

Original Research Article

Surgical site infections in orthopaedic surgeries: incidence and risk factors at tertiary care hospital of South India

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ABSTRACT

Background: Health care associated infections (HAI) are infections that patients acquire while receiving medical care and are one of the most adverse events during health care delivery. Among the HAI surgical site infections [SSI] ranks the second among surgery patients. The present study aims to identify the risk factors, incidence and also to set the strategies required to prevent the development of SSI in orthopaedic surgeries primarily.

Methods: A one year prospective study was conducted with a follow up of cases for one year post surgery in orthopaedic department. Cases that had undergone surgery were followed for development of SSI with a detailed demographic history, risk factor details after ethical committee approval. The data was analyzed using Statistical Package Social Sciences software 16 package (Chicago, USA).

Results: The incidence of SSI was 6.5% with males 61% and females 39% with mean age of 34.12±8.01 years. In our present significant statistical correlation was observed with SSI and associated risk factors which include, Increased age, BMI >25, administration of prophylactic antibiotic's, multiple fractures (>2 in number), contaminated wound, presence of drain at surgical site and blood transfusion. Methicillin resistant *Staphylococcus aureus* was the most common isolated pathogen (48.4%).

Conclusions: The occurrence of SSI was higher in orthopaedic surgery than general surgeries. So our study clearly indicates that increased age, increased duration of surgery, increased hospitalization post-surgery, placement of drain at surgical site and blood transfusion are significant risk factors in development of SSI in orthopaedic surgeries.

Keywords: Surgical site infections, Health care infections, Methicillin resistant *Staphylococcus aureus*, *Pseudomonas*

INTRODUCTION

Health care associated infections (HAI) are infections that patients acquire while receiving medical care and are one of the most adverse events during health care delivery. WHO reports state that the prevalence of HAI in low and Middle income countries range from 5.7% to 19.1% whereas in high income countries range from 3.6% to 12%. These HAI increase morbidity-mortality rates, hospitalization costs, due to increased hospital stay and spending more on diagnostic and therapeutic procedures,

besides neglecting patients distancing from their work and family. Among the HAI surgical site infections (SSI) ranks the second among surgery patients.¹ A surgical site infection is an infection that occurs after surgery in the part of the body where the surgery took place. These are classified as Superficial, deep and organ/space surgical site infection depending upon the site or place involved and features described as per CDC guidelines.² Among The SSIs, those related to orthopaedic procedure are distinct and severe; because they combined involve the organ/space. Global studies report the incidence of SSI in

orthopaedic surgeries to vary from 6% to 9% in low and middle income countries and 7-8% in high income or well developed countries in spite of well developed aseptic procedures, guidelines and surveillance and awareness programmes. Orthopaedic SSI increase the duration of hospitalization by two weeks, double the rate of rehospitalisation, and triple the overall cost of health care. In addition to above, patients also have physical limitations and significant reductions in quality of life.^{3,4}

Identifying patients at risk of developing SSI in orthopaedic surgeries would provide better insight for both patient and healthcare provider with information that helps in improving preoperative assessment of the risk in developing orthopaedic SSI, and providing protective interactions which inhibit the occurrence of SSIs. These risk factors which have been documented in the literature include preoperative, postoperative and intra operative risk factors.⁵ The present study aims to identify the risk factors, incidence and also to set the strategies required to prevent the development of SSI in orthopaedic surgeries primarily. The study also explores the various microorganisms implicated in causation of SSI in orthopaedic surgeries.

