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A Study on Surgical Site Infections (SSI) and Associated Factors in A Tertiary Care Teaching Hospital

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ABSTRACT

Surgical site infections (SSI) are the most common nosocomial infection and frequently cause morbidity and mortality among inpatients of hospitals. The incidence varies from hospital to hospital. Several factors affect the development of SSI. Objectives:To study the incidence of and identify the risk factors for Surgical Site Infections in the surgical wards of the tertiary care hospital, Chennai. Materials and Methods: Study Period: July to August 2007 Study Subjects: One hundred and eighty patients who underwent various surgeries in the General Surgery department of Tertiary care hospital. A predesigned and pretested proforma was used to collect the data. Surgical sites were examined and graded. Culture and sensitivity testing was done on infected wounds. Data was analyzed using SPSS 13 software. Results: Among 180 patients 39 (21.66%) developed surgical site infections (SSI). Of 39 SSIs 20 were grade 3 and 19 were grade 4 infections. SSIs were found more commonly among the aged, males, underweight and overweight, anaemics, diabetics, hypertensives, patients with longer preoperative waiting time, with multiple blood transfusions and without antibiotic prophylaxis. Age, Sex, BMI, Diabetes mellitus, Blood transfusion and pre operative waiting had univariate statistical signifi cance. Gender, extreme BMI, Diabetes mellitus and Blood transfusion remained independent predictors of surgical site infection in multivariate analysis. Most of the SSIs yielded multiple organisms and Staphylococcus aureus was the predominant. Resistance to tetracycline was most common. Conclusion:The incidence of SSI is high. Gender, extremes of BMI, diabetes mellitus and blood transfusion are the important risk factors for it.

Keywords: Tertiary care hospital, risk factors, surgical site infections

INTRODUCTION

Surgical site infections (SSI) frequently cause morbidity and mortality among inpatients of hospitals. They account for a considerable proportion of nosocomial infections among hospital inpatients. Hence they can act as surrogate markers for nosocomial infections (Watanabe et al., 2008). SSIs are the most common nosocomial infection For surgical patients, and they are the leading cause of operation-related adverse events. Several studies have demonstrated an increased length of hospitalization and the associated financial implications for patients with SSI compared with noninfected patients having similar surgical procedures (Suljagić et al., 2010). The prevalence varies from hospital to hospital and across different countries. When surgical patients with nosocomial SSI died, 77% of the deaths were reported as related to the infection, and the majority (93%) were severe infections involving organs or spaces accessed during the operation. An estimate showed that if a hospital with an annual surgical volume of 10000 operations could reduce their SSIs by half; this would result in an average annual cost savings of approximately $450,000 (Urban, 2009). Total quality management in hospitals is gaining emphasis these days. Control of postoperative complications is an essential component of total quality management. In this context, 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. Not many studies are done in India in this direction. Hence the present study had been undertaken (Eriksen et al., 2003).

Aim and Objectives

1. To study the incidence of Surgical Site Infections in the surgical wards of Sree Balaji Medical College and Hospital,chrompet,Chennai,India.
2. To identify the risk factors for the development of SSIs.
3. To prepare an antibiogram to evaluate sensitivity pattern of organisms causing SSIs.

Materials and Methods

Study subjects One hundred and eighty patients who underwent various surgeries in the General Surgery department of Sree Balaji Medical College and Hospital, chrompet, a tertiary care teaching hospital.

Inclusion criteria:

• Elective surgeries

• Those who stayed for at least seven days post-operatively.

Exclusion criteria:

• Grossly contaminated or infected wounds/procedures

Following the surgical procedure, surgical sites were examined on postoperative day 3 and every 3 days thereafter. Wounds were graded on the following scale: grade 1= normal healing; grade 2 = suture line erythema < 1cm; grade 3 = suture line erythema > 1cm; grade 4 = frank, purulent drainage. Four surgeons did the grading for all the subjects. Cultures were obtained on all wounds determined to be infected or as otherwise clinically indicated. Grade 3 or 4 wounds were considered infected. Wounds from which a positive culture was obtained from physical signs of infection (i.e., fever, inflammation) were also considered infected. Antibiogram was prepared from culture sensitivity reports to evaluate the sensitivity pattern of organisms. Demographic characteristics like age and sex were noted. Variables like BMI, comorbidities, prophylactic antibiotic use, blood transfusion, and preoperative waiting period were compared in the infected and non-infected groups. Statistical analysis was done using Microsoft Excel, SPSS 13 software. Those risk factors that were univariately significant using chi-square analysis at $p < 0.05$ were entered into the binary logistic regression equation to evaluate the risk of each factor when adjusted for other factors.

