IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 17, Issue 01 Ver. VIII January. (2018), PP 23-28
www.iosrjournals.org

Surgical Site Infections – Incidence, Risk Factors And Microbiological Pattern – Study From North East India

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Abstract: *Surgical site infections(SSI) are one of the most common yet one of the most troublesome complication following any surgical procedure.In this study an effort has been made to study the incidence, risk factors and microbiological pattern of SSIs in one of the major hospitals of north east india.200 patients who met the inclusion criteria were included in this 2 year study.Patients were followed up for a period of 30 days to look for any signs of SSIs. Those who developed SSIs were further evaluated for the risk factors, microbiological pattern and consequences. All the results were discussed in detail . Literatures for the same type of study in an Indian setting that too in rural part of India are only a few which add on to the significance of this study.*

Keywords : *Incidence, Microbiological pattern, North east India, Risk factors, Surgical site infections.*

Date of Submission: 01-01-2017 Date of acceptance: 20-01-2018

I. Introduction

Surgical site infection is defined as infection that may occur within the surgical site at any depth, starting from the skin itself and extending to the deepest cavity that remains after dissection of an organ occurring within 30 days of the surgery. It is divided in to three – superficial, deep space and organ space SSIs according to the CDC criteria. The incidence of SSIs has been estimated to be about 3% in the US but it varies between 5% for clean surgeries to more than 20% for emergency colon surgeries which is performed in a dirty field.[1] Risk factors involved in the development of SSI include, a) Patient factors – extremes of age,obesity, diabetes, malnutrition, skin carriageof staphylococci, post operative anaemia, hypo albuminemia ,hypocholesterolemia, corticosteroid therapy, chronic inflammation, immunodeficiency, b) Environmental factors - inadequate skin antisepsis, inadequate disinfection/sterilisation, contaminated medications, c) Treatment factors - drains, emergency procedures, inadequate antibiotic prophylaxis, prolonged operative time,prolonged preoperative hospitalization.[2] The microbiology of SSI is reflective of the initial host microflora, either from skin microflora in case of Class I wounds or colonic microflora as in other class of wounds.Gram positive cocci account for half of the infections of which those caused by staphylococcus aureus is the most common. Other microbes include coagulase negative staphylococcus and enterococcus. Staphylococcus aureus normally occurs in the nasal passages, mucous membranes and skin of carriers. In approximately one third of cases gram negative bacilli like E coli, pseudomonas and enterobacter are implicated. These are usually seen after GI surgeries. Rarely group A beta haemolytic Streptococci and Clostridium perfringens are also isolated.[3]This study was conducted among 200 patients who underwent various surgical procedures in the Department of Surgery in Regional institute of Medical Sciences, Imphal from September 2015 to August 2017 and the results were analysed using appropriate statistical tools.

II. Materials And Methods

A cross sectional study was conducted in the Department of Surgery, Regional Institute of Medical Sciences, Imphal from September 2015 to August 2017 among patients who underwent abdominal surgery
Inclusion criteria

1. Patients who underwent abdominal surgery including emergency and elective surgeries in the Department of General Surgery, Regional Institute of Medical Sciences, Imphal.
2. Patients who gave consent for the study
3. Exclusion criteria
4. Surgeries other than abdominal surgery
5. Patients who were on steroids and immunosuppressive therapy
6. Surgery done outside Regional institute of medical sciences
7. Patients who did not give consent for the study

Study variables included age, sex, body mass index, accompanying conditions like hypoalbuminemia, pre-operative anaemia, diabetes mellitus, method and time of preoperative hair removal, preoperative shower, duration of operation, type of wound, type of surgery, prophylactic antibiotics, use of drain , number of days of postoperative hospital stay. The data collection was done as follows – preoperative interview, post operative interview, record completion, pre discharge examinations and weekly follow ups for up to 30 days after operation. Follow up was done once in a week till 30 days after surgery. During follow up vitals including the temperature was measured and wound was examined for any signs of infection or inflammation. The data was entered and analysed by the SPSS 21 v, using Student's t-test for continuous variables and chi- square test for categorical variables. P value of < 0.05 was considered statistically significant.