METHODS

The present prospective cross sectional study was conducted at a tertiary care hospital with bed strength of 1150. The study was conducted at Department of Orthopaedics in association with department of Microbiology. The study proposal was approved by the institutional ethical committee and all the guidelines of the committee were followed throughout the study. The study was explained to all the participants in the study and a written informed consent was obtained. The study period was for one year from January 2016 to December 2016. All the cases admitted in the wards of Orthopaedics and underwent surgery (elective or emergency) were included in the study. All the patients socio-demographic factors were noted by personal interviewing and clinical examination of the cases were done and any risk factors for development of surgical site infections were noted in a predesigned separate questionnaire sheet. The operative history of the patient, type of anaesthesia, duration of surgery, preoperative prophylaxis and the drug used were noted for all the cases. For all the cases in the study, surgical wound were classified as per the CDC classification as clean, clean contaminated, contaminated and dirty. After surgery, surgical notes which included the type of surgery, (e.g. replacement, fixation, without fixation etc.), blood transfusion during surgery, placement of drain at surgical site etc. were noted. Post-surgery all the cases were observed for daily follow up by senior orthopaedic surgeon and during discharge for any signs and symptoms of SSI. In cases developing SSI or suspicion of SSI (pain or tenderness, swelling, redness) a sample was taken from the infected site and sent to microbiology laboratory for culture and identification of the pathogen with antibiotic sensitivity. Diagnosis of the

SSI was made after obtaining growth from the sample and in concordance with the primary surgical team. Post discharge the cases were followed for 12 months period and regularly noted for any development of SSI.

Patients with known risk factors like smoking, alcoholism, diabetes, malignancy, immune compromised or immune suppressed conditions, COPD were excluded from the study.

Statistical analysis

The collected data was entered in a separate Microsoft excel spread sheet and corrected. The corrected Data was analyzed using Statistical Package Social Sciences software 16 package (Chicago, USA).

RESULTS

The present prospective study was conducted for a period of two years and an overall 1978 surgeries were conducted in the department of orthopaedics. Out of 1978 surgical cases, 128 cases were finally diagnosed as SSI. The incidence of SSI was 6.5% with males 78 cases (61%) and females 50 cases (39%). The mean age of the cases with SSI was 34.12±8.01 years. In 1978 cases, 1248 were males and 730 were females with a mean age of 38.24±10.4 years in the study and male to female ratio of 1.7:1. The cases in the study were distributed by age in to three groups, Group-1 with <18 years, Group-2 with 19-50 years and Group-3 with >50 years. 50% of cases who developed SSI were in Group-2 followed in order by Group-3 with 29.7% and Group-1 with 23.4%. There was a statistically significant correlation with age and development of SSI ($p<0.05$).

In considering the risk factors for the cases that developed SSI, 68.8% were smokers (88/128), 57.8% had BMI ≥ 25 . Regarding SSI, 68.8% had emergency surgery and 31.2% had elective surgeries and statistical significance was not associated with this factor. 10.9% of cases who were administered prophylactic antibiotics developed SSI and administration of prophylactic antibiotic was found to be highly significant statistically ($p<0.001$). 85 cases with Multiple fractures (>2 in number) developed SSI when compared with 43 cases with fractures <2 in number. More number of fractures more the chances of developing SSI was noted in our study as it was found significant statistically ($p<0.01$). 78 cases (60.9%) with duration of surgery >3 hours developed SSI when compared with 59 cases with <3 hours duration and in our study no statistical significance was associated with duration of surgery and development of SSI. In our study of 128 cases with SSI, clean wounds were 12 (9.4%), clean contaminated were 18 (14.1%), contaminated were 58 (45.3%) and dirty were 40 (31.3%) ($p<0.05$). In the present study, drain was placed postoperatively in 32 cases where 24 developed SSI and 8 didn't develop SSI, ($p>0.01$) and 54 cases received blood transfusion with 70.4% (38/54) developed SSI and

29.6% (16/54) didn't develop SSI. In our present significant statistical correlation was observed with SSI and associated risk factors which include, increased age, BMI >25, administration of prophylactic antibiotics,

multiple fractures (>2 in number), contaminated wound, presence of drain at surgical site and blood transfusion (Table 1).

Table 1: Distribution of SSI on the basis of independent variables.

