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Orthopaedics

PREDICTORS AND INCIDENCE OF SURGICAL SITE INFECTION IN CLEAN CLOSED FRACTURE FIXATION

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ABSTRACT **INTRODUCTION:** Surgical site infection (SSI) poses a significant threat following orthopaedic surgeries. SSI is defined as superficial infection within 30 days of the surgery or deep infection following 1 year of surgery with implants in situ. **AIM:** To assess the incidence of surgical site infection in closed fracture fixation and correlate neutrophil lymphocyte ratio with occurrence of SSI. **METHODS:** After getting approval from the ethics committee, 72 patients from January 2021 to July 2021 in a single tertiary hospital with closed fractures were included in the study after obtaining their informed consent. They underwent internal fixation and were followed up for 1 year post-surgery for signs of superficial and deep infection. **RESULTS:** 5 patients out of 72 suffered from surgical site infection within the follow-up period, indicating a 6.9% incidence rate of SSI, out of which 4(5.55%) were superficial within 1 month post-surgery, and 1(1.35%) was deep within 1 month of surgery who underwent implant removal. Statistical results showed that duration of surgery >120 min (Mean 180 min with SD 77 min with a p-value of 0.022) and increased NLR (mean of 5.6(SD 6.9) p-value 0.001) were independent risk factors of postoperative SSI. **CONCLUSION:** The incidence of SSI in our hospital was found to be within acceptable range in India with 5.55 superficial and 1.35 deep SSI. Patients with preoperative NLR ratio more than 5.7 and operative time of >120 mins should be kept under better observation as they possess higher risk for postoperative surgical site infection. Age >79, ASA grade ≥4, Patients with diabetes and patients with serum albumin < 3.5 g/dl are independent risk factors of SSI, though, they were not found to be significant in our study.

KEYWORDS : Surgical site infection, NLR, Closed fractures, internal fixation

1. INTRODUCTION

Centre of Disease Control defines Surgical site infection (SSI) as microbial contamination of the surgical wound in 30 days of an operative procedure or within one year post surgery in case an implant is placed.

Surgical Site infection is one of the most common complications, and cause of increased morbidity and mortality among orthopaedic patients. Studies report that the incidence of SSI in orthopedic surgeries globally varies from 6% to 9% in low and middle income countries and 7 to 8 % in developed countries. , Orthopaedic SSI significantly increases the duration of hospitalisation, the rate of rehospitalisation, the overall cost of health, and the patient's financial burden.

Preoperative tests aim to identify and assess diseases in the population subject to a surgical procedure.

Patient Factors like history of concomitant infection, past MRSA infection, personal habits like tobacco use and preoperative leucocyte count affects the postoperative risk of SSI. Changes in neutrophil-lymphocyte ratio indicate the balance between neutrophil and lymphocyte counts, and is an indicator of systemic inflammation. The NLR is a cheap and widely available biomarker. It seemed to us interesting to evaluate the prognostic value of the NLR for SSI. Over the years, NLR rather than the count of neutrophils or lymphocytes was identified to be independently associated with SSI. Surgical factors such as the increased operative time have been shown to be associated with increased incidence of SSI.

So, the present study assessed the incidence of SSI in patients undergoing internal fixation for closed fractures and the significance of these factors in predicting SSI.

2. SUBJECTS AND METHODS

After obtaining approval from IHEC committee, this prospective cohort study took place in a tertiary hospital in Puducherry. All patients who were diagnosed with clean closed fractures and require internal fixation during the study period formed the study population. 72 patients, after taking informed written consents, were included in this study from January 2021 to July 2021 and patients were followed up till July 2022.

Patients with compound fractures, history of decreased renal function, history of chronic liver disease, patients with infections prior to surgery, immuno compromised patients, patients with malignancies or prolonged steroid and chemotherapy were excluded from the study.

Their blood was drawn preoperatively for serum albumin, complete blood count, serum urea, serum creatinine, HbA1c, electrolytes, random blood sugar, RH blood grouping, bleeding time and clotting time.

After taking the necessary consents, Pre-Anesthetic fitness and American Society Association grading the patients was scheduled for surgery. The prophylactic antibiotics were administered according to the HICC guidelines.

Intraoperatively, duration of surgery, the implants used was recorded. The patients were strictly observed for any signs of superficial incisional, deep incisional or organ/space surgical site infection during their stay in hospital.

