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Original Research Article

A prospective study on pattern of superficial surgical site infections in patients undergoing emergency laparotomy for perforation peritonitis

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ABSTRACT

Background: surgical site infections (SSIs) are recognized as a common surgical complication occurring in about 3% of all surgical procedures and in upto 20% of patients undergoing emergency intraabdominal procedures. Aims: To determine the incidence of SSIs in emergency laparotomies done for perforation peritonitis and the organisms involved and their sensitivity pattern in superficial SSI. The objective of the study was to determine the effect of planned intra operative intervention [antibiotic lavage with III generation cephalosporin e.g. ceftriaxone 1 gm and metronidazole 100 ml (5 mg per ml)] on superficial surgical site infection in emergency laparotomies done for perforation peritonitis.
Methods: This prospective randomized case controlled study was carried out in P. G. Department of Surgery, S. R. N. Hospital associated with M. L. N. Medical College, Allahabad, from September 2018 to August 2019 after approval from the ethical committee and after obtaining written and informed consent either from patient or their guardian. Patients were divided into two groups viz. control group receiving the normal saline lavage and case group receiving the antibiotic lavage (III generation cephalosporins i.e., ceftriaxone (1 gm in 1000 ml NS) and metronidazole- 5 mg/ml (100 ml in 500 ml NS).
Results: There is almost 50% incidence of SSI in emergency laparotomy done for perforation peritonitis. The most common organism involved in superficial SSI in present study was gut flora (*E. coli*) followed by normal skin colonizer (*Staph. aureus*).
Conclusions: Intraperitoneal antibiotic lavage has a significant role in reducing the rate of SSI especially in gastroduodenal perforations.

Keywords: Cephalosporin, Surgical site infection, Perforation peritonitis

INTRODUCTION

Surgical site infections (SSIs) are defined as infections 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, that occur within 30 days of surgery (Figure 1).[1]

SSIs are recognized as a common surgical complication occurring in about 3% of all surgical procedures and in upto 20% of patients undergoing emergency intraabdominal procedures.[2] Development of SSI causes significant burden on patients with respect to post-operative morbidity and expenses with prolonged hospital stay. It also cause significant burden on doctors and hospital resources.

Types of surgical site infection

The USA centre for disease control (CDC) states that only infections occurring within 30 days of surgery (or within a year in case of implants) should be classified as

SSIs.[3]

SSIs are split into 3 groups that include superficial incisional SSIs, deep incisional SSIs and organ/space SSIs.

Figure 1: Superficial surgical site infection.

Superficial SSI must meet the two criteria i.e. it should occur within 30 days of procedure and it involves only skin and subcutaneous tissue around the incision.

To consider any wound as superficial SSI criteria any one of the characters should have which include purulent drainage from the incision, organisms identified from wound, superficial incision i.e. deliberately opened by surgeon and diagnosis of SSI by surgeon.

At least one of the following signs or symptoms of infections- pain/tenderness at incision site, localised swelling, erythema or increased temperature.

Deep incisional SSI are the surgical incisional wounds that occur within 30 days of surgery and involves deep soft tissues (facial and muscle layers).[4] Deep SSIs have atleast one of the following- (a) Purulent discharge from deep incision (b) Incisions that dehisces spontaneously or is deliberately opened or aspirated by surgeon, with or without culture (c) Abscess or other evidence of infection i.e. detected on gross anatomic or histopathologic examination or imaging and (d) patient has at least one of the following- fever (temp >38°C), localized pain or tenderness

Organ or space SSI occur within a body cavity i.e. intra-abdominal, intra-pleural, intra-cranial and are directly related to a surgical procedure.[5] These deep infections may remain occult or be manifested with few symptoms; mimicking incisional SSI and leading to inadequate additional initial treatment. Organ or space SSI becomes apparent only when a major complication occurs. Their diagnosis usually requires some form of imaging to confirm the site and extent of infection.

The classification of operative wounds is based on the degree of microbial contamination.[3,6] CDC estimates that the risk of SSI associated with abdominal surgery ranges from approximately 2-8%, depending upon the type of surgery.[6]

- Clean- risk of developing SSI is 2%.
- Clean contaminated- risk of developing SSI is 3%.
- Contaminated- risk of developing SSI is 6%.
- Dirty- risk of developing SSI is 7%.

Aims and Objectives

To determine the incidence of superficial surgical site infection in emergency laparotomies done for perforation peritonitis and the organisms involved and to determine the effect of planned intra operative intervention [antibiotic lavage with III generation cephalosporin e.g. ceftriaxone 1 gm and metronidazole 100 ml (5 mg per ml)] on superficial surgical site infection in emergency laparotomies done for perforation peritonitis.

METHODS

This study was carried out in P. G. Department of Surgery, S. R. N. Hospital associated with M. L. N. Medical College, Allahabad, from September 2018 to August 2019 after approval from the ethical committee and after obtaining written and informed consent either from patient or their guardian.

This study was a prospective randomized case control study. All patients who attended the surgery emergency with the provisional diagnosis of perforation peritonitis and met the inclusion criteria were randomly assigned by odd even method to two study groups. Control group receiving the normal saline lavage and case group receiving the antibiotic lavage (III generation cephalosporins i.e. ceftriaxone (1 gm in 1000 ml NS) and metronidazole- 5 mg/ml (100 ml in 500 ml NS).

Inclusion criteria

Patients between 18 to 60 years of age group undergoing emergency laparotomy for perforation peritonitis treated by resection and anastomosis/primary closure and patients of ASA-IIIE and ASA-IVE only.

Exclusion criteria

Patients below 18 years and above 60 years, with known sensitivity to lavage drug viz. Ceftriaxone and Metronidazole, Patients who develop deep/organ space infection/fecal fistula formation during the post-operative course, Patients in which stoma formation was done as a primary management (ileostomy or colostomy) and patients not willing to take part in the study.

