidence of 8.15% (58/712).

**Table-1: Correlation of various factors with SSI**

Factors (n= Number of patients)		Witho ut SSI	With SSI	Percentage	Chi square Value	P Value	Significance at p < .05
Age (years)	1-20 (101)	96	5	4.95%	2.58	0.27	Not significant
	20-60 (543)	498	45	8.83%			
	>60 (68)	60	8	11.76%			
Sex	Male (452)	414	38	8.4%	0.11	0.73	Not Significant
	Female(260)	240	20	7.7%			
Category of Surgery	I (188)	184	4	2.12%	67.73	<0.00001	Significant
	II (330)	316	14	4.24%			
	III (118)	100	18	15.2%			
	IV (76)	54	22	28.9%			
Anemia	Yes (61)	46	15	24.59%	24.11	<0.00001	Significant
	No (651)	608	43				
Diabetes	Yes (76)	63	13	17.10%	9.13	0.0025	Significant
	No (636)	591	45				
Malignancy	Yes (69)	60	9	13.04%	2.45	0.117	Not significant
	No (643)	594	49				

The age of study subjects ranged between 5years to 67 years. Out of those, majority 543 (77.58%) patients belonged to 21-60 years group, out of which 45(8.28%) patients got infected. In second group of 101 patients having age below 20 years, 5(4.95%) patients developed SSI. And the remaining 68 patients having age more than 60 years, 8(11.76%) patients developed surgical site infection. It was found that the frequency of SSI increased with age, though it wasn't statistically significant. Though this interpretation might be due the less number of patients, it may require even larger sample size [Table 1].

As far as gender is concerned, there were 452 males and among them 38(8.4%) got infected. Among the 260 women 20(7.69%) developed SSI. This difference in incidence was not statistically significant, though there was slightly less incidence of SSI in female as compared to male [Table 1].

All patients were categorized according to different categories of surgical wound.<sup>6</sup> Out of 188 patients in category I (Clean),4(2.12%) patients developed SSI. In second group of 330 patients in category II (Clean Contaminated), 14(4.24%) patients developed SSI. Out of 118 patients in category III

(Contaminated), 18(15.2%) patients developed SSI and in the category IV (Dirty-Infected), 22(28.9%) patients out of total 76 patients developed SSI. The difference in each category was statistically significant and the rate of infection was highest in category IV and was lowest in category I as the category I include the clean surgeries and category IV includes the dirty-infected surgeries. The Chi square value was 67.73 and the P value was < 0.00001 at the confidence limit 0.05, the value suggested that the data is highly significant [Table 1].

Out of various co-morbid conditions, our study focused on anaemia, diabetes mellitus and malignancy in particular. Hemoglobin of 13 and 12gm/dl were considered as the cut off points for the diagnosis of anaemia in male and female respectively. Those with less than 10gm/dl were considered severely anemic and these were the ones who received maximum blood transfusions. Among 61 anaemic patients who underwent surgery 15(24.59%) developed SSI. The Chi square value was 24.11 and the P value was <0.00001 at confidence level of 0.05 suggestive of highly significant data.

Majority of the diabetic patients in our study were not taking medications regularly. This was one of the factors for their increased preoperative waiting period, which might have also added the risk of SSIs. 13(17.10%) patients of the 76 diabetics developed SSI. The Chi square value was 9.13 and the P value was 0.0025 at confidence level of 0.05 suggestive of highly significant data.

In our study patients often had malignancies like carcinoma of breast, head and neck malignancy or GI malignancy etc. Among the 712 study subjects 69 patients had malignancy, out of that 9(13.04%) patients developed SSI. The Chi square value was 2.45 and the P value was 0.117 at confidence level of 0.05 suggestive of not so significant data [Table 1].

All the SSI patients had culture sent from the discharge site. Among these 58 patients, 45 showed growths of colonies, in rest of the cases no organism was isolated. *Escherichia coli* was the predominant organism isolated from the surgical sites accounting for 31% of cases, followed by *Klebsiella* (22.4%), *Staphylococcus aureus*(12%), *pseudomonas* (12%), *Acinetobacter* (5.2%), *Enterococcus* (3.4%). Some surgical sites had mixed infections involving multiple organisms suggestive of polymicrobial etiology in SSI.

Organisms isolated from the SSI showed resistance to most of the group of antibiotics used in the surgery department of our hospital. Ampicillin (86.24%) and Amoxicillin(81.03%) encountered majority of the resistance followed by Cefalexin(58.62%) and Tetracyclin(41.43%). In some cases resistance of ciprofloxacin was also found, though

the resistance of Tigecycline, Polymyxin and Colistin was not found. The commonly used antibiotics like Amikacin, Ceftriaxone and Cefotaxime also encountered resistance and this is a matter of concern.

