e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(8); 89-94

Original Research Article

A Clinical Study of Risk Factors and Outcomes of Surgical Site Infection at a Tertiary Care Teaching Hospital

Mitul K. Patel[1], Pallav S. Mehta[2], Rahil M. Vahora[3], Parth A. Kansagara[4]

[1]Assistant Orthopedic Surgeon, Ashutosh Hospital, Vadodara, Gujarat, India
[3]2enior Resident, Department of Orthopaedics, PDU Medical College, Rajkot, Gujarat, India
[3]Senior Resident, Department of Orthopaedics, GMERS Medical College, Valsad, Gujarat, India
[4]Senior Resident, Department of Orthopaedics, GMERS Medical College, Morbi, Gujarat, India

Received: 27-03-2023 / Revised: 22-04-2023 / Accepted: 25-05-2023
Corresponding author: Dr. Parth A. Kansagara
Conflict of interest: Nil

Abstract:

Background and Aim: Surgical site infection (SSI) is disastrous in orthopedic practice as it is difficult to rid the bone and joint of the infection. Objectives of the study were: to study surgical site infection and its risk factor and outcome, to determine risk factors for surgical site infection and to determine outcomes for surgical site infection.

Material and Methods: Present Observational study was conducted in 50 Adult patients operated in orthopedic department of C.U. Shah Medical College and Hospital developed surgical site infection. After determine SSI by signs of inflammation (redness, swelling, local rise in temperature, fever, quality of discharge) short history was taken and physical examination was conducted on each patient. All of the preoperative factors, intraopertaive factors and post operative factors related to SSI present in the patient were noted down in the data sheet. Postoperatively swab was sent for culture and sensitivity test in every case with discharge from the wound of surgical site infection.

Results: Out of 50 patients, 34 (68 %) were male and 16 (32%) were female. In relation to addiction, it was observed that 31(62%) patients had addiction history and 19 (38%) patients had no addiction history. Out of 50 patient's organisms were isolated from 30(60%) patient and no organism was isolated from 20(40%) patients. Among those 30 patients E. coli was isolated in 15 patients. Out of 50 patient developed SSI 36 (72%) patients were cured with conservative management 10 (20%) patients were complicated are treated with thorough surgical debridement, 4 (8%) patients had undergone septic shock and other SSI related complications and dead.

Conclusion: Various host factors like Male gender, Lower socio economic class, smoking and other addiction like alcohol and tobacco chewing, hyperglycemia, malnutrition, obesity, hypertension, etc coupled with environmental factors such as condition of the wounds, delay to initiate operation, duration of operation, type of operation and experience of operating surgeon greatly contribute to occurrences of SSI.

Keywords: E. coli, Observational study, Socio economic class, Surgical site infection.

Introduction

Healthcare-associated infections (HAIs) are acquired by patients when receiving care, in both primary and secondary environments. These are the most common adverse events affecting patient safety worldwide. Surgical site infection (SSI) is defined as microbial contamination of the surgical wound within 30 days of an operation or within 1 year after surgery if an implant is placed in a patient.[1] Surgical site infection is the greatest enemy to success of a surgeon erodinghis pride and glory which is a dreaded complication and it is difficult to ignore the burden posed on patient's safety in terms of pain, suffering, delayed wound healing, increased use of antibiotics and antibiotic resistance, revision surgery, increased length of hospital stay, mortality, morbidity and excess healthcare costs. Surgical site infection is the most important cause of morbidity and mortality in the post operative patients, but it is preventable in most of the cases if proper assessment and appropriate measures are taken by the surgeons, nursing staffs, patients and others in the peri-operative period.[2-4]

Microbial contamination of the surgical site is an essential precursor of SSI. These infections are caused by exogenous (from the environment of the operating theatre or the surgical ward) and endogenous microorganisms, patient are skin, mucous membrane or hollow viscera. When mucous membrane or skin is incised, the exposed tissues are at

risk for contamination with endogenous flora. [5] *Staphylococcus aureus*, coagulase negative Staphylococcus, *Enterococcus species*, *Escherichia coli* remain the most frequently involved pathogens.6,7 Outbreaks of SSI have also been caused by unusual pathogens such as Rhizopus oryzea, Clostridium perfringens, and Rhodococcus.[8,9]

Factors responsible for infections should determine, that will be helpful to prevent infection in future following similar types of operations. Many preventable causes of SSI have been identified, and if proper measures are implemented, the incidence could be reduced.[10] Patients, surgeons, and nurses, as well as operative room atmosphere and instrumentation are prime areas of concern. Various methods have been established to reduce infections in implant surgery, but infection does occur. So, these study findings will play an important role to reduce the infection rate and thereby reduce the morbidity and mortality.[11] Furthermore, application of the recommendations of this study in the practical field will reduce the rate of surgical site infections in our country and thereby will improve results of operations better as a whole.