In case surgical site infection occurred before the bone heals, wound debridement and appropriate antibiotic treatment was given. Uncontrolled infection was treated by removing the implant.

The patients were asked to come to the department for any complaints of pain at site of surgery, fever, discharge through the incision or swelling at the site of surgery. The patients were be followed up for 1 month on out patient basis and monthly for the next 1 year on telephone basis.

Privacy and Confidentiality was maintained throughout. All patient identifiable numbers and information was stripped and replaced by anonymous numbers.
Incidence of SSI was observed.

4. RESULTS

Data analysis

Data was entered into Microsoft Excel spreadsheet and was checked for any discrepancies. Summarized data was presented using Tables and Graphs. The data was analysed by SPSS (21.0 version). Shapiro Wilk test was used to check which all variables were following normal distribution. Data were not normally distributed (p-value was more

than 0.05). Therefore, bivariate analyses were performed using the parametric tests i.e Independent t test (for comparing two groups). Chi square test was used for categorical variables. Level of statistical significance was set at p-value less than 0.05.

Out of total 72 study subjects, infection at surgical site was present among 5 subjects. 1 of the infected patient died due to natural causes during the follow up period after getting discharged from hospital after SSI treatment.

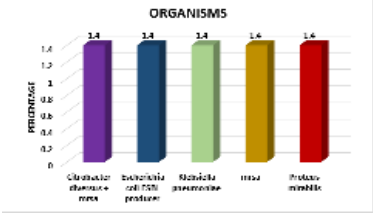
Infection at surgical site

		Frequency	Percent
	Absent	67	93.1
	Present	5	6.9
	Total	72	100.0

Out of 5 subjects having infection at surgical site, each one subjects was having presence of organism Citrobacter diversus + MRSA, Escherichia coli ESBL producer, Klebsiella pneumoniae, MRSA and Proteus mirabilis respectively.

Organism

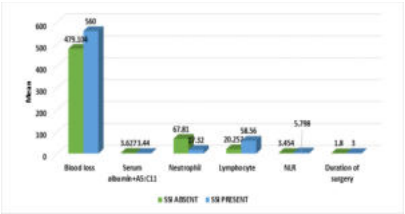
		Frequency	Percent
	Citrobacter diversus + MRSA	1	1.4
	Escherichia coli ESBL producer	1	1.4
	Klebsiella pneumoniae	1	1.4
	MRSA	1	1.4
	Proteus mirabilis	1	1.4
	Total	5	100.0



No significant correlation was seen in the mean blood loss and Serum albumin level among subjects with or without infection whereas Neutrophil count, lymphocyte, NLR and duration of surgery was found to be significantly more in subjects having infection at surgical site.

Comparison of blood profile

	Infection at surgical site	N	Mean	Std. Deviation	P VALUE
Blood Loss	Absent	67	479.104	267.1609	0.467, ns
	Present	5	560.000	167.3320	
Sr Albumin	Absent	67	3.627	.3983	0.301, ns
	Present	5	3.440	.1342	
Neutrophils	Absent	67	67.810	11.8880	0.001*
	Present	5	17.320	31.0202	
Lymphocyte	Absent	67	20.257	8.9631	0.001*
	Present	5	58.560	23.1640	
Neutrophil Lymphocyte Ratio	Absent	67	3.454	2.1317	0.038*
	Present	5	5.798	4.9967	
DURATION OF SURGERY	Absent	67	1.8806	1.03751	0.022*
	Present	5	3.0000	1.22474	



5. DISCUSSION

Surgical site infection is a complication following orthopaedic surgery, which results in prolonged hospital stays and additional financial burdens. Surgical site infections (SSIs) are among the most frequently reported hospital-acquired infections. They may develop post-surgery due to patient factors, perioperative factors, contaminated instruments or environmental conditions of the healthcare facility.

Even though our patients pay their own treatment expenses, financial burden was encountered for reprocedure, hospital stay and, operative and treatment costs. Early detection is the first step to prevent or decrease damage.

Hence, we intended to do this study to observe the incidence of SSI and analyse the incidence and predictors of Surgical Site Infection in Closed Fracture Fixation. Therefore, the present prospective study has been carried out in our hospital on 72 admitted cases that had undergone internal fixation for clean closed fractures between January 2021 to August 2021.

