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Surgical Site Infections and its Clinico-bacterial Relation at a Tertiary Care Centre

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Abstract
Surgical site infection is a type of health care-associated infection, in which a wound infection occurs after an invasive procedure. SSI has been shown to compose up to 20% of all health care -associated infection. SSI are among the most common complications of inpatient admission but majority are preventable.
This study was carried out at NMCH, Patna, Bihar on 500 patients during April 2016 to September 2017. The objective of the study was to determine the incidence of SSI among different type of surgeries and their relation to the type of wound and to identify the various pathogens causing SSI in our setting and to study their antibiotics sensitivity and resistance pattern and also to assess the various risk factors contributing to SSI in our hospital.
In this study the overall incidence is 9% with no significant difference between both Genders. SSI in emergency surgery (13.33%) was significantly higher than that of elective surgery (8.88%) and incidence was significantly higher in which duration of surgery was more than two hours. E.coli and klebsiella infection were significantly higher.
Keywords: *SSI, Surgical site infection.*

Introduction

Surgical site infection are infection present in any location along the surgical tract after a surgical procedure.[1] A surgical site infection may range from a spontaneously limited wound discharge within 7-10 days of an operation to a life threatening post-operative complication. Surgical site infection[SSI] have been shown to compose up to 20% of all healthcare associated infections and at least 5% of patients undergoing a surgical procedure develop a surgical site infection. SSIs are among the most common complications of inpatient admission and have serious consequences for outcomes and costs. It is associated with considerable morbidity and extended hospital stays.

But the fact is the majority of surgical site infections are preventable with measures taken in pre, intra – and post-operative phases of surgical care. Treatment of infection has been an integral part of surgeon's practice since the dawn of the time and the body of knowledge that led to present

field of surgical infection disease was derived from the evolution of germ theory and antisepsis.

Over the past 50 years, increased interest in the discipline of surgical infection has resulted in post surgical infection control. Remarkable life saving discoveries have been made but infection causing organism have been succeful in combacting antibiotics and the research continues. It is also important that the effectiveness of any new procedure introduced must be evaluated.

Aims and Objectives

As surgical site infections are the commonest among in-patient complications, this can have serious consequences for outcomes and cost effectiveness and as well as the quality care.

This study was aimed to

1. Determine the incidence of surgical site infection among different types of surgeries (elective vs emergency) and their relation to the wound (clean, clean contaminated, contaminated and dirty)
2. Identify the various pathogens causing surgical site infection in our setting and to study their antibiotic sensitivity and resistance pattern
3. Assess the various risk factors contributing to surgical site infection in our hospital.

Materials and Methods

A prospective observational study in the department of General Surgery, Nalanda Medical College and Hospital, Patna Bihar was carried out from April 2016 to September 2017.The total no of patients studied were 500 and they were randomly chosen from the patients undergoing surgery in the department of General Surgery, Nalanda Medical College and Hospital.

Inclusion Criteria

All cases operated in the department of General Surgery in our hospital, in the above mention time period and regardless of age or associated co-morbidities like diabetes, jaundice, anemia.

Exclusion criteria

Wound site previously infected

Immunocompromised status

All the pre-operative prepartion and precations in terms of hand wash and part preparation were followed according to standard protocols. The clothing and ventilation of operation theatre was also looked for their standard protocol. Post-operative antibiotics were given according to hospiatal policy and post-operative care in terms of ventilation, linen. food and dressing in the ward were also looked for set standards.

Method of data collection

An elaborated study of these cases with regard to date of admission, history, clinical features, date and type of surgery with pre-operative preparation and postoperative management was done till the patient is discharged from hospital and then we followed-up the patients on OPD basis. So those 500 patients who continued for follow-up were selected for our study.

Procedure in laboratory

The sample collected were processed as follows:

- Direct microscopic examination of gram stained smear.
- In oculation of the sample into different culture media for aerobic and anaerobic organism
- Preliminary identification
- Bio-chemical tests
- Antibiotic sensitivity

Now the wound and the surgical site infection follows the criteria set by CDC as mention below:

Centres for disease control and prevention criteria for defining a surgical site infection[2]

1.Superficial Incisional

Infection less than 30 days after surgery and it involves skin and subcutaneous tissue only, plus one of the following

- Purulent drainage
- Diagnosis of superficial surgical site infection by a surgeon
- Symptoms of erythema, pain, local oedema

2.Deep Incisional

Infection less than 30 days after surgery with no implant and soft tissue involvement and infection less than 1 year after surgery with an implant; involves deep tissues(fascia and muscle),plus one of the following-

- Purulent drainage from the deep space but no extension into the organ space.
- Abscess found in the deep space on direct or radiological examination or on reoperation.
- Diagnosis of deep space surgical site infection by the surgeon.
- Symptoms of fever ,pain and tenderness leading to dehiscence of the wound or opening by a surgeon.

