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Original Research Article

Factors predicting surgical site infection after clean contaminated surgery

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ABSTRACT

Background: The infection of a wound is defined as the invasion of organisms through tissues following a breakdown of local and systemic host defences, leading to cellulitis, lymphangitis, abscess and bacteraemia. Southampton criteria and the centers for disease control and prevention criteria for the diagnosis of surgical site infections are used now for severity assessment. There is still controversy existing on the multifactorial causal relationship.
Methods: Longitudinal Observational study with nonrandom purposive sampling carried out in the patients in OT, Casuality, ICU and Wards, in our hospital having clean contaminated abdominal operations for one-year period starting from November 2015 determine the factors responsible for surgical site infections following clean contaminated abdominal operations with prophylactic antibiotics(n=150).
Results: Diabetes mellitus (odds ratio of 1.9) and emergency procedure (12.6%) were the most important risk factors for development of SSI. E. Coli (45%, n= 9) was the most common organism. Midline incision (n=6/22 = 27.27%) showed highest rate. Other high-risk factors are obesity, malnutrition, anemia, old age and prolonged duration of surgeries.
Conclusions: Various host factors like malnutrition, obesity, patients knowledge about hygiene, presence of co-morbidity etc. coupled with environmental factors such as condition of the wounds, delay to initiate operation, duration of operation, prolonged exposure of peritoneal cavity to environment, prophylactic use of antibiotics and factors associated with surgery like type of incision, 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. Moreover, in absence of highly advanced surgical amenities, preoperative resuscitative units, modern operation theatre facilities and sophisticated sterilization procedure it is necessary to use prophylactic antibiotics to encounter the various types of micro-organisms responsible for surgical site infection, particularly *E. coli*.

Keywords: Clean contaminated, Laparotomy, Southampton, Surgical site infection

INTRODUCTION

Surgical site infections and its complications were identified as one of the most important cause for postoperative morbidity following abdominal surgeries.[1] More over they significantly increase the hospital stay and treatment and hospital expense adding on to the economic burden of the dependent population especially in the developing countries.[2] Study of the surgical site infections and its risk factors and proper surveillance is the single best method for prevention of SSIs and thus reducing the postoperative morbidity and economic burden. In surgical literature, the term risk factor is often used in broad sense to include patient or operation

features, which although associated with SSI development, in univariate analysis are not necessarily independent predictors. Different risk factors associated with the patients and the procedure have been studied to identify to what degree they influence the development of SSI. Knowledge about the surgical procedure and patient characteristics, which might influence the risk of SSI development, are useful in two ways:

- They allow stratification of the procedures.
- Knowledge of risk factors before surgery may allow for targeted preventive measures.

Studying the microbial flora enables us to identify the source of contamination, the common organisms and their sensitivity patterns so that prevention and containment of infection becomes more specific and targeted. As the organisms and their sensitivity patterns change from hospital to hospital and time to time, studying the microbial flora helps in setting up the institutional protocols for antibiotic therapy against SSIs. Thus, the study not only helps to reduce the emergence of drug resistant organisms but also enables early identification of emergence of drug resistant organisms so that timely control measures can be instituted, and the data can be used for national surveillance

METHODS

It's a longitudinal non-random purposive study conducted in our hospital for a period of one year on patients undergoing clean contaminated surgery the following were the inclusion and exclusion criteria

Inclusion criteria

- The patients having clean contaminated open abdominal operations in all age groups
- The patients having elective and emergency abdominal operations
- Operations carried out in General Surgery O.T. with antibiotic prophylaxis as per/not as per Hospital norms

Exclusion criteria

Contaminated and dirty cases, Traumatic cases, Nonabdominal surgeries, laparoscopic surgeries.

The objective of the study was to:

- Factors influencing development of surgical site infection
- Bacterial culture: specimens also sent for bacterial culture

Data collection methods

By analysing the history and clinical examinations and investigations of each patient.

Statistical methods

The population for study was the entire population coming to the Department of General surgery. The sample was those who underwent clean contaminated abdominal surgeries. Their data was analysed using SPSS 23.0. Categorical variable was expressed in frequencies with percentage. Proportions were expressed with 95% confidence interval. Continuous variable was expressed as mean+ or- SD or median with interquartile range. Categorical variable was tested using Chi-square, Fishers exact test. For all tests P value <0.05 were considered as statistically significant.

