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SURGICAL SITE INFECTIONS AND ITS ASSOCIATED FACTORS AMONG POST OPERATIVE PATIENTS ATTENDING A TERTIARY CARE CENTRE IN SOUTH KERALA

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Abstract

Background: Surgical site infections (SSIs) pose to be a major problem among health care associated infection, increasing hospital cost, substantial morbidity & occasional mortality related to surgical operations. In spite of the standard protocols of preoperative preparation & antibiotic prophylaxis along with advanced surgical techniques, the complete elimination of SSIs is not possible. This is due to various factors such as the changing patterns of antibiotic resistance and difficulties in fully effective surveillance measures.

Methodology: A study on clean & clean-contaminated wounds of 280 post-op patients at Sree Gokulam Medical College in one year was conducted to know the prevalence rate of surgical site infections in our hospital, and the various factors associated with an increase in infection rate. Double swabs were taken from the wound site for bacterial culture and sensitivity. All data collected was analysed by SPSS software.

Results: The SSI rate was 7.5% with 5.4% in clean and 31.8% in clean-contaminated wounds. Elective cases (11/238=4.4%) showed a lesser rate than emergency cases (10/21=32.3%); as did longer surgeries (5.0% in cases of 1 – 2 hours and 15.9% in cases > 2 hours). Among patient comorbidities, diabetes mellitus was found to be the most common comorbidity associated with SSI. As part of Standard antimicrobial prophylaxis, Most SSI cases were given cefalexin (20.0%) and cefotaxime (6.9%) as the preoperative antibiotic.

Conclusion: The prevalence of SSI was higher in clean-contaminated wounds, in longer surgeries and in cases operated on an emergency basis. The length of hospital stay had a significant association with SSI directly reflecting on the economic burden it causes in healthcare settings. Standard Antimicrobial prophylaxis played a major role, infection rates were lowest in patients given amoxycillin clavulanate, cefotaxime-metronidazole, and cefaperazone sulbactam-metronidazole preoperatively.

Keywords: Surgical site infection, Healthcare associated infection, Standard Antimicrobial Prophylaxis.

INTRODUCTION

World Health Organisation (WHO) defines Health care-associated infections (HAI) as those infections affecting patients in a hospital or other health-care facility, which are not present or incubating at the time of admission, and those acquired by patients from a hospital or a health facility manifesting after discharge, as well as the occupational infections among the health care staff.[1] Among these health care associated infections, Surgical site infections (SSI) ranks the second place after catheter associated urinary tract infections (CA-UTI) according to various studies.[2,3,4] and account for nearly 20% to 25% of all HAI[5]. In India, the incidence of SSI varies from 4.04% to 30%.[6] Postoperative wound infections give the surgeon a major headache in managing the patient in the post-operative period. Three major factors are known to contribute: the degree of microbial contamination of the wound during surgery, the duration of operative procedure, and host factors such as age, obesity, malnutrition, diabetes, immunosuppression, anaemia, renal failure, exposure to radiation and carrier state of various organisms, like staphylococcus, pseudomonas etc.[7] In addition to complicating the recovery period and increasing the length of hospital stay, surgical site infections also result in significant economic burden for the patient and the hospital, by delaying discharge with associated increase in the need for investigations, treatment and nursing care. Also, these infections are likely to have an important role in the development of antimicrobial resistance.[6,7]

Though the Centre for Disease Control and Prevention (CDC) reports give an update of surgical site infections, being 22% of the total HAI,[8] the real issue is of a much larger magnitude. This is because, most cases of SSI manifest after discharge, and is missed out in surveillance. A recent prevalence study found that SSIs were the most common healthcare-associated infection, accounting for 31% of all HAIs among hospitalized patients[9].

Surgical site infections develop in at least 2% of the hospitalized patients undergoing operative procedures and it ranges from 2.5% to 41.9%, globally resulting in high morbidity and mortality[10,11]. Approximately 2% to 5% of the 16 million people undergoing surgical procedures each year develop surgical site infection with more recent data putting it at two-thirds of patients who undergo operations.[12,13] Most of these infections appear between the 5th and 10th day after operation, and can be reduced by the appropriate use of surgical antimicrobial prophylaxis[14]. In hospital practice 30-50% of antibiotics are prescribed for surgical prophylaxis and 30-90% of this prophylaxis is inappropriate. This inappropriate use increases the selection pressure, favouring the emergence of pathogenic drug resistant bacteria, hence increasing the risk of post-operative wound infections[15].