Objectives of the study were

1. To study surgical site infection and its risk factor and outcome.
2. To determine risk factors for surgical site infection.
3. To determine outcomes for surgical site infection.

Material and Methods

Present Observational study was conducted in 50 Adult patients operated in orthopedic department of C.U. Shah Medical College and Hospital developed surgical site infection. Prior to commencement of this study, Ethical Committee of C.U. Shah Medical College and Hospital had approved the thesis protocol. Present study was done from June 2020 to July 2021.

After determine SSI by signs of inflammation (redness, swelling, local rise in temperature, fever, quality of discharge) short history was taken and physical examination was conducted on each patient. Only very essential investigations were done (CBC, CRP, ESR, Pus culture and sensitivity) to take correct decision about the management. All the necessary information regarding the study was explained to the patients or their valid guardian. Informed written consent was taken from the patients or their guardian willing to participate in the study. Detailed history was taken from the study group to establish proper diagnosis and to know about the presence of the risk factors regarding surgical site infection.

Thorough physical examination was done in each case. Data collection sheets were filled in by the investigator himself. All of the preoperative factors, intraopertaive factors and post operative factors related to SSI present in the patient were noted down in the data sheet. Appropriate management was given to each of the patients of surgical site infection. Antibiotic was changed where necessary after getting the report of culture and sensitivity test. Postoperative events were recorded in the data sheet during every follow up. After completing the collection of data it was compiled in a systematic way.

All cases were evaluated clinically. Only essential investigations necessary for diagnosis and preoperative assessment were carried out before operations. Postoperatively swab was sent for culture and sensitivity test in every case with discharge from the wound of surgical site infection. The patients of both sexes and different ages were included in the study.

Data were collected by pre-tested structured questionnaire. Data were collected from all the respondents by direct interview after getting informed consent from them or from their legal guardian. Some data was also obtained from discharge card given to patient. Data analysis was done both manually and by using computer. Calculated data were arranged in systemic manner, presented in various table and figures and statistical analysis was made to evaluate the objectives of this study.

Results

This observational study was carried out to determine factors responsible for surgical site infections following orthopedic surgeries that will be helpful in reducing rate of surgical site infections.

Table 1: Age distribution of the patients having SSIs

Age group	Number of patients	Percentage (%)
15-24	12	24
25-34	7	14
35-44	2	4
45-54	8	16
55-64	10	20
65-74	7	14
75-84	4	8

It was observed that percentage of patients in different age groups were as follows 24% in the 15-24 years, 14% in the 25 - 34 years, 4 % in the 35 - 44 years, 16 % in the 45- 54 years, 20 % in the 55 - 64 years and 14 % in the 65 - 74 years. 8% in the 75 - 84 years. It was highest in the age group of 15-24. Regarding sex distribution, out of 50 patients, 34 (68 %) were male and 16 (32%) were female. Male-female ratio was 2.12:1. SSI is higher in males.

Regarding relationship between Social economic status and SSI it was observed that percentage of patient was highest 31 (62 %) in lower S.E group. It was 8 (16 %) in upper lower S.E group, 4 (8 %) in lower middle S.E group, 5(10 %) in upper middle S.E group which is higher than lower middle S.E class, 2 (4%) in upper S.E group. It was observed that rate of SSI decreased with rise in level of Social economic class.

Regarding relationship between obesity and SSI it was observed that percentage of patient having SSI was higher 26 (52%) in non-obese patients rather than obese patient 24(48%).

Table 2: SSI distribution based on Addiction

Addiction	Number of patients	Percentage (%)
Absent	19	38%
Present	31	62%

In relation to addiction, it was observed that 31(62%) patients had addiction history and 19(38%) patients had no addiction history. The difference of rate of infection between these two groups was obvious. It was clear that addiction in different forms played avital role as a host related risk factor for SSI.