RESULTS

Out of the 150 patients studied during the study period of 1year, the median age of the population studied was 45.5 (25^{th}-75^{th} IQR= 29-57). Highest number of patients belonged to the age group of less than 30 years (Figure 1), because appendicectomy was the most common operation performed and the incidence of appendicitis is highest in the young population. Among the population studied 56% (n=84) were males and 44% (n=66) were females. Diabetes was properly controlled with insulin before elective surgeries. Infections were treated with appropriate antibiotics before elective surgeries and procedures were done only after clinical cure of the infection. But in the case of emergency surgeries, these were not always possible. The prevalence of surgical site infections in my study group was 13% (n=20), Males were more commonly affected (55%, n=11) with SSIs. Diabetes mellitus was analyzed (Figure 2) as a risk factor for SSI and found that out of 14 patients with diabetes, 3 had SSI and out of 136 patients only 17 had SSI, with an odds ratio of 1.9 (p value= 0.35). There was high incidence of SSI among obese and malnourished group (25% each) compared with normal population. Equal number of elective and emergency abdominal surgeries were studied during the study period (n=75) (Table 1).

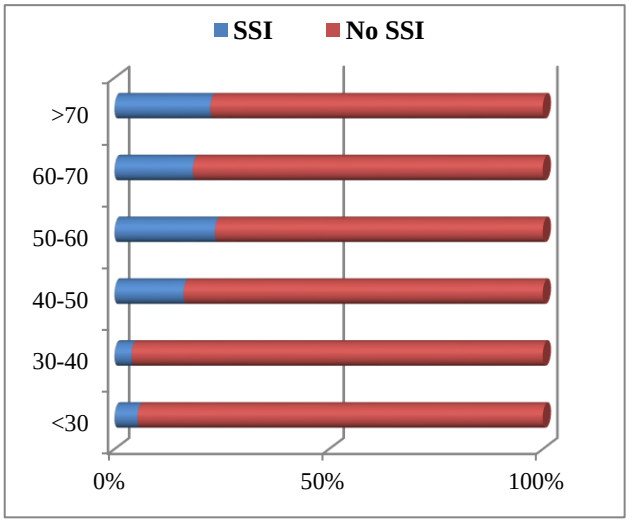

Figure 1: SSI in relation with age.

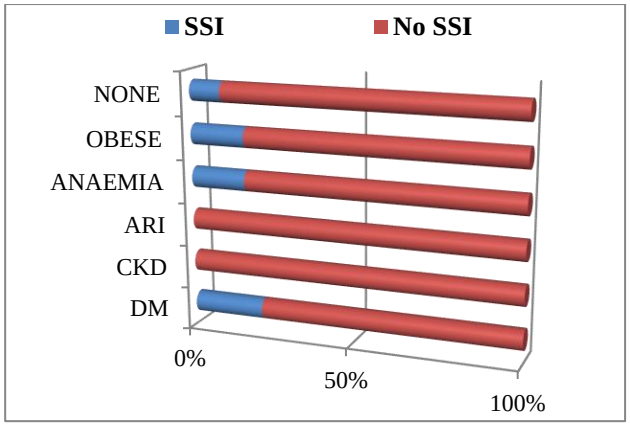

Figure 2: SSI in relation with comorbidities.

Table 1: Prevalence of SSI among diabetics.

Infection					
Diabetes	**Yes**	**No**	**Total**	**ODDS ratio**	**P value**
Yes	3	11	14	1.90	0.349
No	17	119	136		
Total	20	130	150		

Most commonly used prophylactic antibiotic in sample population was a combination of parenteral Metronidazole in combination with the following in descending order.

- Cefoperazone+ Sulbactum (71)
- Cefotaxime (34)
- Ciprofloxacin (16)
- Cefazolin (18)
- Cefuroxim (11)
- The best performance was exhibited by Cefaperazone group (2.8% SSI) and worst by Ciprofloxacin group (23.9% SSI)

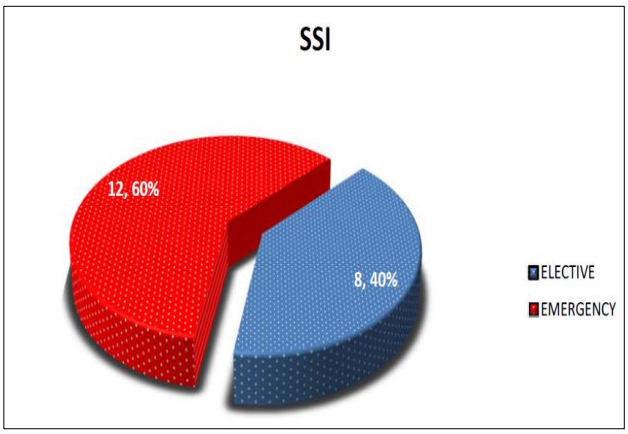

Figure 3: SSI relation with type of surgery.