Undoubtedly, it is the most expensive HAI type; it has an estimated cost of 3.3 billion dollars globally, with nearly 1 million additional inpatient days annually. Each patient with SSI stays an additional 7 – 11 days in the hospital and has 2 – 11 times the higher death risk than other post-operative patients. Besides, it is the most frequent cause of unplanned readmissions after a surgical procedure. While the CDC NHSN data from the US reports a 17% reduction of SSI rates related to 10 selective procedures between 2008 and 2014, several multicentric studies from India point to an SSI rate ranging from 4.1% to 11.0%. The true data is expected to be much higher as the post-discharger follow up is a big challenge in SSI surveillance.[13,16,17]

This study has been carried out, in order to understand the current prevalence of surgical site infections and the various factors associated with it. Only clean and clean-contaminated categories of surgical wounds have been included in this study, in-order to avoid any ambiguity in identifying the true hospital pathogens.

MATERIALS & METHODS

A prospective study was conducted among 280 post operative patients from the departments of General Surgery, Orthopaedics, Obstetrics & Gynaecology, and Gastro-surgery at Sree Gokulam Medical College, obtained in a period of 1 year. The sample size (n) was calculated based on the formula: $n = z_{\alpha}^2 pq/d^2$ (where p = 16, q = 84, d = 4.5). All patients were monitored for development of infection, starting from the first day of their post-operative period till the date of discharge, during January 1st -December 31st 2017. SSI was diagnosed as per the CDC guidelines. The operations were classified as Clean, Clean-Contaminated, Contaminated and Dirty, and only patients undergoing clean & clean-contaminated surgeries were included in this study. Cases which were not SSI as per CDC, such as stitch abscess, 'Infection Present At The Time Of Surgery' (PATOS), post burns patients, as well as patients who develop infection outside the period of surveillance (as per CDC criteria) were also excluded from the study.

Two samples were collected using sterile cotton swabs; the 1st sample taken at the time of the first dressing and the 2nd in evidence of infection (fever, redness, wound gaping, or discharge). Double swabs were used for sampling. Any aspirated pus or tissue if obtained were preferred over swabs. The wound was thoroughly irrigated with saline to remove any visible debris & loose necrotic tissue. No betadine or antiseptic solution was used before swabbing. Double swabs were collected for processing. Gram smear was prepared and examined for the presence of pus cells to differentiate any coloniser from the true pathogen and to observe the morphology of any organism if present. The swab collected for culture and sensitivity was plated on Blood agar, MacConkey agar and Mannitol Salt Agar. The plates were incubated at 37^{o}C for 24 hrs. Gram smears were prepared from any growth obtained, and was subjected to biochemical identification using standard biochemical tests and antibiotic sensitivity. If the plates showed no growth, the plates were further incubated for another 24 hours, before declaring as culture sterile. Antibiotic sensitivity was studied by Kirby Bauer's disc diffusion method on Muller Hinton Agar, as per CLSI guidelines.

RESULTS

Of the 280 post-operative patients, 21 patients showed clinical signs of SSI with a positive growth on culture, (7.5%). 259 patients (92.5%) showed no growth. Higher rates of infection were seen in clean-contaminated surgeries (31.8%) than in clean surgeries (5.4%); (this association was found to be statistically significant ($p<0.001$)).

The types of surgeries taken for the study in their decreasing order of SSI rates are as follows: cholecystectomy (28.6%), arthroplasty (23.1%) total abdominal hysterectomy (16.7%), mastectomy (12.5%), caesarean section (11.8%), appendicectomy (7.7%), laparotomy (6.7%), hernia repair (3.8%), thyroidectomy and varicose vein stripping (0%). Among the different types of surgeries, the highest rate of SSI was seen in cholecystectomy (28.6%) followed by arthroplasty (23.1%) and Total abdominal hysterectomy (TAH). In thyroidectomy and varicose vein stripping, no cases developed SSI.

On correlating with duration of surgery, the procedures which lasted for 2 hours or more had the highest rate of developing a surgical site infection (15.9%), followed by the cases finished in 1 – 2 hours (5.0%). None of the cases completed in 1 hour developed any infection in this study. So, the rate of SSI was seen to rise with increase in duration of surgery, ($p=0.008$). The rate of SSI was seen to prolong the hospital stay; the highest rate of SSI was seen in post-operative stay of > 7 days (51.5%). ($p<0.001$). Among elective and emergency cases, emergency surgeries were found to have a higher rate of SSI (32.3%) than that of elective surgeries (4.4%) ($p<0.001$).

On studying the association of patient comorbidities with SSI, The rate of SSI was higher in patients with comorbidities (27.5%) in comparison with patients with no comorbidities (3.1%). Diabetes mellitus was the most common comorbidity associated with most cases of infection (23.7%), after steroid therapy (44.4%) and this association was found to be statistically significant ($p<0.001$). There was no statistical association for rate of SSI to age or gender of the patient in this study.

