

A study of incidence and risk factors of surgical site infection

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Abstract Introduction: Surgical site infections (SSI) are commonest nosocomial infections after Urinary tract infections (UTI), responsible for increasing cost, substantial morbidity and occasional mortality related to surgical operations and continue to be major problem even in hospital with most modern facilities and standard protocols of pre-operative preparation and antibiotic prophylaxis. **Aims and Objectives:** To Study Incidence and Risk Factors of Surgical Site Infection **Material and Methods:** This was a prospective study conducted at the Sri Ramachandra Medical College and Research institute, a tertiary health care centre. The patients admitted for elective clean and clean contaminated surgical procedures in the department of general surgery, Orthopaedics, Obstetrics & Gynaecology and Cardiothoracic surgery units were included in the study. A total of 945 cases were enrolled over a period of one year (December 2005 to January 2007). Surveillance was done by reviewing patient's case sheets (following doctor's daily notes, fever, drug charts and operative notes) as well as by directly questioning the patient, surgeon and staff nurse for any signs and symptoms of infection. The statistical analysis was done by Chi-square test. **Result:** Out of total of 459 cases in clean procedures, 14 developed SSI giving an overall infection rate of 3.0%. In clean contaminated procedures infection rate was shown to be 6.2% (15/241). It was seen that risk of infection is higher in patients who had Personal Habits (risk factor) if they underwent a clean surgical procedure. The difference was found to be statistically significant ($p=0.048$). Out study in clean cases showed an increase rate of infection 6.21% (11/177) in those patients whom surgery lasted >2 hours when compared to infection rate of 1.06% (3.282) in those patients whose surgery lasted <2 hours. This difference was found to be statistically significant ($p=0.000654$). In clean wound with risk factors of immune-compromised state was significantly associated with SSI ($P<0.050$) **Conclusion:** In clean wounds the risk factors like Personal Habits (risk factor), surgery lasted >2 hours, immune-compromised state were significantly associated with SSI but these factors were not co-related in contaminated wounds.

Keywords: Risk Factors of Surgical Site Infection, SSI (Surgical Site Infection), immune-compromised state.

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INTRODUCTION

Surgical site infections (SSI) are commonest nosocomial infections after Urinary tract infections (UTI), responsible for increasing cost, substantial morbidity and occasional mortality related to surgical operations and continue to be major problem even in hospital with most modern

facilities and standard protocols of pre-operative preparation and antibiotic prophylaxis. SSI rate has varied from a low of 2.5% to a high of 41%¹. Pathogens that cause SSI are acquired either endogenously from the patient's own flora or exogenously from contact with operative room personnel or the environment. However, the period of greatest risk remains the time between opening and closing the operating site. The incidence of SSI in clean procedures is variously reported as between 1.5% and 10.19%^{2,3,4 &5}. Several studies identify the following risk factors that predispose patients to developing SSI: Diabetes mellitus (DM), an increase in age, and longer duration of surgery^{6,7,8,9,10,2&4}.

MATERIAL AND METHODS

This was a prospective study conducted at the Sri Ramachandra Medical College and Research Institute, a tertiary health care centre. The study was conducted on

patients admitted for elective clean and clean contaminated surgical procedures in the Department of General Surgery, Orthopaedics, Obstetrics & Gynaecology, and Cardiothoracic Surgery. A total of 945 cases were included. The study was undertaken for a period of over one year i.e. From December 2005 to January 2007. Operation theatre list was reviewed every day and the name, hospital number of the patient and ward in which the patients resided were identified for those who were to undergo elective, clean and clean contaminated surgery. The procedure excluded from the study were: Re-exploration procedures, Orthopaedics patients with external fixators, patients who underwent trauma with external injuries, any history of skin infection at the site of incision, presence of abscesses, sinuses, fistulas and stitch abscesses. Surveillance for SSI (surgical site Infection) was performed from the third post-operative day, and then every other day until the patient was discharged from the hospital. For calculations the day of operation was denoted day zero and day started at 6 a.m. the morning following surgery. Surveillance was done by reviewing patient’s case sheets (following doctor’s daily notes, fever, drug chart and operative notes) as well as by directly questioning the patient, surgeon and staff nurse for any signs and symptoms of infection. The statistical analysis done by Chi-square test.