SSI rate was found to become higher as the duration between giving the dose and putting incision increase (8% if within 5hr v/s 71% if after 2hrs) (Figure 4).

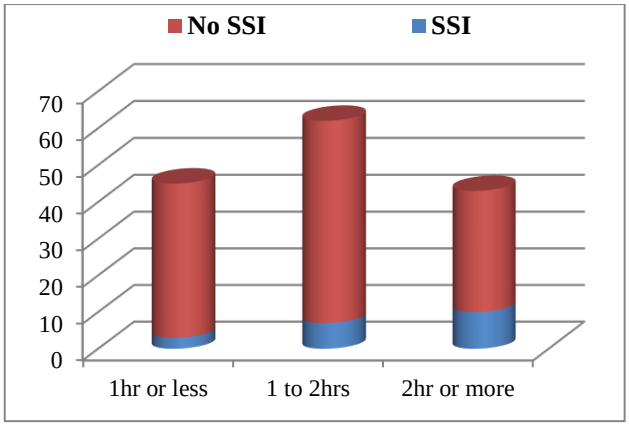

Figure 4: Duration of surgery and SSI incidence.

SSI rate was found to become higher also when the duration of surgery is higher (Figure 5).

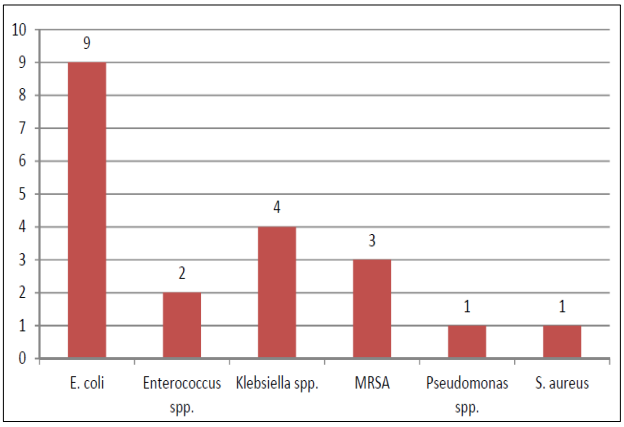

Figure 5: SSI bacterial profile.

E. coli (45%, n= 9) was the organism most commonly isolated from abdominal wounds.

Followed by *Klebsiella spp.* (20%, n=4), MRSA (15%, N= 3), *Enterococcus spp.* (10%, n=2), *Pseudomonas aeruginosa* and *S. aureus* (5% each, n=1).

Prevalence of SSI was high after emergency (16%, n= 12) compared to elective (10.6%, n=8) abdominal surgeries in the population studied.

E. coli was the most common organism in both groups (elective-4, emergency-5).

Out of the 4 samples of *Klebsiella spp.* 3 were obtained after emergency surgeries and out of 3 MRSA 2 were in emergency cases.

Among the 9 samples of *E. coli* obtained, 7 were found sensitive to Amikacin and Gentamicin. Only 7 were tested for sensitivity to Piperacillin+ Tazobactam and Imipenem and all 7 were found sensitive. 2 each were found sensitive to Cotrimoxazole and Ciprofloxacin.

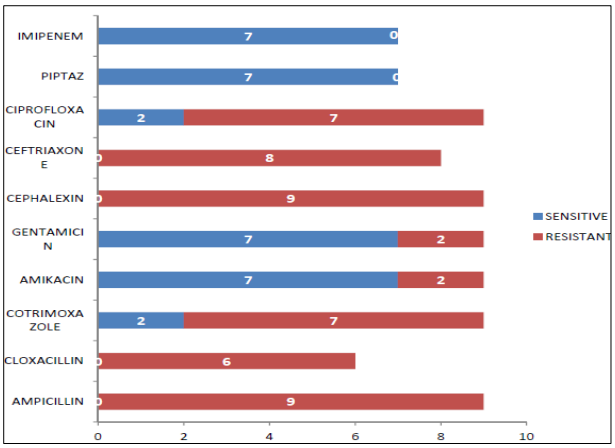

Figure 6: Antimicrobial profile of *E coli*.

