ORIGINAL RESEARCH

Incidence, root causes and outcomes of surgical site infections following orthopaedic surgery in a tertiary care centre

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ABSTRACT

Introduction: Surgical site infection is an infection of an incision, organ or space where a surgical procedure has been done. The definition for surgical site infection given Centre for Disease Control and Prevention (CDC) as a surgical procedure related infection that occurs at or near a surgical incision within 30 days of surgery or within 90 days of a prosthetic implant. **Aims:** To investigate incidence, root causes and outcomes of surgical site infections following Orthopaedic surgery in a tertiary care centre. **Material and methods:** The present study was a Prospective cohort study. This Study was conducted from February 2021 to November 2022 at Department of Orthopaedics, Rajendra institute of Medical Sciences, Ranchi, Jharkhand. Total 275 patients were included in this study. **Result:** In our study out of 275,45 patients had surgical site infections(16.5%),3 superficial infections(1.1%),42 deep infections(15.4%). Associated risk factors were found to be an increased age, comorbidity of the patient, longer duration of surgery. The most common pathogen were Staphylococcus(55.5%), Klebsiella(28.1%), Streptococcus(6.2%), Ecoli. Sensitive antibiotic to the pathogens were Amikacin, Ciprofloxacin, Meropenem, Piperacillin. **Conclusion:** Surgical site infections incidence rate was revealed to be higher than acceptable international ranges due to poor set up of hospital ward, lack of equipment and materials needed to maintain strict asepsis, poor hygiene of patients increasing SSI and overwhelmed emergency services due to population burden. However, multi drug resistance was seen in half of the isolates leaving clinicians with few choices of drugs for the treatment of patients with SSI. Periodic surveillance of bacteria and antibiotic susceptibility coupled with the implementation of strict protocol for antibiotic administration and operative room regulations are important to minimise the burden of SSI with resistant bacteria pathogen.

Keyword: Surgical site infection, Incidence and Risk factors.

INTRODUCTION

Surgical site infection is an infection of an incision, organ or space where a surgical procedure has been done. The definition for surgical site infection given Centre for Disease Control and Prevention (CDC) as a surgical procedure related infection that occurs at or near a surgical incision within 30 days of surgery or within 90 days of a prosthetic implant.

Surgical site infection is one of the most common healthcare associated infection and results in important cause of morbidity after surgeries.[1,2]

Surgical site infection (SSI) causes increased use of antibiotics, increases days of hospital stay and increased morbidity and mortality rates. They are also the main cause of hospital readmissions and contribute to increase the cost of healthcare.

According to Meterological Society of India- Entire year has been divided into 4 seasons.

(1) Winter- December to February, (2) Summer- March to May, (3) Monsoon- June to September.(4) Autumn- October to November.

The meterological data of Jharkhand is evaluated on annual basis as well as for monsoon(June- September), winter(October-January) and summer(February-May) seasons respectively.[3]

Winter months promotes a sedentary lifestyle, changes in eating pattern which result in fewer follow up visits. Where are in Summer months, the increased

temperature and humidity improves survival of microbe, increases vitamin D levels, encourages being outdoors and activity levels.[4]

Vitamin D has Immunomodulatory effects on both the innate and adaptive immune system and it modulates the expression of antimicrobial peptides such as cathelicidin. It also influences the inflammatory cascade via NFKB.[5]

It is already been demonstrated by previous studies an association between seasonality and surgical site infection. Although there is lacking of such existing related studies in India.

Most of the studies are focused on specific surgical procedure e.g. TKR, Spinal Surgery or Specific body parts e.g. Hip fracture surgery, fracture of leg and foot. All these studies are done in Western Countries. This study will cover all closed fracture and in all age group.

It is revealed by various observational studies that the incidence of surgical site infection is higher in summer and lower in winter because higher temperature and humidity are thought to result in higher skin bacterial proliferation rates for both patients and hospital staff.[6]

My study will investigate seasonal variations in the incidence of surgical site infection following orthopaedic surgery. According to ICD 10 Codes(Diagnosis Coding) comorbidities and outcomes.

Surgical Site infections (SSI) are the infection following an invasive surgical procedure and are the most frequently reported hospital acquired infections (HAI) [7,8]. SSI is a type of hospital-acquired infection (HAI) that arises following surgery and it is related to the surgical site [9]. Currently, SSI is defined as an infection that happens within 30 days of the operation if no implant is left in place or within 1 year of operation if an implant is left in place [10].

SSI may result in increased morbidity and mortality, prolonged hospital stay, increased hospital readmissions even reoperation and healthcare costs [11,12]. It has been reported by numerous studies that diverse surgical specialties were associated with elevated costs next to the development of an SSI in United Kingdom. In the United States, for example, SSI is found to be a serious complication with an incidence of 2 to 5% in patients undergoing surgery complicating approximately 300,000 to 500,000 surgeries per year and costing the health-care system upward of $1.6 billion [13,14]. SSI is the most common surgical complications in both developed and developing countries [15]. Fan Y.et al., 2014 reported 4.5% to be an average incidence of SSI in mainland China from 2001 to 2012 and abdominal surgery to be the most common surgical procedure.