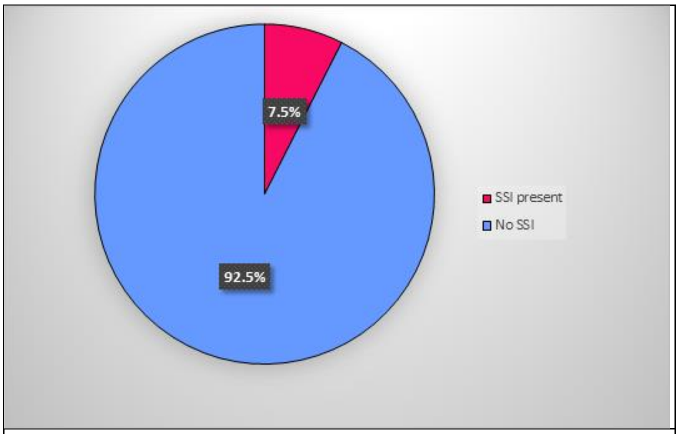

Figure 1.1 Rate of SSI. – 21/280

Sl. No.	Name of surgery	SSI				Total		χ^2	df	p value
		Present		Absent						
		Frequency	%	Frequency	%	Frequency	%			
1	Thyroidectomy	0	0	61	100	61	100			
2	Hernia repair	3	3.8	77	96.3	80	100			
3	Caesarian section (LSCS)	6	11.8	45	88.2	51	100			
4	Total Abdominal Hysterectomy (TAH)	4	16.7	20	83.3	24	100			
5	Mastectomy (MRM)	1	12.5	7	87.5	8	100			
6	Laparotomy	1	6.7	14	93.3	15	100			
7	Cholecystectomy	2	28.6	5	71.4	7	100			
8	Appendicectomy	1	7.7	12	92.3	13	100			
9	Varicose vein stripping	0	0	8	100	8	100			
10	Arthroplasty	3	23.1	10	76.9	13	100			
	Total	21	7.5	259	92.5	280	100	20.791	9	0.014

Table 1.1 SSI rates in different types of surgeries

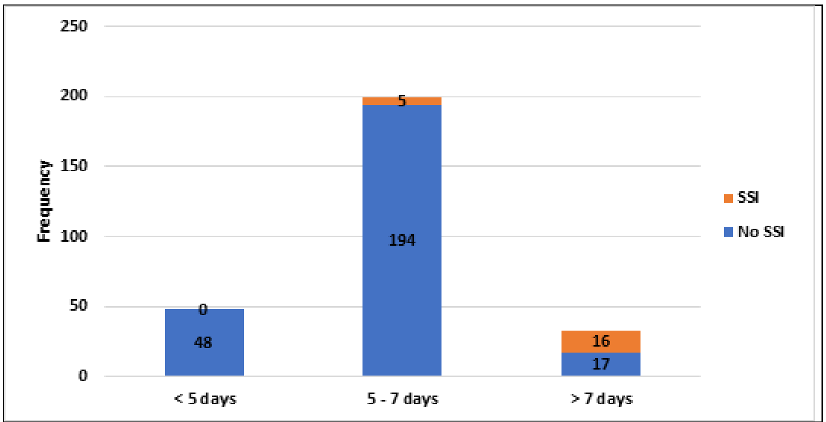

Figure 1.2 Impact of SSI on post-operative stay in hospitals

Type of surgery	SSI				Total		χ^2	df	p value
	Present		Absent						
	Frequency	%	Frequency	%	Frequency	%			
Elective	11	4.4	238	95.6	249	100			
Emergency	10	32.3	21	67.7	31	100			
Total	21	7.5	259	92.5	280	100	30.800	1	<0.001

Table 1.2 SSI rates in emergency and elective surgeries

Nature of surgery	SSI				Total		χ^2	df	P
	Present		Absent						
	N	%	N	%	N	%			
Clean	14	5.4	244	94.6	258	100			
Clean-Contaminated	7	31.8	15	68.2	22	100			
Total	21	7.5	259	92.5	280	100	20.353	1	<0.001