3.Organ space

Infection less than 30 days after surgery with no implant. Infection less than 1 year after surgery with an implant; involves any part of the operation opened or manipulated, plus one of the following

- Purulent drainage from a drain placed in the organ space.
- Cultured organisms from material aspirated from the organ space.
- Abscess found on direct or radiological examination or during re-iperation
- Diagnosis of organ space infection by a surgeon

Classification of surgical wounds:

Clean wound

- No hollow viscus entered
- Primary wound closure
- No inflammation
- No breaks in aseptic techniques
- Elective procedure
- Infection rate is 1%-3%.

Clean-contaminated

- Hollow viscus entered but controlled
- Primary wound closure
- No inflammation
- Minor breaks in aseptic techniques
- Mechanical drain used
- Bowel preparation pre-operatively
- Infection rate is 5%-8%.

Contaminated

- Uncontrolled spillage from viscus
- Inflammation apparent
- Open, traumatic wound
- Major break in aseptic technique.
- Infection rate is 20%-25%.

Dirty

- Untreated, uncontrolled spillage from viscus
- Pus in operative wound
- Open suppurative wound
- Severe inflammation.
- Infection rate is 30%-50%.

Result and Discussion

This is a prospective observational study of 500 cases who underwent surgery and were followed up from the day of operation to 30 days after discharge to look for the development of SSI. In our study the incidence of SSI was 9% which almost corresponds to the different studies conducted in India. According to Satyanarayana V et al (2011); the incidence was found 13.7% and one more study of Barnali et al (2013);the incidence was found to beb7.44%.

There was no significant difference between male and female population in our study as incidence of SSI among male was 8.97% and among female 9.09%. Mahesh C B et al also reported incidence of SSI 21% and 18.88% among male and female respectively.

The present study shows highest incidence of SSI was found in the age group of 51years-60years. The younger age group had lesser incidence of SSI. This confirms the understanding that there is gradual rise in the incidence of SSI with advancing age. Son J I et al; found higher incidence of SSI in the age group of 51-60 years. Mizrahi I et al; reported higher incidence of SSI above the age of 60 years.

The SSI rate in elective surgeries, in our study, was found to be 8.88% and it was found to increase to 13.33% in emergency surgeries. Bernali et al; suggested that the incidence of SSI

in elective surgery was 4.86% while in emergency surgeries it was 15.2%.

Patients with risk factors like anemia, diabetes, hypoproteinemia, obesity and smoking had higher incidence of wound complications. Fischer JP et al;reported that medical co-morbidities including obesity, smoking, hypertension, diabetes and anemia increases the rate of surgical site wound infection.

Incidence of SSI was significantly higher in the patients with preoperative hospitalization of 11-15 days. Mahesh CB et al; found that as the preoperative stay increases the incidence of SSI also increases. Lilani SP also reported that the incidence of SSI increased with increase in the duration of preoperative stay.

Most of the SSI were superficial type constituting 66.67% of infected cases followed by deep SSIs (26.67%) and organ space infection (6.66%). Neuman D et al; in their study also found that rate of superficial infection was more than deep infection.

In our study, regarding incidence in relation to the type of wound, clean cases had infection rate of 1.83%,clean contaminated had incidence of 19.29% and dirty cases had incidence of 66.66%,which was similar to the findings in other studies as Mahesh CB in their study reported that incidence of SSI was less on clean cases(11.53%) than clean contaminated (23.33%) and in the Same study it was found that highest incidence was associated with dirty cases(57.14%).

49.62% cases with duration of surgery less than 1 hr showed an incidence of SSI of 4.52%. Cases with duration of surgery 1-2 hrs (37.65%) showed an incidence of SSI of 11.26% and almost 12.71% cases with duration of surgery of more than 2 hrs showed an incidence of SSI of 19.61%.When compared with Bernali et al; they also showed surgery with less than 1 hr has incidence of SSI, 6.66%, surgery going for 1-2 hours had incidence 6.23% and when surgery took more than 2 hours incidence was found 38.46%.

Most common organism isolated in your study is E-coli was 31.11%, followed by klebsiella (22.22%), pseudomonas (13.33%), followed by staph aureus and MRSA. Our finding of predominance of gram negative bacilli are similar to that of other studies. In most cases of SSI the organism is usually the patient's endogenous flora. This group of organisms tend to be endemic in hospital environment by being easily transferred from object to object, they also tend to be resistant to common antiseptics and are difficult to eradicate in the long term.

E. coli, klebsiella, pseudo on as were most commonly isolated from clean contaminated wounds in 54.5%, 75% and 60% cases respectively. staph. aureus was most commonly isolated from clear wounds. Healy B et all reported that in clean surgery, [i.e, nonemergency surgeries that does not enter the gastrointestinal or genitourinary tract],where infection does occur, antibiotic resistant organism, such as methicillin resistant staphylococcus aureus [MRSA] and in contaminated surgery, enterobacteriaceae was most common.

The mean duration of hospital stay [mean+-SD] of the patients was 7.83+- 2.26 days with range 5-14 days and the median was 7 days. Most of the patients stayed in hospital for 6-10days.Gregory DL et all reported that SSI extended length of hospital stays by an average of 9.7 days.