Incidence of SSI

SSI rate varies in different countries, different areas, different hospitals and even in different wards of a hospital. The incidence of SSI differs according to various factors of each nation all over the world. The incidence of SSIs in Asian countries was 7.8%, as per the WHO's global guidelines for the prevention of SSIs[5].

In low- and middle-income countries (LMICs), the incidence rate of SSIs was much greater compared to high-income settings3. In India, considerable variations in SSIs rates have been reported from different geographical locations within the country and ranged from 1.6% to 38% The overall incidence of SSI in the present study was 6.9%, superficial 5.55% and deep 1.35%.

Risk factors associated with SSI: Patient factors

Xiapo Liu et al.[6] conducted a multicenter retrospective study in three level I hospitals and found out of 1240 patients of >60 years undergoing orthopaedic surgeries, age > 79 years , and ALB < 4.16 mg/L were associated with an increased incidence of SSI after fracture. Various patient characteristics like older age, comorbidities, predominantly diabetes, smoking, drinking, obesity and coincidental infections or colonization at other site have been shown to have a significant, independent association with SSI prediction.[2]

In our study, out of 72 total patients, the mean age was 51.98 (SD 19.22), with 45 (62.5%) males and 27 (37.5%) females. We had infection in 5(6.9%) patients with a mean age of 45.4 (SD 16.77), 2(4.4%) were males and 3(11.1%) were females.

Though old age is associated with an increased risk of SSI, young patients who are malnourished and undergoing surgeries with implantations can develop SSI.7 Smoking has been linked with an increased incidence of surgical site infection amongst closed elbow fractures, as reported by Claessen FM et al.8 In our study, 2 out of 5 patients had history of tobacco use.

In a retrospective study conducted by Dawei Liu et al., they linked preoperative Neutrophil Lymphocyte ratio of >7.8 (OR, 3.45; 95% CI, 1.33-6.74).9 Different cut-off for NLR have been published for predicting the prognosis of sepsis, the metaanalysis by Zhiwei Huang et al., the cut-off value varied considerably ranging from 4.36 to 23.8.[10]

Similarly, in our study, all patients with SSI had increased preoperative NLR with a mean of 5.7(SD 5), which was statistically significant.

Hypoalbuminemia is linked with poor tissue healing, decreased collagen synthesis and granuloma formation in surgical wounds. This medical condition increases wound dead space and creates an environment which predisposes a person to infection. Low serum albumin causes tissue oedema and a leak of interstitial fluid into the wound, which provides a medium for bacterial propagation. Serum albumin is the most commonly used indicator of a patient's nutritional status owing to its reliability. It is an efficient predictor of surgical risk closely correlated with the degree of malnutrition.[11–13]

Yuwen et al. concluded with their meta-analysis that patients with Serum albumin less than 3.5 mg/dl had a 2.5 times increased risk of SSI in Orthopaedics.14 Using this study as the basis, our study showed that out of 16 patients who had preoperative serum albumin <3.5g/dl, only 1 was infected.

Risk factors associated with SSI: Intraoperative factors

American Society of Anesthesiologists classified III-IV score (OR, 2.2; 95% CI, 1.3-3.8), surgical duration of >132 minutes (OR, 2.9; 95% CI, 1.1-5.0) were independent risk factors of postoperative SSI according to Jimbo le, Zhijie Dong and others who conducted a retrospective analysis in Geriatric Traumatic cases.[15]

Increased duration of surgery has been established as a significant risk factor for postoperative SSI. In a retrospective study conducted by Xing Dong et al.16, they reported that the operative time of >122 minutes significantly affects SSI incidence in upper extremity fractures.

In our present study all the patients with SSI had ASA grade 3. All patient's operative time was more than 120 min (Mean 180 mins with SD 77 mins), which was found to be significant in our study. The mean blood loss of infected cases during surgery was 560mL which did not correlate statistically with incidence.

Limitations

- Prospective study with a larger sample size needs to be conducted for better analysis.
- Multiple operating surgeons
- Study conducted in one department of one hospital including only clean trauma cases undergoing internal fixation.

6. CONCLUSION

The incidence of SSI in our hospital was found to be within acceptable range in India with 5.55 superficial and 1.35 deep SSI. Patients with preoperative NLR ratio more than 5.7 and operative time of >120 mins should be kept under better observation as they possess higher risk for postoperative surgical site infection. Age >79, ASA grade ≥4, Patients with diabetes and patients with serum albumin < 3.5 g/dl are independent risk factors of SSI, though, they were not found to be significant in our study.

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