Once a SSI developed, antibiotics were changed empirically or according to the culture and sensitivity test reports. Adequate wound management in terms of stitch removal, debridement, daily dressing was carried out. Co-morbid conditions like diabetes, anaemia were taken care of. Despite these measures 45(77.5%) patients with SSI required average of additional 9 days (6 to 15 days) stay in ward and were completely healed at the time of discharge. 13(22.5%) patients went home with SSI still persisting and they get cured in 15 to 32 days, average 19 days. All the patients followed up on regular OPD days twice a week and one patient had to be operated again to control SSI.

## DISCUSSION

Post-operative wound infection still remains one of the most important causes of morbidity and is one of the most common nosocomial infections in surgically treated patients. The present study was carried out among 712 surgery cases in the tertiary care teaching hospital at Ahmedabad, Gujarat. The rate of SSI varies greatly worldwide and from hospital to hospital. The rate of SSI varies from 2.5% to 41.9% as per different studies. The incidence of SSI in the present study is 8.15%. In some other studies like Khairy *et al.* [7] it was 6.8% and in Shahane V *et al.* [8] it was 6% so it is in correspondence like other studies worldwide.

The rate of SSI increases with the increase in age. In the current study a higher proportion of SSI was found among the subjects older than 60 years. In studies like Kikkeri Net al<sup>5</sup> the incidence was 9.4%, 32.4%, 63% in age less than 20 years, 20 to 60 years age and >60 years of age respectively. The similar incidence was also noted in Valecha SM *et al.* [9] where 2.56% incidence was noted in age between 20 to 60 years of age and 46.66% incidence in age >60 years. This is comparable to our study. This may be due to poor immune response, existing co morbidities in old patients and reduced compliance with treatment.

In the present study male to female ratio of SSI is marginal. In male it is 8.4% and in female it is 7.7%, so it shows only slightly marginal increase in male SSI. In another study by Khairy *et al.* [7] the incidence in male and female was 6.4% and 7.8% respectively. In Shahane V *et al.* [8] there was a marginal preponderance of male patients developing SSI (7.4%) over female patients with SSI (5.1%). Although the study by Emine Alp *et al.* [10] demonstrated the incidence of 18.76% in males and 10.38% in females and in Kikkeri N [5] it was 29% in males and 10% in females. This variation may be due to the different sample size and different racial populations. Even larger and

generalized study may be required to prove this data statistically.

The incidence of SSI is greatly influenced by the category of the surgery. In present study the lowest rate of SSI was found in category I i.e. clean surgeries (2.12%) and maximum rate of SSI was found in category IV i.e. dirty-infected surgery (28.9%). In category II and category III it was 4.24% and 15.2% respectively. This pattern of increasing rate of infection

from category I to category IV is also seen in other studies. In Pathak A *et al.* [11] it was 1% for category I and reached upto 30% in category IV surgery. Other studies by Khairy *et al.* [7], Inigo JJ *et al.*[15] and Emine Alp *et al.* [10] showed the similar results. Though the rate of SSI may vary in different studies but the consistent crescendo pattern of infection from category I to category IV surgery is clearly evident in all [Table 2].

**Table-2: Comparison of current study with other studies with respect to wound category**

Study	Category I	Category II	Category III	Category IV
Pathak A <i>et al.</i> [10]	1%	9%	--	30%
Khairy <i>et al.</i> [7]	4.6%	--	6.2%	12.5%
Inigo JJ <i>et al.</i> [15]	2.27%	9.17%	11.4%	19.14%
EmineAlp <i>et al.</i> [10]	--	5.2%	23.2%	21.7%
Present study	2.12%	4.24%	15.2%	28.9%

Co-morbid conditions like anemia, diabetes and malignancy were the significant risk factors for SSI. Diabetes and anemia remained significant predictor of SSI in our study and so was observed in Kikkeri Netal[5]. Comparable results were found in various studies involving different surgical procedures.

E. Coli was the predominant organism isolated from the surgical sites followed by Klebsiella, Pseudomonas, Staphylococcus Aureus in the present study. S. Aureus, Acinetobacter, Enterococcus were the other organisms isolated from SSI. The study by Shahane V *et al.* [8] also noted E. Coli as the most common pathogen followed by Pseudomonas and S. Aureus. Also the study by Shah KH *et al.* [12] found the E. Coli as the commonest organism followed by Klebsiella and S. aureus. This frequency of organisms in SSI is almost similar in our study. Although the studies by Owens CD *et al.* [13] and Dohmen PM *et al.* [14] showed the most common organism as S. Aureus. Similarly some other studies outside the India have reported Staphylococcus aureus as the commonest isolate from the postoperative wound infection. Other organisms have shown varied preponderance in different studies. The high incidence of gram-negative organisms in the postoperative wound infections can be attributed to be acquired from patient's normal endogenous microbial flora.

**CONCLUSION**

The incidence rate of SSI in our study was consistent with other studies. Age, gender, comorbid conditions like anaemia, malignancy and diabetes mellitus were risk factors for SSI. E.Coli was the most common organism associated with SSI. Majority of the SSIs were resistant to multiple antibiotics.

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