The global estimated prevalence of HAI, at any given time, approximates to 1.4 million. Incidence varies widely across countries and surgical procedures; however, it is estimated to occur in at least 2% of surgeries [13]. In low- and middle-income countries (LMIC), SSI incidence may be approximately up to 4 times higher than in high-income countries [14]. In sub-Saharan

AIMS AND OBJECTIVES

AIM

To investigate incidence, root causes and outcomes of surgical site infections following Orthopaedic surgery in a tertiary care centre.

OBJECTIVE

- **Primary Objective:** To find the incidence and root causes of surgical site infection following orthopedic surgery.
- **Secondary Objective:** To find the relation of Surgical Site Infection with Surgical procedure, duration of surgical procedure, seasonal variation of surgical site infection.

MATERIALS AND METHODS

STUDY DESIGN

Prospective observational study. The study was conducted on the patient who will undergo Orthopaedic Surgery during February 2021 to November 2022 in the Department of Orthopaedics, Rajendra institute of Medical Sciences, Ranchi, Jharkhand.

SAMPLE SIZE

In the study, they would conduct a prospective study focussing on all the patients belongs population of Jharkhand undergoing orthopedic surgery in the department of orthopaedics RIMS, Ranchi hospital. The initial design used an estimate of the incidence of Orthopedic Surgical Site Infection approximately ranged from 1.8% to 7.7% according to literature review. With an assumed odd ratio of 5.8 and a prevalence of 2%, power of 80%, sample size is 244. Considering 10% loss to follow up they obtained final sample size of 270.

METHOD

Prospective follow up cases of Post-operative Orthopaedic Surgery was done for 3 months during months period in Rajendra Institute of Medical Sciences, Ranchi. Variables of each patient was recorded and analysed with respect to age, sex, type(grading) of closed fracture injury, Closed fractures wiil be classified according to Tscherene classification with open fractures being excluded from study, mode of injury, associated injuries, timing and duration of operation, duration of hospital stay, confounders e.g. DM, HTN, etc. Charlson Commorbidity Index (CCI) predicts 10 yrs survival in patients with multiple commorbidities e.g. Age, MI, CHF, CVA, Dementia, COPD, Liver Disease.

Standard protocol and data sheet was prepared for every patient undergoing operative procedure with documentation of pre-operative investigation including Hemoglobin, Albumin, Transferrin level, Glycemic index, Body mass Index. Samples were collected from

surgical site on post-operative day 2 and day 6 by swab following laboratory standard procedure for specimen collection and were sent immediately to microbiology laboratory for analysis.

Documentation of pre-operative clinical condition was done along with month and season of operative procedure. Post-operative wound condition was evaluated as per standard protocol on 2nd post-operative day followed by at the time of discharge. Follow up was done at 1 month and 3 month.

INCLUSION CRITERIA

1. Closed fracture cases of either gender in all age group admitted for elective / Emergency orthopaedic surgery.
2. Patient belongs to population of Jharkhand..
3. Patient willing to give informed consent.
4. Joint Replacement Surgery, Arthroscopic Surgery, Spine Surgery.

EXCLUSION CRITERIA

1. Open fracture with pre-existent infected wound before surgery.
2. Amputation, External fixation surgery.
3. Patient not willing to give informed consent.
4. Patient with Neurovascular deficit and Immuno Suppressive Patient.

STATISTICS

All statistical analysis was performed using the Statistical Package for the Social Science (SPSS) software. First descriptive statistics, including count and percentage, was used to describe the demographic characteristics of the subjects. The mean and standard deviation was computed for quantitative data variables while Qualitative data were compared using proportion. Bivariate analysis for association between potential risk factors and their potential association with SSI was performed using Chi square and Fisher's exact test. P-value <0.05 was considered statistically significant.

Socio-demgraphic characteristics of participants who had surgery

	(n = 275)	**n(%)with SSI(n = 45)**	**n(%) without SSI(n=230)**	**P value**
Age, Yrs, mean = 40.17 ± 17.8				
<20	56(20.3)	6(16)	47(84)	0.008
26 — 45	133(48.3)	5(3.7))	128(96.3)	
>45	86(31.2)	31 (36)	55(64)	
Gender				
Male	215(78.2)	31 (14.4)	184(85.6)	0.172
Female	60(21.8)	14(23.3)	46(76.7)	
Smoking				
Yes	75(27.3)	14(18.6)	61(81.4	0.235
No	200(72.7)	31(15.5)	169(84.5)	
Alcohol				
Yes	100(36.3)	20(20)	80(80)	0.286
No	175(63.6)	25(14.2)	150(85.8)	