Results

During the study period, 180 patients underwent various surgeries in the general surgery department of Sree Balaji Medical College and Hospital. Among them, abdominal surgeries constituted the majority (76.11%) followed by limb surgeries. Other categories included thyroid surgeries, lipoma, and other tumor excisions [Table 1].

Table 1: Distribution of surgeries according to site

Surgical site	No. (%)
Abdominal	137 (76.11)
Limbs	29 (16.11)
Others	14 (7.78)
Total	180 (100)

Among the 180 patients, 39 developed surgical site infections giving a cumulative incidence of 21.66%. Out of 39 SSIs 20 were grade 3 infections and responded to change in antibiotic guided by antibiogram. 19 patients developed grade 4 infection and some of them had constitutional symptoms like fever. The age of study subjects ranged between 18 years to 67 years. Majority (64.44%) of them belonged to 18-30 years group. Out of 116 patients in this group 11 (9.5%) got infected. 19 patients were more than 50 years and among them 12(63%) developed surgical site infection. It was found that the frequency of SSI increased with age, which was statistically significant [Table 2]. There were 110(61.11%) males and among them 32(29%) got infected. Among the 70 women 7(10%) developed SSI. This difference in incidence was statistically significant. Majority of the study subjects (133-73.89%) had normal BMI. Among them 10 (7.5%) developed SSI. Out of 24 underweight patients, 18 (75%) developed SSI. Of the 23 overweight patients, 11(47.83%) developed infection of their surgical sites. This difference was found to be statistically significant [Table 2]. Anemia, hypertension and diabetes mellitus were the three comorbid conditions studied. Hemoglobin of 13 and 12 gm% were considered the cut-off points for diagnosing anemia in men and women, respectively. Those with less than 10gm% were considered severely anemic and these were the ones who received maximum blood transfusions. Among 37 anaemic patients who underwent surgery 23 (62.16) developed SSI. The study subjects who knew their diabetic and hypertensive status before admission and those diagnosed after admission were considered diabetics and hypertensive respectively. Majority of them knew their status before admission and majority were not taking medication regularly. This was one of the factors for increasing their preoperative waiting period. It was also found that majority had both conditions. Twenty (83.33%)patients of the 24 diabetics and 17(73.91%) of the 23 hypertensives respectively developed SSIs [Table 2].

Table 2: Factors associated with SSI

Factors		SSI	No SSI	Univariate	Multivariate	
		No. (%)	No. (%)	*P* value	OR (95%CI)	*P* value
Age group (yrs)						
18-30		11 (9.48)	105 (90.52)		1.00	
31-40		12 (32.4)	25 (67.6)	<0.000	1.06 (0.70-1.96)	0.66
41-50		4 (50)	4 (50)		1.02 (0.33-2.80)	0.30
>50		12 (63.15)	7 (36.84)		1.26 (0.89-1.80)	0.87
Gender						
Male		32 (29.1)	78 (70.91)	0.001	1.00	
Female		7 (10)	63 (90)		0.43 (0.31-0.73)	0.003
Body Mass Index (BMI)						
<18.5		18 (75)	06 (25)		1.00	
18.5-25		10 (7.52)	123 (92.48)	<0.000	0.37 (0.26-0.48)	0.006
>25		11 (47.83)	12 (52.17)		1.56 (1.39-2.65)	0.02
Co morbid conditions*						
Anaemia	Yes	23 (62.16)	14 (37.84)	<0.000	1.25 (0.73-1.81)	0.98
	No	16 (11.19)	127 (88.81)		1.00	
Hypertension	Yes	17 (73.91)	06 (26.09)	<0.000	1.13 (0.69-1.92)	0.54
	No	22 (14.01)	135 (85.99)		1.00	
Diabetes mellitus	Yes	20 (83.33)	04 (16.67)	<0.000	1.23 (1.16-3.09)	<0.000
	No	19 (12.18)	137 (87.82)		1.00	
Blood transfusion						
No transfusion		8 (5.7)	131 (94.24)		1.00	
1-3 units		27 (72.97)	10 (27.03)	<0.000	2.02 (1.77-4.80)	0.004
>3 units		4 (100)	00 (00)		6.26 (2.89-9.08)	0.02
Pre operative waiting period						
<2 days		11 (9)	111 (91)		1.00	
2-7 days		16 (53.33)	14 (46.67)	<0.000	1.06 (0.73-1.87)	0.21
>7 days		12 (42.86)	16 (57.14)		1.16 (0.66-1.91)	0.43
Prophylactic antibiotic						
Yes		01 (4.55)	21 (95.45)	0.0375	1.0	
No		38 (24.1)	120 (75.95)		1.08 (0.82-1.17)	0.41