Most of the patients were treated with imipenam, amikacin, piperacillin+tazobactum, amoxicillin+ calvulanic acid, cefoperazone+ sulbactum, which was also the case in most of the other studies.

In terms of antibiotics sensitivity and resistance E.coli was found to be most sensitive to Imipenem, meropenem (91.11%) followed by amikacin, piperacillin+tazobactum, cefoperazone+ sulbactum, levofloxacin, gentamycin.

Klebsiella was found to be most sensitive to imipenem, meropenem (86.66%) followed by amikacin, piperacillin+tazobactum, levofloxacin, clindamycin.

Pseudomonas was found to be most sensitive to imipenem, meropenem, piperacillin+tazobactum (82.22%) followed by clindamycin, amikacin, cefoperazone+sulbactum and vancomycin.

Pseudomonas was found to be most sensitive to imipenem, meropenem, piperacillin+tazobactum (80%) followed by clindamycin, amikacin, cefoperazone+sulbactum and vancomycin (60%).

Staphylococci was most sensitive to amoxicillin+clavunic acid, imipenem, meropenem (100%), followed by piperacillin+tazobactum, ceftriaxone, cefotaxim, ceftazidime, azithromycin (75%).

MRSA was found to be most sensitive to imipenem, meropenem (100%),followed by piperacillin+tazobactum, cefoperazone+sulbactum (75%).

Proteus, Acinetobacter and others were most sensitive to higher antibiotics like imipenem, meropenem followed by piperacillin+tazobactum.

E.coli was found to be most resistant to clindamycin, vancomycin and amoxicillin+clavunic acid (72.7%).

Klebsiella was found to be most resistant to cefotaxim, amoxicillin+clavunic acid and gentamycin (75%).

Pseudomonas was most resistant to amoxicillin+clavunic acid, azithromycin, gentamycin, ciprofloxacin and levofloxacin (80%).

Staphylococci was most resistant to gentamycin, ciprofloxacin and cefoperazone+sulbactum (75%).

MRSA was found most resistant to ceftriaxone, amoxicillin+clavunic, azithromycin (100%), follwed by levofloxacin, ciprofloxacin, gentamycin, cefotaxim and ceftazidime (75%).

Proteus, acinetobacter and others were most resistant to antibiotics like-ceftriaxone,cefotaxim, ceftazidime, amoxicillin+clavunic acid, azithromycin, amikacin, gentamycin, ciprofloxacin, levofloxacin (100%). The results of our study were similar to other various studies.

The relative frequency of different isolates also varied between different studies. Thus it can be concluded that the organisms that cause SSIs change from place to place and from time to time in the same place. Different studies have showed gradual increase in drug resistance to many antibiotics.

Table: 1 Incidence of SSI

Total Number Of Cases	Number Of Cases Infected	Percentage
500	45	9%

Table: 2 Incidence in Relation to Sex

Gender	No. Of Cases	No. Of Cases Infected	Percentage
Male	368	33	8.97%
Female	132	12	9.09%
Total	500	45	9%

Table 3 Incidence in Relation to Age-Group

Age Group (years)	Total No Of Cases	No Of Cases Infected	Percentage
12-20	42	3	7.14%
21-30	63	5	7.93%
31-40	84	6	7.14%
41-50	102	8	7.84%
51-60	125	15	12%
61-70	52	5	9.61%
71-80	32	3	9.37%
81-90	500	45	100%

Table 4 Type Of SSI

Type Of SSI	Number	Percentage
Superficial SSI	30	66.67%
Deep SSI	12	26.67%
Organ Space SSI	3	6.66%
Total	45	100%

Table 5 Incidence of Organism Isolated

Organism Isolated	No. Of Cases	Percentage
E. Coli	14	31.11%
Klebsiella	10	22.22%
Pseudomonas	6	13.33%
Staphylococci	5	11.11%
MRSA	3	6.66%
Proteus	2	4.44%
Acinetobactar	2	4.44%
Others	3	6.66%
Total	45	100%

Table 6 Duration of Hospital Stay (In Days) After SSI

Duration of Hospital Stay	Number	Percentage
<5	7	15.55%
6-10	32	71.11%
>10	6	13.33%
Total	45	100%

Conclusion

A preexisting medical illness, prolonged operating time,the wound class, emergency surgeries and wound contamination strongly predispose to

surgical site infection. Antimicrobial prophylaxis is effective in reducing the incidence of post - operative would d infections for a number of different operative procedures but, timing of administration is critical.

Reduction of length of procedure through adequate training g of the staff on proper surgical techniques, proper intraoperative infection control measures and feedback of appropriate data to surgeons regarding SSIs would be desirable to reduce the surgical site infection rate.

A surveillance programme for SSI need to be applied by the hospital followed by auditing the infection rate on regular basis.

Each and every hospital should adopt an antibiotic policy and strict adherence to the same is necessary. Apart from this regular review and monitoring of the implementation of guideline is equally important.

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