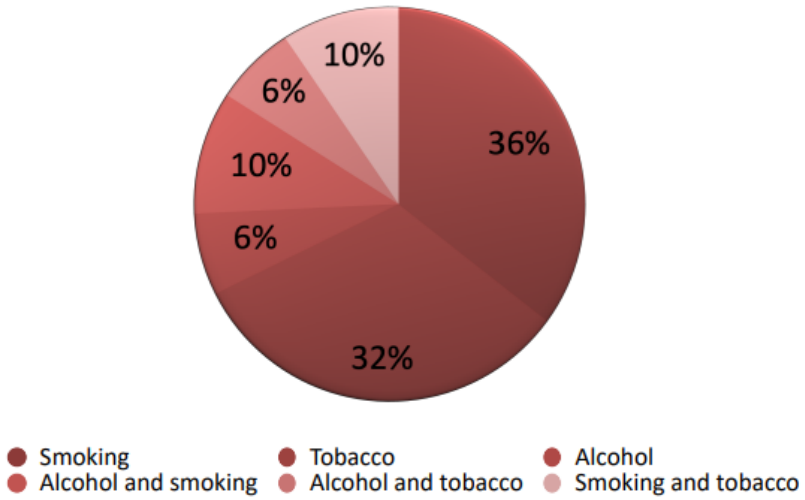

Figure 1: SSI distribution based on Addiction

Among 31 patients with addiction history, 11(36%) patients having history of smoking who developed SSI, which is higher among other addictions, whereas 10(32%) patients with tobacco chewing developed SSI. 2(6%) persons were alcoholic who developed SSI.3(10%) persons were taking alcohol and smoking developed SSI, 2 patients (6%) who were taking having history of alcohol consumption and tobacco chewing developed SSI, whereas 3(10%) persons having history of smoking and alcohol consumption developed SSI. In relation to co-morbidities, it was observed that 32(64%) patients had compromised immunology status and 18(36%) patients had normal immunology status.

Among 32 patients with co-morbidities, 8(25%) patients having history of diabetes who developed SSI, which is higher among other co-morbidities, whereas 4(13) patients with hypertension alone developed SSI. 5(16%) persons with malnutrition who developed SSI., 4 patients (13%) who were having COPD developed SSI, whereas 2(6%) patient having history of jaundice developed SSI. 3(9%) patients with diabetes and hypertension both developed SSI.3(%) patients were taking diabetes and COPD developed SSI, 2 patients (6%) who were having hypertension and malnutrition developed SSI, 1(3%) patient with cerebral palsy developed SSI.

Table 3: SSI distribution based on nature of lesion

Nature of lesion	Number of patients	Percentage
Close fracture	30	60%
Open fracture	15	30%
Osteoarthritis	4	8%
Osteomyelitis	1	2%

In relation to nature of lesion it was observed that 30(60%) patients had closed fracture type developed SSIs which is higher than open grade fracture type 15(30%). 4 (8 %) patients developed SSI who are having osteoarthritis, 1(2 %) patient developed SSI who is having osteomyelitis.

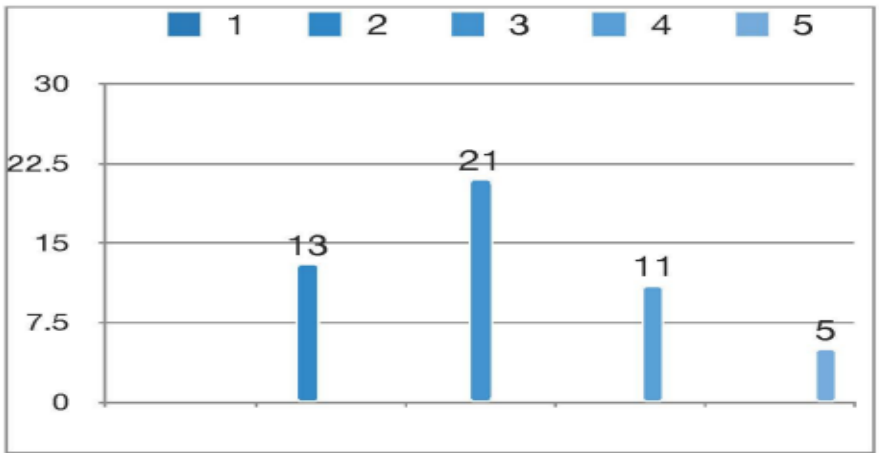

Figure 2: SSI distribution based on ASA score

In relation to ASA score, it was observed that 13(26%) patients had ASA score 2 developed SSI. 21(42%) patients had ASA score 3developed SSIs which is higher among other. 11(22%) patients developed SSI who are having ASA score 4, 5(10%) patient developed SSI who are having ASA score 5.

Table 3: SSI distribution based on operation time

Operation time	Number of patients	Number of patients
<60min	1	2%
60-120min	19	38%
121-180min	20	40%
>180min	10	20%

In relation to operation time, it was observed that 20(40%) patients operated within 121 to 180 min developed SSI which is higher among other. 19(38%) patients operated within 60 to 120 min developed SSI. 10(20%) patients developed SSI whose operation duration were more than 180min, 1(2%) patient developed SSI who's is operated within hour.

In relation to base on total hospital stay it was observed that 3(6%) patients had total hospital stay less than 1 week developed SSI. 35(70%) patients had total hospital stay between 1 to 2 weeks developed SSIs. 12(24%) patients developed SSI who were stayedin hospital for more than 2 weeks.