Parameters		Number	%	P Value
Gender	Male	78	61	0.02
	Female	50	39	
Age	<18 years	30	23.4	<0.05
	19-50	64	50.0	
	>50 years	38	29.7	
Risk factors				
Smoking	Yes	88	68.8	>0.07
	No	40	31.2	
BMI	<25	54	42.2	<0.05
	≥25	74	57.8	
Time of operation	Emergency	88	68.8	>0.08
	Elective	40	31.2	
Prophylactic antibiotics	Taken	14	10.9	<0.001
	Not given	114	89.1	
Multiple fractures	<2 fractures	43	33.6	<0.01
	>2 fractures	85	66.4	
Duration of operation	<1.5 hours	12	9.4	<0.187
	1.5-3 hours	38	29.7	
	>3 hours	78	60.9	
Type of wound	Clean	12	9.4	< 0.05
	Clean-contaminated	18	14.1	
	Contaminated	58	45.3	
	Dirty	40	31.3	
Post duration of hospitalization	1-9 days	68	53.1	>0.123
	>10 days	60	46.9	
Placement of drain	Yes	24	75	<0.05
	No	8	25	
Blood transfusion	Yes	38	70.4	<0.05
	No	16	29.6	

Table 2: Distribution of patients based on fracture and SSI incidence.

Site of fracture	No of SSI	%
Pelvis	28	21.9
Femur	14	10.9
Hip	13	10.2
Foot	11	8.6
Shoulder	8	6.3
Humorous	14	10.9
Multiple fracture	19	14.8
Forearm fracture	8	6.3
Tendon & peripheral nerve repair	13	10.2

Table 2 represents the association of development of SSI with relation to site of fracture. Maximum association development of SSI was observed in cases with pelvic fracture (21.9%), followed by multiple fractures (14.8%), humerus, femur (10.9%) and hip and tendon and peripheral nerve repair (10.2%).

Table 3 lists the various pathogens isolated from SSI of the cases in the study. A total of 128 pathogens were isolated from all the cases. Methicillin resistant *S. aureus* was the most common isolate with 48.4% followed by other less common which include *Staphylococcus epidermidis* (11.7%), *Pseudomonas* sp (10.9%), *Escherichia coli* (10.2%), *Klebsiella pneumoniae* (8.6%), *Proteus* sp (2.3%), Methicillin sensitive *S. aureus* (4.7%) and *Acinetobacter* (3.1%).

Table 3: Distribution of organisms isolated from various SSI.

Type of surgery	SSI (No)	Organism isolated	% (n/128)
Arthroplasty	8	7 MRSA	5.5
		1 <i>E. coli</i>	0.8
Hand transplant	18	8 <i>S. epidermidis</i>	6.3
		2 <i>K. pneumoniae</i>	1.6
		2 <i>Acinetobacter</i> sp	1.6
		3 <i>E. coli</i>	2.3
		3 <i>Proteus</i> sp	2.3
Operation with fixation	78	43 MRSA	33.6
		6 MSSA	4.7
		7 <i>S. epidermidis</i>	5.5
		6 <i>E. coli</i>	4.7
		5 <i>K. Pneumoniae</i>	3.9
		11 <i>Pseudomonas</i> sp	8.6
Operation without fixation	24	12 MRSA	9.4
		4 <i>K. pneumoniae</i>	3.1
		3 <i>E. coli</i>	2.3
		2 <i>Acinetobacter</i> sp	1.6
		3 <i>Pseudomonas</i> sp	2.3
Total	128	62 MRSA	48.4
		6 MSSA	4.7
		15 <i>S. epidermidis</i>	11.7
		13 <i>E. coli</i>	10.2
		11 <i>K. Pneumoniae</i>	8.6
		4 <i>Acinetobacter</i> sp	3.1
		14 <i>Pseudomonas</i> sp	10.9
3 <i>Proteus</i> sp	2.3		

MRSA: Methicillin resistant *S. aureus*; MSSA: Methicillin sensitive *S. aureus*.