III. Results

200 patients who underwent abdominal surgeries were randomly selected and were followed up for a period of 30 days. Data were collected with a pre prepared proforma and analysed using SPSS 18. The following observations were made following the analysis, out of the total 200 patients followed up 37 developed SSIs , with an incidence rate of 18.5% . Out of the total 200 patients 106 were males and 94 were females, youngest patient was 1 year old and the oldest patient was 83 years old with maximum number of patients belonging to the age group of 31-40 years. According to the BMI distribution, 167 patients had their BMI in the normal range (18-23 Kg/m^2) and 31 patients were obese (>23 Kg/m^2). Among the co morbidities studied 16 patients had diabetes mellitus and 7 of them had deranged blood glucose levels at the time of surgery, 9 patients had hypertension and none of them had thyroid diseases. Out of the 200 patients 6 had anaemia, 34 patients had elevated total count and 19 patients had hypoalbuminemia. Deranged serum urea and creatinine prior to surgery was found in 91 patients. All patients were given pre-operative antibiotic prophylaxis about 30 minutes to 1 hour before the incision was made. Pre-operative hair removal was done for 185 patients and shaving was the only mode of hair removal. Out of the 185 patients, 137 patients had undergone hair removal 12 hours prior to the procedure. None of the patients have taken pre-operative shower on the day of surgery. 146 patients underwent elective abdominal surgeries whereas 54 patients underwent emergency procedures, 176 surgeries were open procedures and 25 were laparoscopic procedures. Out of the 200 procedures 88 were cholecystectomies,46 were appendicectomies, 26 cases each of hollow viscus perforation and hernia surgeries , 5 cases each of trauma and tumors and 4 cases were resection anastomosis procedures. Only one case took more than 3 hours for completion of surgery out of the 200. No drain was put in the wound in any of the cases. Out of the 37 patients who developed SSIs , 23 had a prolonged hospital stay and the maximum duration of hospital stay was for 3 months and 5days, whereas minimum hospital stay was for 18 days. Pus culture was done in all cases of SSIs and gram negative bacilli belonging to enterobacteriacea were the most common organism followed by gram positive aerobes and anaerobic bacteriae. All the variables studied were analysed using appropriate statistical tests and results were obtained. The significant variables for development of SSI according to the study were age of the patient , sex of the patient , diabetes , leucocytosis , uncontrolled blood sugar at the time of operation , hypoalbuminemia , time of hair removal , type of surgery whether elective or emergency , type of surgery whether open or laparoscopic , type of surgical wound , and post-operative hospital stay.All the patients who developed SSI recovered, the only morbidity being increase in hospital stay and increased expenses for the treatment. The study was conducted with due attention to research ethics. However sample size and problems met during follow up of discharged patients have imposed limitations on the study.

IV. Figures And Tables

Table 1: Distribution of types of Surgical site infections

Types	**No. of patients (n=37)**	**%**
Superficial	34	91.8
Deep space	2	5.4
Organ space	1	2.7