Table 4: Organism isolated from infection

Organism	Number of patients	Percentage (%)
Organism isolated	30	60%
No Organism isolated	20	40%
Total	50	100%

Out of 50 patient's organisms were isolated from 30(60%) patient and no organism was isolated from 20(40%) patients. Among those 30 patients E. coli was isolated in 15 patients which is 50%, *Staphylococcus aureus* was isolated from 9 patients which is 30%, and *Klebsiella pneumonia* was isolated in 3 patients which is 10% and *Pseudomonas Aeruginosa* was isolated in 2 patient which is 7% and *Acinetobacter baumani* was isolated from one patient which is 3%.

Table 5: Outcome of SSI

Outcome	Number of patients	Percentage (%)
Cured	36	72%
Complicated	10	20%
Death	4	8%

Out of 50 patient developed SSI 36 (72%) patients were cured with conservative management 10 (20%) patients were complicated are treated with thorough surgical debridement, 4 (8%) patients had undergone septic shock and other SSI related complications and dead.

Discussion

The study was carried out with a view to determine the factors responsible for surgical site infections (SSI) following surgery in orthopaedic department which will be helpful in reducing the rate of surgical site infection in the near future.

In our study most of the patients 12(24%) were in between 15-24 years which is opposite to above study. Regarding relationship between age and SSI, study conducted by Fisichella et al. in 2015, observed that higher age (>65) had higher chance of having infection than younger age.[12]

In our study out of 50 patients, 34 (68%) were male and 16 (32%) were female who gets SSI. Male-female ratio was 2.12:1. Results from 10 years of surveillance in Germany shows that for orthopaedics and traumatology as well as abdominalsurgery, he observed that SSI-rates were significantly higher for male patients.[13]

Among 31 patients with addiction history,11(36%) patients having history of smoking alone who developed SSI which is higher among other addictions, 3(6%) patients having history of smoking and tobacco chewing who developed SSI. 3(6%) patients having history of smoking and alcohol consumption who developed SSI. Fisichella et al. in 2015 found a significant high rate of infection in patients having history of tobacco use and other addictions (79%), in our study it is 62%.[12] Grammatico-Guillon et al. retrospectively analyzed 32,678 patients in the French Regional Hospital Discharge database and found that alcohol abuse was correlated with a significant increase in SSI risk (HR 2.47, 95% CI 1.67-3.63) [14]

In our study 4(8%) patients had history of hypertension and 3(6%) and 2(4%) patients had history of Diabetes with Hypertension and Hypertension with malnutrition respectively. In a cohort study by Lavernia et al. it was reported that there were more numbers of patients developed a deep infection with malnutrition as compare to controls which determine that malnutrition is risk factor for SSI, in our study 5(10%) and 2(4%) patients developed SSI who had malnutrition alone and malnutrition with hypertension respectively.[15] In our study patient 21(42%) patient had ASA score 3 who developed SSI which is highest among other ASA score. Al-Mulhim et al. observed that an ASA grade of >2 was associated with increased risks of SSIs which is a risk factor.[5] CDC has classified surgical wound in clean, clean contaminated, contaminated and dirty. Undoubtedly, the high- energy mechanism and the resultant serious soft-tissue damage and poor blood supply contribute to a greater risk of SSI, study done by Altemeier et al. suggest that rate of SSI in clean, clean contaminated, contaminated and dirty is <1, 2-5, 5-10 and more than 10 respectively.[16]

70% (35 patients out of 50) of the patients are infected who's hospital stay is in between 7 to 10 days which is higher than stay >14 days. Which suggest majority of surgical site infections occur after discharge from the hospital. In our study E.coli organism most commonly found from culture which is almost half of the patients from organism was isolated. E. coli invasion of the wound is a clear case of poor patient hygiene and hospital hygiene. Out of 50 patients organism were isolated from 30(60%) patient and no organism was isolated from 20 (40%) patients. Study done by Al-Mulhim et al[5] found common infective organism was Staphylococcus species including Methicillin Resistant *Staphylococcus aureus* (MRSA) in 23 patients (29.11%) in our study it is 30%.

Out of 50 patient developed SSI 36 (72%) patients were cured with conservative management and debridement in outpatient department with minimal hospital stay and minimum cost, 10 (20%) patients were complicated are treated with thorough surgical debridement or amputation of limb with many days of hospital stays and great cost. 4 (8%) patients were undergone septic shock and other SSI related complications and dead.

Limitations of the study are as this study has been carried out over a limited period of time with a limited number of patients and there was Covid-19 epidemic, it could not have been large enough to be of reasonable precision and determination of risk factor cannot be done from this study.

Conclusion

Various host factors like Male gender, Lower socio economic class, smoking and other addiction like alcohol and tobacco chewing, hyperglycemia, malnutrition, obesity, hypertension, etc coupled with

environmental factors such as condition of the wounds, delay to initiate operation, duration of operation, type of operation and experience of operating surgeon greatly contribute to occurrences of SSI. So, quality of surgical care including immediate assessment of patients, resuscitative measures, adequate preparation of patients and aseptic environment are important for control of SSI.

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