RESULTS

Table 1: Incidence of surgical site infection according to wound contamination

Type of cases	Total Number of cases	Number of infection	Percentage
Clean	459	14	3.0
Clean-Contaminated	241	15	6.2
Total	700	29	4.14

Table 2: Incidence of surgical site infection in cardiothoracic surgery

Type of cases	Total number of cases	Number of infection	Percentage of infection
cardiothoracics	245	31	12.65

The results of incidence rate for SSI in clean, clean contaminated and cardiothoracic surgeries are shown in the Table: 1 & Table: 2. Cardiothoracic surgery is categorized separately because of variation in the risk factors being studied such as age, types of antibiotic administered and other parameters. Hence even though all cardiothoracic procedures studied were clean cases, the results were studied separately. Out of total of 459 cases in clean procedures, 14 developed SSI giving an overall infection rate of 3.0%. In clean contaminated procedures infection rate was shown to be 6.2% (15/241). The

difference was shown to be statistically significant (p=0.045). In cardiothoracic surgery, out of 245 cases studied 31 developed SSI giving an infection rate of 12.65% age in relations to SSI.

Table 3: Personal habits and SSI (clean cases)

Personal Habits(risk factor)	Total number of patients with risk factor	Number of infection
Yes	44	4
No	401	10
Total	459	14

Table 4: Personal habits and SSI (Clean contaminated cases)

Personal habits(risk factor)	Total number of patients with risk factor	Number of infection
Yes	13	0
No	228	15
Total	241	15

Table 5: Personal habits and SSI (Cardiothoracic patients)

Personal habits(risk factor)	Total number of patient with risk factor	Number of infection
NO	173	21
Yes	72	10
Total	245	31

Patient personal habits such as smoking/alcohol consumption were evaluated for risk of infection (Table: 3, 4 & 5). It was seen that risk of infection is higher in patients who had these habits if they underwent a clean surgical procedure. The difference was found to be statistically significant (p=0.048). However in clean contaminated procedure these factors did not contribute to risk of infection, as all 15 patients who had surgical site infection had no personal history of smoking or alcohol consumption. Similarly in cardiothoracic surgery a total of 72 patients out of 245 had history of smoking or alcohol consumption out of which 10 developed SSI (14.0%). This infection rate was more compared to those patients who did not have any history of smoking or alcohol intake [12.0% (n=21/173)]. Our study in clean cases showed an increase rate of infection 6.21% (11/177) in those patients whom surgery lasted >2 hours when compared to infection rate of 1.06% (3.282) in those patients whose surgery lasted <2 hours Table: 6.

Table 6: Duration of surgery and SSI (clean cases)

Duration of surgery (minutes)	Total number of samples	Number of infections
>20	177	11
<120	282	3
Total	459	14

Table 7: Duration of surgery and SSI (clean contaminated cases)

Duration of surgery (minutes)	Total number of samples	Number of infections
>120	75	4
<120	166	11
Total	241	14

Table 8: Duration of surgery and SSI (cardiothoracic)

Duration of surgery (minutes)	Total number of samples	Number of infections
>120	215	28
<120	30	3
Total	245	31

This difference was found to be statistically significant (p=0.000654). In clean contaminated and cardiothoracic cases the rate of infection increased with duration of surgery, but the difference in infection was just marginal hence no statistical significance was obtained from the above data Table: 7 & 8. The mean post-operative stay in patients who did not develop any SSI, was 9.34 days in orthopaedic cases, 6.04 days in Obstetrics & Gynaecology patients, 4.39 days in general surgery and 11.8 days in Cardiothoracic cases. The mean post-operative stay increases in the presence of SSI. Additional days in the hospital of 18.37 days, 15.08 days, 14.07 days and 22.21 days for orthopaedics, Obstetrics & Gynaecology, General surgery and Cardiothoracic respectively were observed. The relationship of immunocompromised state with SSI in 3 categories are shown in Table: 9, 10 & 11.