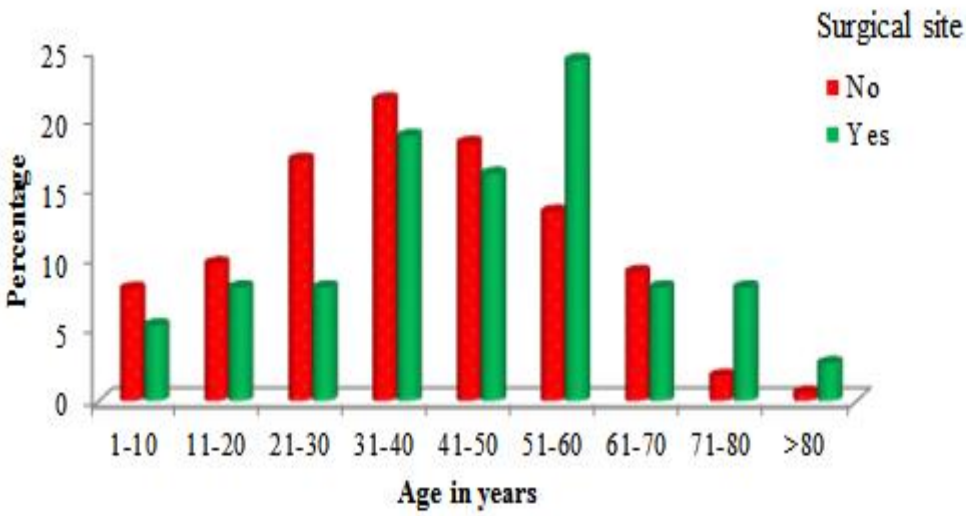

Figure.1. Age wise distribution of SSI in the study population

Table .2. Sex distribution of patients under study in respect to SSIs

Gender	Surgical site infection		Total
	No	Yes	
Female	82(50.3%)	12(32.4%)	94(47%)
Male	81(49.7%)	25(67.6%)	106(53%)
Total	163(100%)	37(100%)	200(100%)

P=0.049*, Significant, Chi-Square test

Table 3: Distribution of SSI in respect to co-morbidities

Co morbidities	Surgical site infection		Total (n=200)	P value
	No (n=163)	Yes (n=37)		
DM	4(2.5%)	12(32.4%)	16(8%)	<0.001**
HTN	8(4.9%)	1(2.7%)	9(4.5%)	1.000
Thyroid DS	0(0%)	0(0%)	0(0%)	1.000

Chi-Square test/Fisher Exact test

Table 4: Deranged blood parameters in relation to SSIs

Investigations	Surgical site infection		Total (n=200)	P value
	No (n=163)	Yes (n=37)		
Anemia	3(1.8%)	3(8.1%)	6(3%)	0.078+
Leucocytosis	20(12.3%)	14(37.8%)	34(17%)	<0.001**
Hyperglycemia	0(0%)	7(18.9%)	7(3.5%)	<0.001**
FBS	0(0%)	0(0%)	0(0%)	1.000
PPBS	0(0%)	0(0%)	0(0%)	1.000

Chi-Square test/Fisher Exact test

Table.5. Deranged blood parameters in relation to SSIs

Investigations	Surgical site infection		Total (n=200)	P value
	No (n=163)	Yes (n=37)		
Raised serum Urea (mg/dl)	75(46%)	16(43.2%)	91(45.5%)	0.760
Raised serum Creatinine (mg/dl)	75(46%)	16(43.2%)	91(45.5%)	0.760
Raised bilirubin	0(0%)	0(0%)	0(0%)	1.000
Hypoalbuminemia	5(3.1%)	14(37.8%)	19(9.5%)	<0.001**

Chi-Square test/Fisher Exact test

Table 6: distribution of SSI with type of surgery

Type of surgery	Surgical site infection		Total (n=200)	P value
	No (n=163)	Yes (n=37)		
Elective	133(81.6%)	13(35.1%)	146(73%)	<0.001**
Emergency	30(18.4%)	24(64.9%)	54(27%)	<0.001**

Chi-Square test/Fisher Exact test

Table.7. distribution of SSI with type of surgery

Type of surgery	Surgical site infection		Total (n=200)	P value
	No (n=163)	Yes (n=37)		
Open	139(85.3%)	36(97.3)	175(87.5%)	0.009**
Laparoscopic	24(14.7%)	1(2.7%)	25(12.5%)	0.053