Table 3: Organisms associated with SSI

Organism	Frequency at SSI* No.	(%)#
Staph. Aureus	20	55.56
Pseudomonas	13	36.11
Klb. Pneumonia	10	27.78
Citrobacter	6	16.67
E.Coli	6	16.67
Proteus	5	13.89

Table 4: Antibiogram

Antibiotic	No. of resistant SSIs*#	%
Tetracycline	34	94.45
Erythromycin	26	72.23
Ampicillin	22	61.11
Gentamycin	19	52.78
Amikacin	20	55.56
Cotrimoxazole	19	52.78
Cephalexin	18	50.00
Norfloxacin	16	44.45
Ciprofloxacin	17	47.23
Cefotaxime	16	44.45

Among the 180 study subjects 41(22.78%) patients received blood transfusions. Perioperative, transfusions accounted for major share of these transfusions. Eight (5.7%) patients who did not receive any transfusion developed SSI. Four patients were completely healed at the time of discharge. However, 11(28.21%) patients went home with SSI persisting. One patient had to be operated on again to control SSI and one elderly patient succumbed to septicemia.

Discussion

Postoperative wound infection remains one of the most important causes of morbidity and is the most common nosocomial infection in surgically treated patients. The present study was carried out among 180 elective surgery cases in the tertiary care teaching hospital. The majority of the surgeries were abdominally followed by limb, thyroid surgeries, lipoma and other tumor excisions (Lilani et al., 2005). 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 21.66% even though high, agrees with the various studies. 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 50 years. This is comparable to other studies (Anvikar et al., 1999). This is due to poor immune response, existing co

morbidities in old patients and reduced compliance with treatment. In the present study a signifi cant proportion of males developed SSI compared to females. In another study in Pune, there was a marginal preponderance of male patients developing SSI (7.4%) over female patients with SSI (5.1%). In Aligarh, females (27%) showed preponderance of SSI than males (18%). However, according to Berard F and Gandon J sex is not a pre determinant of SSI risk. In the present study, both underweight (BMI 25.0) have significantly influenced the onset of SSI. Similar results were found by Ashby et al. In a study by Xue et al., and Giles et al., higher BMI was a significant predictor of SSI. Comorbid conditions like anemia, diabetes, and hypertension were the significant risk factors for SSI. Diabetes remained a significant predictor in multivariate anlaysis (Patel et al., 2012). National Academy of Science also reported a higher rate of infection in patients with Diabetes mellitus, which is similar to our study. Comparable results were found in various studies involving different surgical procedures. A dose-response relationship was noted in the association between blood transfusion and SSIs in the current study. Majority of the transfusions were intra or per operative. In a study by Tang et al., blood transfusion was an important risk factor in determining SSI, which is similar to the present study. Allogeneic blood transfusion induces immunosuppression and predisposes to postoperative infection. A prolonged preoperative hospital stay with exposure to hospital environment has been shown to increase SSI risk. Comparable findings were found in the present study. Anvikar A.R. and Lilani S.P. also reported higher rate of SSI in patients with the prolonged preoperative hospital stay. Prolonged preoperative hospital stay leads to colonization with antimicrobial-resistant microorganisms, and itself directly affects patient's susceptibility to infection either by lowering host resistance or by providing increased opportunity for ultimate bacterial colonization. Pre-operative antibiotics are known to decrease incidence of SSI cases. Prophylactic antibiotic usage was not a routine in the studied hospital. Only selected patients who had some infection or other risk factor received antibiotic prophylaxis. When it was not used a large proportion (24%) developed SSI compared to the situations where such prophylaxis was given (Morris et al., 2013). In the present study, S*taphylococcus aureus* was the predominant organism isolated from the surgical sites followed by Pseudomonas and Klebsiella. *E. coli*, C*itrobacter* and *Proteus* were the other organisms isolated from SSIs. Lilani et al., and Mahesh et al., also found the preponderance of Staphylococcus aureus and Pseudomonas in SSIs in their studies. Many studies have reported Staphylococcus aureus as the commonest isolate from the postoperative wound infection. Other organisms have shown varied preponderance in different studies. Staphylococcus aureus forms the bulk of the