Table 9: Immunocompromised states and SSI (clean cases)

Immunocompromised	Total number of cases	Number of infection
Yes	87	3
No	372	11
Total	459	14

Table 10: Immunocompromised states and SSI (clean contaminated cases)

immunocompromised	Total number of cases	Number of infection
Yes	65	6
No	176	9
Total	241	15

Table 11: Immunocompromised states and SSI (cardiothoracic cases)

Immunocopromised	Total number of cases	Number of infection
Yes	120	17
No	125	14
Total	245	31

DISCUSSION

Despite advance in operative techniques, better understanding of the pathogenesis of wound infection and wide spread use of antibiotics, post-operative SSI continues to be a major source of morbidity and mortality for patients undergoing operative procedure. This study on surgical site infection was of over one year duration

from December 2005 to January 2007 and was conducted on 2 categories of surgery. 1) General surgical procedure which included the following surgical specialities; orthopaedics, general surgery and obstetrics and Gynaecology 2) cardiothoracic surgery. Despite cardiothoracic surgery being a clean surgical procedure. It was categorised separately because the category of patient's risk factors and intraoperative data were significantly different when compared to the general surgical procedures. The overall incidence rate of surgical site infection has a wide variation from 2%-17% in the western countries (Table: 12).

Table 12: Incidence rates of SSI in Western countries

Western studies	Infection rate in clean cases	Infection rate in clean contaminated	Overall infection rate	Reference
U.S.A	-	-	2.8%	Philip S, <i>et al</i> ; Barie 2002 ¹¹
Brazil	3.1%	5.2%	5.1%	Aldo cunha, <i>et al</i> ; 2006 ¹²
Spain	2.27%	8.25%	9.17%	Bermejo B, <i>et al</i> ; 1997 ¹³

In the current study, however, when viewed with the fact that 90.57% (634/700) of the patients had received prophylactic antibiotics preoperatively and all these patients had continued the drug postoperatively, the revealed infection rate though it compares favourably with the Western data could be of great concern. This probably means that patient may be at a higher risk of infection due to more than one factor. Our surgical site infection incidence rate for cardiothoracic procedures was 12.9% Western data had shown an infection rate of 8.3%(Bundy J K *et al*¹⁴) and 7.8% (Roy M C *et al*¹⁵). Although the risk for many infectious disease increase with age, the association between age and the risk of surgical site infection is still unclear. Age in relation to surgical site infection has been studied by many authors, Razavi S M *et al*² and Kaya E *et al*¹⁶ all reported an increase in SSI in relation to age. Our result is consistent with the result of 2 other studies. Kaye S K *et al*¹⁷ in their study of SSI in elderly patient noted an increase in risk of SSI until the age of 65 years, after this the risk for SSI decreased. Similarly Bhatia J Y *et al*¹⁸ in their study on CABG patients has also noted, among the 13.4% patient over the age of 66 years only 3.7 % developed SSI. Kaye S K *et al*¹⁷ has stated that the elderly patients who are at increased risk of SSI undergo surgery less frequently than do their healthier peers. It is not clear what effect a shorter duration of surgery may have on SSI rates. On the other hand the literature shows that the duration of above 2 hours increase the risk of surgical site infection. (Bhatia J Y *et al*¹⁸, Pessaux P *et al*¹⁹, Adraina C *et al*²⁰, Medeiros

A C *et al*¹², Bermejo B *et al*¹³, Gulacsi L²¹). One of the complications of SSI is the need for readmissions and re-explorations which increase the hospital stay for the patients. Our study showed surgical site infection resulted in additional hospital stay of 15-22 days. Rantala A *et al*⁴, in their study in general surgical patients, Bhatia J Y, *et al*¹⁸ in their study of CABG patients and Lilani S P, *et al*¹ in their study in clean and clean contaminated cases all observed and additional 17.4 days, 15days, 24.82 days respectively due to the development of SSI.

CONCLUSION

In clean wounds the risk factors like Personal Habits(risk factor), surgery lasted >2 hours, immune-compromised state were significantly associated with SSI but these factors were not co-related in contaminated wounds. All the contributory risk factors need to be analysed and preventive factors implemented. A uniform antibiotic policy should be formed and this should be combined with aseptic techniques for a reduction in surgical site infection.

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