Table 1.3 SSI rates in clean and clean-contaminated surgeries

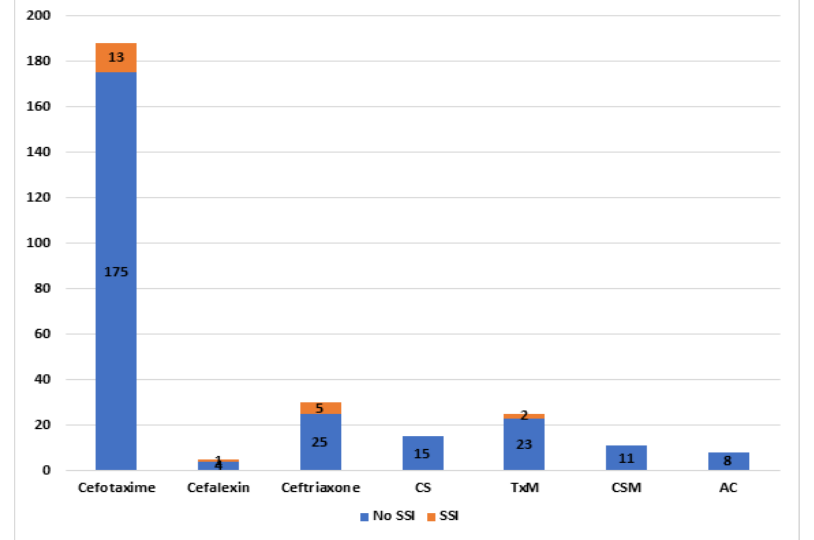

Figure 1.3 Correlation of SSI with SAP

Discussion

Surgical site infections (SSI) are considered to be the second highest amongst health-care associated infections (HAI)[6]. The factors influencing the rate of surgical site infections were studied through different variables such as gender of the patient, type of surgery, duration of the surgical procedure, duration of the period of post-operative hospital stay, associated comorbidities (diabetes mellitus, steroid therapy, malignancy and HIV infection), the type of wound (clean / clean-contaminated) nature of surgery (elective / emergency), and the antibiotics administered both preoperatively and postoperatively. The management of surgical site infections remain a significant concern for both the microbiologist as well as the clinician in the health care setting, despite all the current advances in surgical techniques and the better understanding of wound pathogenesis.

In this study, the overall rate of surgical site infection obtained was 7.5%; (21/280) with a rate of 5.4% in clean wounds and 31.8% in clean-contaminated wounds - SSI in clean wounds was much lesser than that of clean-contaminated wounds. The net SSI rate as well as that of independent rates of clean and clean-contaminated were similar to studies done by S.P Lilani et al[10](8.9%; with 3.03% in clean and 22.41% in clean-contaminated wounds), Elbur et al[18] (9.0%; with 8.0% in clean and 9.5% in clean contaminated cases) and Patel Sachin et al,[3] (16%; with 3% SSI for clean cases and 11.4% SSI for clean contaminated cases). The rate of surgical site infections around the world varies from hospital to hospital. It has a wide range from 2.5% to 41.9% across the globe.[5,10,19]

On correlation of SSI with different surgeries, 61 thyroidectomy (21.7%), 80 herniorrhaphy (28.6%), 8 mastectomy (2.9%), 51 LSCS (18.2%), 24 total abdominal hysterectomy TAH (8.6%), 15 laparotomy (5.4%), 7 cholecystectomy (2.5%), 13 appendicectomy (4.6%), 8 varicose vein stripping (2.9%) and 13 arthroplasty (4.6%) cases were taken. The highest SSI was seen in cholecystectomy (28.6%), then arthroplasty (23.1%); both clean-contaminated cases. Among clean surgeries, SSI was highest in Total Abdominal Hysterectomy(16.7%) followed by Lower Segment Caesarean Section

(11.8%). In surgeries involving superficial structures, (thyroidectomy and varicose vein stripping), none developed infection. This result was in accordance with many other investigators[3,7,10,20,21.]
Another significant finding was that procedures which lasted for more than 2 hours as were shown to develop a higher infection rate than the rest. To correlate the duration of surgery, the cases were categorized as surgeries in < 1 hr, 1-2 hrs and > 2 hours. The rate of SSI was as follows: No infection < 1 hour, 5.0% in cases of 1 – 2 hours and 15.9% for cases of > 2 hours. Prolonged procedures resulted in increased exposure of the surgical site to environmental contaminants, increased stress of anaesthesia and more blood loss. In S P Lilani et al's[10] study, surgeries < 30 min had only 1.47% infection rate while those >= 2 hrs had 38.46% infection. Anvikar et al[11], Varsha Shahana et al[22] and Mannarakkal et al[23] all gave similar results. In a retrospective study by Cheng et al, [105] the mean operative time was 30 min longer in patients with SSIs compared with those patients without SSI. Among elective and emergency procedures, 11 elective & 10 emergency cases developed infection; the SSI rate in emergency cases (32.3%) was significantly higher than elective cases (4.4%). This result was in accordance with Patel Sachin et al[3] (19.6% (18/92) in emergency & 12.9% in elective procedures (14/108)) and Mannarakkal et al[24], (Emergency surgeries (16%, n= 12) compared to elective (10.6%, n=8) abdominal surgeries in the population studied) and Kumar Ansul et al[24] (emergency surgeries - 17.7% & elective surgeries -12.5%).