Clinical and commorbibity of participant who had surgery

	(n = 275)	**SSI(n = 45)**	**n(%) without (230)**	**P value**
BMI kg/m^2 mean = 2.0.561 ± 3.2				
<20	125(45.4)	28(22.4)	97(776)	0.481
20-25	142(51.6)	10(7)	132(93)	
>25	8(2.9)	4(50)	4(50)	
Diagnosis				
Neck of femur	194(70.5)	15(7.7)	179(92.3)	<0.05
Shaft of femur	61(22.2)	20(32.7)	41(67.3)	
Others	20(7.3)	10(50)	10(50)	
Commorbidity				
Yes	45(16.3)	33(73.3)	12(26.7)	<0.05
No	230(83.7)	12(5.2)	218(96.8)	

Descriptive data and bivariate analyses of surgical risk Factors associated with SSI

	Total%	**(n = 294)**	**N(%)with SSi(n = 34)**	**n(%)without SSI(n=30)**	**P.value OR(95% CI)**
Tscherene classification					
Grade 0	263(95.6)	40(15.2)	223(8.48)	Reference	<0.024
Grade 1	12(4.4)	5(41.6)	7(58.8)	2.9(1.9-8.1)	
Duration of surgery (hours)					

<2hrs	171(62.2)	21(12.2)	150(87.8)	Reference	0.024
>2hrs	102(37.8)	24(23.5)	7(58.8)	2.5(1.1-4.6)	
Hospital stay (post operation day)					
<14days	215(78018)	13(6)	202(9.9)	Reference	<0.001
>14days	60(21.82)	32(53.3)	28(46.6)	46(16.4-108.4)	

RESULTS

The mean age of patients was 40.17 years, standard deviation 17.8 years. Half of the patients (48.3%) were between 26-45 years, 20.3% patients were below 25 years and 31.2% patients were above 45 years of age. Most of the patients 215 (78.2%) were males and 60 (21.8%) were females. The mean BMI of patients was 20.561, majority of patients were healthy weight(51.6%), only 2.9% were obese. 27.3% of patients were smoker and 36.3% consumed alcohol.

Tscherene classification used for closed fracture as open fracture were excluded from the study, Grade 0 for healthy skin (95.6%) of patients, Grade 1 for abrasion 4.4%.

All operated patients who developed SSI were discharged from the hospital, no patient died during the study.

INCIDENCE OF SURGICAL SITE INFECTIONS

The incidence of SSI after surgery was 16.5% (45/275), most of the infections were superficial only 15.4%, 42 patients had deep infections according to CDC definition. No infection was identified 30 days after discharge from hospital. The incidence of SSI among <25 years was 16%, among 26-45 years age group SSI was 3.7% and among >45 years age group the incidence of SSI was 36%. The

incidence of SSI among male was 14 % and among females was 23%, however the difference in the incidence of SSI among male and female were not significant (p=0.172).

RISK FACTORS ASSOCIATED WITH SSI DEVELOPMENT

Bivariate analysis of risk factors that causes occurrence of Surgical site infections , as shown in the Table 2 and Table3. The duration of surgery had major affect on causes of SSI, the surgery lasted for more than 2 hours associated with SSI more frequently than shorter operation(OR=2.5,95% CI: 1.1-4.6, p=0.024). The duration of hospital stay plays major role in the causes of SSI, more than 14 days post operative stays(OR=46,95% CI:16.4-108.8,p<0.001). Preoperative skin condition, Tscherene classification for closed fracture, Grade 0 for closed fracture and Grade 1 for abrasion (OR=2.9,95% CI:1.9-8.1, p<0.024). The difference in incidence of SSI due to prophylactic antibiotic were not significant.

BACTERIAL ISOLATION AND THEIR ANTIBIOTIC SENSITIVITY

All patients with SSI were tested for swab culture and sensitivity in the Microbiology department. The most common pathogens isolated were Staphylococcus(55.5%), Klebsiella(28.1%), Streptococcus(6.2%) and E coli. Sensitive antibiotic to the pathogens were Amikacin, Ciprofloxacin, Meropenem and Piperacillin.

OUTCOMES

All patients who developed SSI were discharged from the hospital after proper management of the wound, no patients died during the study. The superficial SSI required regular antiseptic dressing with parenteral antibiotics and got healed. 45 patients who had deep infections were treated with thorough debridement of infected site along with parenteral and oral antibiotic according to sensitivity profile and they got healed with scar and fibrosis. No patients loosed the limb or amputated.

CONCLUSION

Surgical site infections incidence rate was revealed to be higher than acceptable international ranges due to poor set up of hospital ward, lack of equipment and materials needed to maintain strict asepsis, poor hygiene of patients increasing SSI and overwhelmed emergency services due to population burden. However, multi drug resistance was seen in half of the isolates leaving clinicians with few choices of drugs for the treatment of patients with SSI. Periodic surveillance of bacteria and antibiotic susceptibility coupled with the implementation of strict protocol for antibiotic administration and operative room regulations are important to minimise the burden of SSI with resistant bacteria pathogen.

Limitation of the study was that it was done in a single center.

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