Chi-Square test/Fisher Exact test

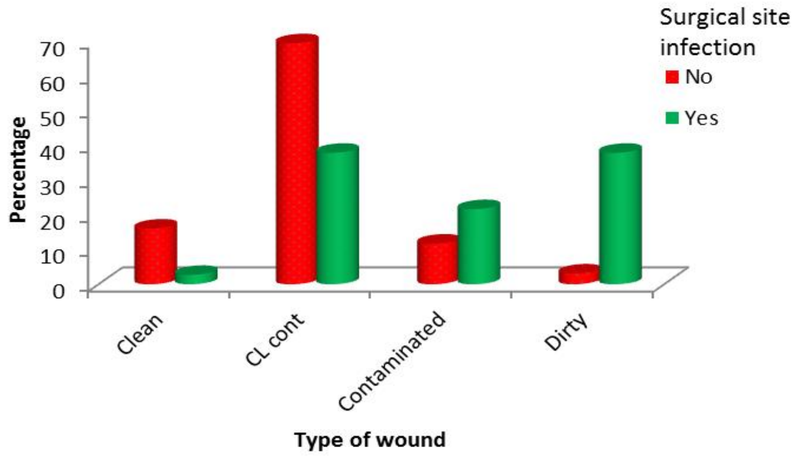

Figure.2. distribution of type of surgical wound

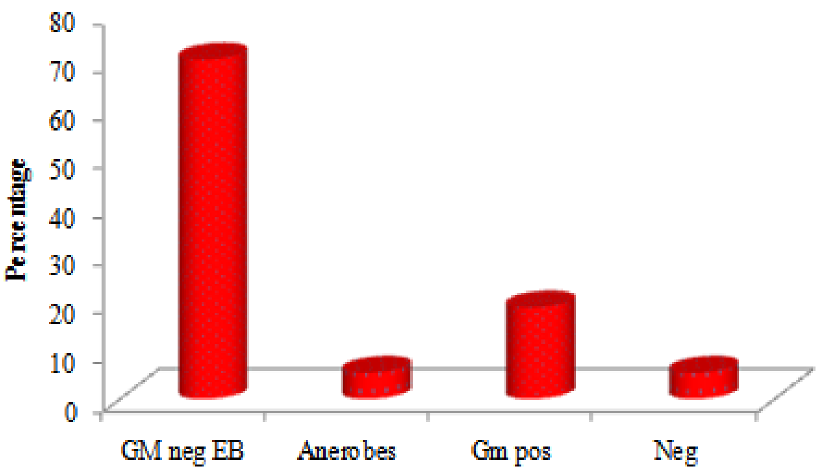

Figure.3. Bacteriological pattern of SSI

V. Discussion

200 patients who underwent abdominal surgeries in Department of Surgery in our institute were randomly selected and were followed up for a period of 30 days after surgery. Initial follow up was done in the ward until the patients were discharged and rest of the follow up was done in OPD. In this study, out of 200 patients who were operated, 37 patients developed SSIs and the incidence rate was calculated to be 18.5%Other