Though preoperative antibiotic prophylaxis was given in 100% of the patients, the timing of administration was difficult to maintain in emergency cases. Standard antibiotic prophylaxis (SAP) must be given at least 60 min before surgery as per WHO guidelines[1]. All patients had received standard antibiotic prophylaxis (SAP). With cefotaxime (67.1%), 13 patients developed infection (6.9%). Both cefalexin and ceftriaxone showed high SSI (20.0% and 16.7% respectively. Cefaperazone sulbactam was administered to 25 patients, and 8.0% developed infection. Patients on amoxycillin clavulanate, cefotaxime-metronidazole, and cefaperazone sulbactam-metronidazole, did not develop infection.

The impact of SSI on hospital stay was also evaluated. Patients who stayed for more than a week post-op had 48.5% of them develop SSI in contrast to those who stayed for less than 7 days (2.5%). S P Lilani et al[10] had concluded that the mean post-op stays in patients who developed infection was almost four times (24.82 days) as that of patients who did not develop infection, in whom the mean post-operative stay was 6.19 days. Golia et al[25] also found that patients who had a hospital stay >20 days had 4 times more incidence of SSI, indicating that it contributed to the development of infection. Patients who develop infection are 60% more likely to spend time in an ICU, and 5 times as likely to be readmitted[26].

The association of comorbidities such as Diabetes mellitus, intake of oral or parenteral steroids (including patients with history of bronchial asthma on steroids, patients with a drug history of oral / parenteral hormonal contraception), presence of malignancy/ chemotherapy were also studied. The SSI rate of patients with comorbidities (27.5%) was found to be much higher than that of patients without any comorbidities (3.1%). Of the total 280 patients, the most common comorbidity associated was diabetes mellitus (74.5%), followed by steroid therapy (17.6%). In the present study, diabetes has been found to be a significant risk factor for SSI (25.0% of diabetic patients developed SSI, and 47.6% of total 21 cases of SSI were known cases of diabetes). This was in accordance with numerous other authors, who gave a significant association of diabetes with SSI. Patel Sachin et al[3] reports in his study that out of the 22 patients with diabetes mellitus, 8 patients had SSI (The rate of SSI was 36.4% (8/22) in patients with diabetes mellitus compared to rate of SSI in patients without diabetes mellitus, which was 13.5% (24/178)). In a study by P. Preetishree et al[7], diabetes mellitus was a very important risk factor in the development of infection. A K Baburajan et al[26], who studied the incidence, risk factors and the microbial profile of SSI in cardiac surgery patients, reported that 65% of SSI cases in his study were diabetics. In another study by Ellen Korol et al[27], 85% of the patients

diagnosed with diabetes developed surgical site infection, thus giving a statistically significant association. The increased infection rate in diabetes has been attributed to the impairment of neutrophil chemotaxis, phagocytosis, adherence plus the glycosylation of collagen matrix proteins – all of which led to weakened antibacterial defences and delayed wound healing.
It was found that there was no marked difference in the rate of SSI with regard to the gender of the patient, although females showed a slight predominance (8.9%). While some studies, such as those by Ahmed I et al[28] and Mulu W[29] et al report a higher association of SSI with female gender, other authors such as Prasanna Gupta et al[4], A K Baburajan et al[26] and Mannarakkal et al[23], report a higher incidence of SSI in males. In most studies, the gender of the patient is found to have no significant association with SSI, and it has been postulated that sex of the patient is not a very significant factor in the development of surgical site infection.

CONCLUSION

On studying the prevalence of surgical site infections along with the profile and sensitivity of the bacteria obtained for 1 year, the SSI rate is found to be 7.5%. Various causative factors such as the nature of surgery, the duration of surgery, the type of surgery conducted, and any correlation of patient comorbidities were studied. The impact of SSI on post operative hospital stay was also noted. The peak in SSI with regards to clean contaminated wound and longer surgeries especially operated on an emergency basis is worth noticing. Association of comorbidities such as diabetes mellitus has also proved to be a significant risk factor. The proper Standard Antimicrobial Prophylaxis; the right antibiotic at the right time; at least 60 minutes prior to surgery (as per WHO recommendation) may have influenced the high rates in emergency cases. The significant impact of SSI on longer postoperative hospital stays in proves again the huge economic burden it is, in addition to poor outcome.

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