normal flora of skin and nails. Hence; it is the commonest organism found in most of the SSIs. The high incidence of gram-negative organisms in the postoperative wound infections can be attributed to be acquired from patient's normal endogenous microflora.

Conclusion

The incidence of SSI was high. Age, gender, BMI, Comorbidities like Anemia, Hypertension and Diabetes mellitus, Blood transfusion, preoperative waiting, and prophylactic antibiotic usage were risk factors for SSI. However, only gender, extreme BMI, Diabetes mellitus and Blood transfusion were significant predictors for SSIs on multivariable analysis. Staphylococcus aureus was the most common organism associated with SSI. Majority of the SSIs were resistant to multiple antibiotics.

Author contribution

Umashankar R, Sundarrajan K, Anupama K A and Prathiba B encouraged and supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

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Study significance:

The incidence of SSI was high. Age, gender, BMI, Comorbidities like Anemia, Hypertension and Diabetes mellitus, Blood transfusion, preoperative waiting, and prophylactic antibiotic usage were risk factors for SSI. However, only gender, extreme BMI, Diabetes mellitus, and Blood transfusion were significant predictors for SSIs on multivariable analysis.

References

Anvikar AR, Deshmukh AB, Karyakarte RP, Damle AS, Patwardhan NS, Malik AK, et al. A one-year prospective study of 3280 surgical wounds. Indian J Med Microbiol1999;17:129-32.

Eriksen HM, Chugulu S, Kondo S, Lingaas E. Surgical-site infections at Kilimanjaro Christian Medical Center. JHosp Infect 2003;55:14-20.
https://doi.org/10.1016/S0195-6701(03)00225-1

Lilani SP, Jangale N, Chowdhary A, Daver GB. Surgical site infection in clean and clean-contaminated cases. Indian J Med Microbiol 2005;23:249-52.
https://doi.org/10.1016/S0255-0857(21)02530-5

Ma ngram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection, 1999. Hospital Infection Control Practices Advisory Committee. Infect Control HospEpidemiol1999;20:250-78.
https://doi.org/10.1086/501620

Morris CD, Sepkowitz K, Fonshell C, Margetson N, Eagan J, Miransky J, et al. Prospective identifi cation of risk factors for wound infection after lower extremity oncologic surgery. Ann SurgOncol 2003;10:778-82.
https://doi.org/10.1245/ASO.2003.07.023

Patel SM, Patel MH, Patel SD, Soni ST, Kinariwala DM, Vegad MM. Surgical site infections: Incidence and risk factors in a tertiary care hospital, Western India. Natl JCommunity Med 2012;3:193-6.

Suljagić V, Jevtic M, Djordjevic B, Jovelic A. Surgical site infections in a tertiary health care center: Prospective cohort study. Surg Today 2010;40:763-71.
https://doi.org/10.1007/s00595-009-4124-4

Urban JA. Cost analysis of surgical site infections. Surg Infect (Larchmt)2006;7(suppl 1):S19-22. 4. Reichman DE, Greenberg JA. Reducing Surgical Site Infections: A Review. Rev ObstetGynecol 2009;2:212-21.
https://doi.org/10.1089/sur.2006.7.s1-19

Watanabe A, Kohnoe S, Shimabukuro R, Yamanaka T, Iso Y, Baba H, et al. Risk factors associated with surgical site infection in upper and lower gastrointestinal surgery. Surg Today2008;38:404-12.
https://doi.org/10.1007/s00595-007-3637-y