variables included in the study were age, gender, BMI, comorbidities, blood investigations, hair removal time and mode of hair removal , pre-operative shower, prophylactic antibiotics, type of surgery, type of wound, duration of surgery, presence or absence of drains, types of SSIs, post-operative hospital stay and the bacteriological pattern in SSIs. ncidence of SSIs was highest in the age group of 51-60 years 24.3% of all SSIs. It was also observed that incidence of SSIs are maximum in the mean age group of this study ie; 39.82 ± 18.76 and such a distribution was statistically significant with a p-value of 0.041. Increasing age was found out as an independent risk factor for development of SSI in another prospective study.[5] In the present study male gender was found to be a significant risk factor for development of SSIs with 67.6% of all SSIs developing in male patients and 32.4% of SSIs developing in female patients which was statistically significant, possibly due to differences in propensity for skin colonization or other anatomical differences. In this study BMI was studied as a risk factor for development of SSI and was concluded that increased BMI was found to be a statistically significant risk factor for development of SSI with a p-value of 0.032. Co-morbidities studied were diabetes mellitus, hypertension and thyroid disease. Among all patients studied 16 were diabetic and 12 among them developed SSIs which constituted 32.4% of all SSIs. Diabetes mellitus was found to be significantly associated with development of SSIs with a p-value of <0.001 indicating highly significant statistical association. Another variable under this study was deranged blood parameters which included anemia (Hb <10gm%) , raised total leucocyte count (> 12,000 in adults and >15,000 in children), raised RBS (>200mg%), raised FBS(>110mg%) and PPBS(>140mg%) wherever it was applicable, as it was not done in emergency cases, raised serum urea (>90Mg%), raised serum creatinine(>1.2mg% in females and >1.4mg% in males), raised bilirubin (>2mg%) and hypoalbuminemia (<3gm%) . Among these variables raised total leucocyte count was found to be highly significant statistically with a p-value of <0.001 for development of SSI.Another variable which was found highly significant for development of SSI was pre-operative hyperglycemia indicated by raised RBS with a p-value of <0.001 and all these patients were known diabetic patients also indicating significance of proper glycemic control prior to surgery in diabetic patients. In this study 19 out of total 200 patients had hypoalbuminemia and 14 of them developed SSI which constituted 37.8% of total SSI and this was highly significant statistically with a p-value of <0.001. Time of pre-operative hair removal was studied, incidence of SSI was found to be maximum in first group were hair removal was done <12 hours prior to surgery which constituted 56.8% of all SSIs and this was highly significant statistically with p-value of <0.001, indicating that hair removal done <12 hours before surgery has significant risk of development of SSIs.In our institute pre-operative shower is not being followed as a part of pre-operative preparation and hence none of the patient in this study had taken pre-operative shower on the day of surgery. Hence incidence of SSI, could not be compared with those who have and those who haven't taken pre-operative shower.It is a mandatory practice in our institute to give prophylactic antibiotics in every patient who undergoes both emergency and elective procedures. In this study all the patients have received at least one dose of prophylactic antibiotic 30 minutes to 1 hour prior to the procedure irrespective of elective or emergency setting. Since all the patients belong to single group, it could not be evaluated as a risk factor for development of SSI. Type of surgery has been compared in 2 groups, one in which comparison was done between emergency and elective and the other in which comparison was done between open and laparoscopic procedure. Incidence of SSIs was found to be 64.9% of total SSIs in the emergency group whereas it was 35.1% in the elective group. This distribution was found to be highly significant statistically with a p-value of <0.001 indicating that surgeries done in emergency setting had a very high risk of developing SSIs. The second group was the one which compared open and laparoscopic procedures as a risk factor for development of SSIs. Incidence of SSIs was found to be highest in the group which had underwent open procedures which constituted 97.3% of all SSIs. This was highly significant statistically with a p-value of <0.009 indicating that laparoscopic procedures are safer in respect to development of SSIs. In this study surgical wounds were categorized in to four categories namely, clean, clean contaminated, contaminated and dirty. Out of these clean contaminated wound was found to be a highly significant risk factor for development of SSIs with a p-value of <0.001 and same result was obtained for dirty wounds also with p-value of <0001 indicating that dirty wounds are also a highly significant risk factor for development of SSIs. Association of contaminated wound with development of SSIs was also found to be statistically significant with a p-value of 0.033 whereas association of clean wounds with SSI was statistically insignificant in this study.

In this study an effort was made to find out the most common organism causing SSI following abdominal surgeries. From the study it was found that 70.27% of all SSI were caused by gram negative aerobic bacteria belonging to the gut flora, 5.4% was caused by anaerobes.

Another variable under this study was association of SSI with post operative stay. Post operative stay was studied under 2 groups, one group with <15 days and another with >15 days. In this study 23 patients stayed in hospital for more than 15 days following their surgery out of which 19 patients had SSIs which constitutes 82.6% of patients with increased hospital stay and 4 patients had other surgery related complications. After analysis it was concluded that occurrence of SSIs was highly significant for prolonged hospital stay after surgery, with a p-value of, 0.001.