DISCUSSION

SSI is a complication resulting in excess morbidity, increased duration of hospitalization, economical burden and loss of physical activities in bone and joint surgeries. Most of the studies reported an increasing trend in orthopaedic surgeries across the world and also emphasizing the importance of surveillance programmes in reducing the incidence of SSI in orthopaedic surgeries. Globally the incidence of SSI in orthopaedic surgeries is reported around 2.6% to 41.9%.⁶ In our study we found the incidence of SSI around 6.47% which is less than the incidence reported in developing countries and higher than the incidence in developed countries. However the

higher rate observed in our study may be poor infection control practices and improperly maintained ventilation procedures in the operating rooms. However emergence of active surveillance programmes in developing countries may be quite helpful in reduction of SSI in orthopaedic or general surgeries.⁷

The factors which are associated with development of SSI are modifiable factors like infection control practices, prophylactic antibiotic administration etc. while a few are non-modifiable like increasing age etc. In our present study, we assessed the risk factor association with development of SSI in elective as well as emergency bone and joint operations. In our study, the most common age group involved in development of SSI were between 19-50 years which is on par with the findings of Nichols et al who reported the same in his study.⁸ BMI >25 was a significant risk factor for development of SSI with a p value of <0.05. This fact that BMI >25 is a risk factor for SSI was also proved by many studies done by Ridgeway et al.⁹ However the BMI in Indian scenario is quite variable from the west population who has BMI.35 and a few studies considered BMI >35 was significant risk factor in development of SSI.¹⁰ Obesity has shown to increase the risk of SSI by 4.5 times as mentioned in earlier studies.

In our study, prophylactic antibiotic administration was found as a highly significant factor in development of SSI. Similar association was observed in the study of Osler et al who reported that prophylactic administration 1 hour before surgery was associated with a high reduction in number of SSI.¹¹ In our study the type of antibiotic administered was dependent upon the antibiotic policy of the institution, only 3rd generation cephalosporin was used and was found to be highly effective in reduction of SSI, but few studies by Owens et al recommended the use of aminoglycosides and found that SSI were reduced on par with our study.¹²

In our study other modifiable risk factors with non-significant association in development of SSI include prolonged duration of surgery and more number of stays in hospital post-surgery. Findings of our study were on par with findings of Lecuona et al but in contrast to the reports of others who reported that increased duration of surgery was associated with development of SSI.¹³ In our study it was observed that SSI are associated more with dirty and Contaminated than other wounds. The findings of our study similar to reports of many studies done globally but few reported that development of SSI is dependent upon not the type of wound but based on the duration of surgery and administration of antibiotic prophylactically and also the type of antibiotic used.¹⁴

Two more important factors associated significantly with development of SSI in our study included placement of drain at the surgical site and a blood transfusion during or post-surgery. These reports were always found contrary to various studies who reported association with

development of SSI and few studies who reported no association between SSI and placement of drain.¹⁵

As mentioned universally methicillin resistant *S. aureus* was the commonest in our study also but with higher incidence than the reports of Pull ter Gunne et al who reported MRSA incidence in his study as 62% in contrast to 48% in our study.¹⁶ Other gram negative bacteria associated were *Escherichia coli*, *Pseudomonas* and *Klebsiella pneumoniae* in our study. These findings and pathogens isolated from our study were similar to findings of Kim et al but among gram negative bacteria *Pseudomonas* was commonest in his study.¹⁷

CONCLUSION

To conclude, our study highlights that presence of active surveillance problems in hospitals can curtail the incidence and prevalence of SSI in hospitals with limited resource settings. Surgeon can identify the cases with risk factors and modify the strategy and plan in performing and managing the cases in prevention of SSI. The occurrence of SSI was higher in orthopaedic surgery than general surgeries. So our study clearly indicates that increased age, increased duration of surgery, increased hospitalization post-surgery, placement of drain at surgical site and blood transfusion are significant risk factors in development of SSI in orthopaedic surgeries.

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