Out of 2 samples of Enterococci, both were found sensitive to Cotrimoxazole, Imipenem and Piperacillin+ Tazobactam. One was sensitive to Amikacin, Gentamicin and Ciprofloxacin (Figure 6).

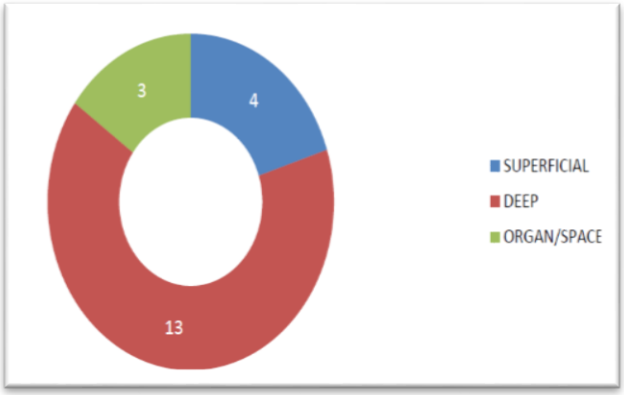

Figure 7: SSI- incidence as per anatomical classification.

Among the SSIs deep incisional infections were the most common, which constituted 65% (n= 13), followed by superficial 20% (n=4) and organ/space- 15% (n= 3) (Figure 7). Midline incision (n=6/22 = 27.27%) showed highest while Lenz/McBurney incision lowest incidence.

DISCUSSION

The sample size used in this study (150) was subnormal according to most of the prospective literature data. But the mean/median population age was comparable to majority of them (45.5). As it was based on clean contaminated cases, here the study group involved mainly young population as in similar data. There also appendicectomy were the majority.[3,4]

The prevalence of surgical site infections in my study group was 13 % (n= 20), which was little high compared to developed countries but comparable with other tertiary care centers in India.[5,6]

Sex (84M/66F) and co morbidity criteria are not comparable to those in western countries, were lifestyle diseases predominated. Still, Diabetes mellitus was the most common and adverse one.[7]

Antibiotic criteria as per standard guidelines were not followed in most of the institutions, still hospital based protocols were strictly carried, as is the case in here also. But most of them discontinued the prophylactic antibiotic postoperatively in clean contaminated cases, unlike my hospital protocol.[7-10]

In emergency surgeries, the focus of infection could not be well controlled before surgery as in literature data and therefore, the higher (16%)SSI incidence.

Prevalence of SSI in diabetics (4/13) is comparable with other studies. But the frequency of cases n rate of SSI was lesser, probably due to lesser incidence of obesity in our country.[11]

Among antibiotics, cefaperazone showed best performance (2.8% SSI only) as in other studies also.

But *E. coli* was the predominant organism only in studies including contaminated and dirty cases also. Here in my study, even though it included clean contaminated case only, the major pathogen was *E. coli* (45%).[3,4,12]

Incidence of deep SSI in major percentage in my study is against the literature data, as most of them gave superficial group in greater number. It may be due to under/over estimation or follow up bias.[3,4,13]

Limitations of this study of the study was to:

- Sample is not representative according to national standards
- Limited period of time
- Environmental factors were not considered
- Laparoscopic cases were not included
- Contaminated culture swabs due to wrong method of collection

CONCLUSION

Various host factors like malnutrition, obesity, patients knowledge about hygiene, presence of co-morbidity etc. coupled with environmental factors such as condition of the wounds, delay to initiate operation, duration of operation, prolonged exposure of peritoneal cavity to environment, prophylactic use of antibiotics and factors associated with surgery like type of incision, 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.

Moreover, in absence of highly advanced surgical amenities, preoperative resuscitative units, modern operation theatre facilities and sophisticated sterilization procedure it is necessary to use prophylactic antibiotics to encounter the various types of micro-organisms responsible for surgical site infection, particularly *E. coli.*

Recommendations

- Prompt diagnosis, proper assessment, quick resuscitation and appropriate preoperative preparation are keys to better outcome in all operations, but undue delay should be avoided in treating any emergency condition.
- Duration of operation should be optimum to minimize the level of wound contamination and prevention of SSI.
- Emergency conditions should be managed by the experienced surgeons.
- Proper care of the patients as a whole throughout the peri-operative period is very vital to reduce the rate of surgical site infection.
- Appropriate antibiotic prophylaxis should be practiced.
- Further research is necessary in large scale for guidance regarding prevention of surgical site infections in our country.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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