VI. Conclusion

This was a 2 year study from September 2015 to august 2017 conducted among the patients who had undergone abdominal surgeries in the Department of General Surgery in RIMS, Imphal. Sincere attempt was made to include most of the risk factors and outcomes of SSI, but due to the short duration of study and small sample size some of the factors included in the literature could not be studied. Moreover problems encountered during follow up of the patients in out-patient department had imparted some limitations to the study. Despite these limitations this study could bring out some significant findings that may help in improving patient care in the future. A total of 200 patients were included in the study and the results obtained were as follows. The number of patients who developed SSI was 37 over a follow up period of 30 days and incidence of SSI in this study was 18.5%. The risk factors under study were age of the patient, sex of the patient, BMI, co-morbid conditions, deranged blood parameters, time and mode of pre-operative hair removal, pre-operative shower, prophylactic antibiotics, type of surgery, type of surgical wound, duration of surgery, presence of drain in the wound, post operative hospital stay and bacteriological pattern in SSI. The significant findings from this study are as follows.

1. Highest incidence of SSI in this study was in the age group of 51-60 years, constituting around 24.3% of all SSIs
2. Male gender had slightly more risk of developing SSI
3. Obesity was found to be strongly associated with SSI
4. Diabetic patients were at high risk for developing SSI
5. Pre operative hyperglycemia was found to be strongly associated with SSI
6. Pre operative leukocytosis had a significant impact on development of SSI
7. Hypoalbuminemia was found to be a significant risk factor
8. Hair removal <12 hours prior to surgery significantly increased the risk of SSI
9. Surgeries done in emergency setting had a higher risk of SSI
10. Open procedures were associated with higher risk of SSI compared to laparoscopic procedures
11. Clean contaminated, contaminated and dirty wounds were associated with increase in SSI with risk being maximum for dirty wounds
12. Patients who developed SSI had significant morbidity in the form of prolonged hospital stay and increase in hospital expenses
13. The most common pathogen encountered in SSI in this study was gram negative bacilli belonging to gut flora

Mode of hair removal, pre-operative shower, prophylactic antibiotics, duration of surgery and presence of wound drain could not be studied as a variable in this study.

This study has brought out most of the modifiable causes of development of SSIs so that proper measures can be taken to prevent the same. Surgical site infections are one of the most common wound related complication following any general surgical procedure and more so for abdominal surgical wounds. Development of SSI causes significant burden on patient in respect to post operative morbidity and expenses, which almost double following development of SSI and significant burden on doctors and hospital resources in respect to wastage of resources.Every measure should be taken to prevent the occurrence of SSI so as to reduce mortality and morbidity for the patient as well as to reduce significant economic burden on a developing country like India.

References

[1]. Leaper DJ. Surgical infection. In: Williams NS, Bulstrode CJK, O'Connell PR, editors. Bailey & Love's Short Practice of Surgery. 26th ed.(London: Hodder Arnold; 2008. p. 50-67).

[2]. Barie PS. Surgical infections and antibiotic use. In: Townsend CM, Beauchamp RD, Evers BM, Mattox KL, editors. Sabiston textbook of surgery- the biological basis of modern surgical practice. 19th ed. (Philadelphia: Elsevier; 2013. p. 240-80).

[3]. Beilman GJ, Dunn DL. Surgical Infections. In: Brunicardi FC, Anderson DK, Billiar TR, Dunn DL, Hunter JG, Matthews JB, Pollock RE, editors. Schwartz's Principles of Surgery. 10th ed. (New York: Mc Graw Hill; 2015. p. 135-60).

[4]. Scott JD, Forrest A, Feuerstein S, Fitzpatrick P, Schentag JJ. Factors associated with postoperative infection. Infection Control & Hospital Epidemiology 2001 Jun;22(6):347-51.

Dr. Lekshmi Priya.R "Surgical Site Infections – Incidence, Risk Factors And Microbiological Pattern – Study From North East India." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 17, no. 1, 2018, pp. 23-28.