Parameters to be studied

Detailed history and clinical examination. Full blood count, blood biochemistry, LFT, ABG. Operative

findings include perforation site and peritoneal content. Post-operative wound infection rate and culture and sensitivity pattern of wound discharge

Study technique

All patients admitted in emergency surgery department needing laparotomy for perforation peritonitis were potential candidates for the study. Pre-operative investigations were done which will included parameters to be studied. Intravenous antibiotics (III generation cephalosporins- ceftriaxone 50 mg/kg i.v.) were given to all patients at induction of anesthesia. At laparotomy intra-op findings were noted. Decision was taken with regard to the operative procedure to be performed and patients were included in the study if they met inclusion criteria. Patients were randomized by odd even method into two study groups- cases and controls. All patients received peritoneal toilet with copious amount of normal saline. In addition, patients belonging to the case group received antibiotic lavage (1 gm ceftriaxone in 1000 ml normal saline along with 100 ml metronidazole (5 mg/ml) in 500 ml NS). All of the lavage solution was left inside peritoneal cavity. Intraabdominal drain if put, was clamped for two hours so that the antibiotic solution was not drained. After closure of the rectus sheath in the case group the wound was washed with 50 ml antibiotic lavage in addition to NS wash in all patients. Post operatively patients were closely monitored for signs of SSI. In patients with infected wounds, discharge was sent for culture sensitivity and findings were noted. Standard practice of wound care with regular dressing was done in in Dr. Ratika Original Article infected wounds and outcome was recorded.

The data was analyzed using SPSS ver.20 and presented in number and percentages.

RESULTS

During the duration of this study, a total of 298 patients were admitted in the surgery emergency ward of Swaroop Rani Nehru Hospital, Prayagraj with perforation peritonitis as the primary diagnosis. Out of which 60 patients were included in the study after considering inclusion and exclusion criteria.

There were total 60 patients in this study. Age distributions of the patients were as tabulated in Table 1. Maximum number of patients i.e. 25 patients (41.7%) were of 51-60 years of age group. Age group of 18-30 years had 19 patients (31.7%). There were 8 (13.3%) patients each in age groups of 31-40 years and 41-50 years. Mean age of all the 60 patients was 41.35 year. Mean age of case and control group was 39.08 year and 42.97 year respectively.

Both the groups were comparable as per age group because there was almost similar distribution of the patients in both the groups.

In case group there were total 25 patients out of which 11 patients (44%) were of age group 51-60 years and 09 patients (36%) were of 18-30 years of age. In control group there were total 35 patients out of whom 14 patients (40%) were of 51-60 years of age and 10 patients (28.6%) were of 18-30 years of age. Age group of 31-40 years and 41-50 years had 2 (8%) and 3 (12%) patients respectively in case group. Control group had 6 (17%) and 5 (14.3%) patients in the same age group.

Table 1: Age distribution.

Age group (years)	Case N (%)	Control N (%)	Total N (%)
18-30	09 (36)	10 (28.6)	19 (31.7)
31-40	02 (08)	06 (17.1)	08 (13.3)
41-50	03 (12)	05 (14.3)	08 (13.3)
51-60	11 (44)	14 (40)	25 (41.7)

Out of total 60 patients, 51 (85%) were males and 9 (15%) were females. Male to female ratio in the study group was 5.67:1. Case group had total 25 patients, out of which 20 (80%) patients were males and 5 (20%) were females. Control group had total 35 patients, out of which 31 (88.6%) patients were males and 4 (11.4%) were females.

This study included subjects of perforation of different sites, although there was prevalence of cases of duodenal perforation i.e. 28 out of total 60 cases which is almost 50% of total cases.

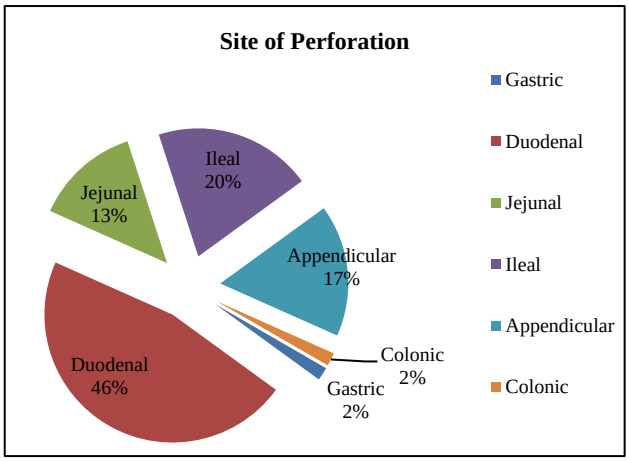

Figure 1: Surgical management.

From above data (Figure 2) it was observed that duodenal perforation 46.7% (28 out of 60) is the most common site of perforation peritonitis in present study followed by ilealperforation 20% (12 out of 60). Appendicular perforation was 16.7% (10 out of 60) and jejunal perforation 13.3% (8 out of 60). Gastric and colonic perforation had equal occurrence of 1.7% (1 out of 60).

Table 2: Number of patients with SSI.

Groups	Male	Female	N (%)	P value
Case (25)	8	1	09 (36)	0.00096
Control (35)	21	0	21 (60)	0.00001
P value	0.00064	0.156		

There were 30 patients out of total 60 patients, who had infected wound. In the intervention group, 09 patients (36%) out of 25 had SSI, out of which most were males (8 males and only 1 female). In control group 21 patients (60%) out of 35 had SSI, all of whom were males. So, most of the patients of SSI were males in both the groups (Table 2).

The difference in the incidence of SSI among males and females was significant in case group (p-value=0.00096) and also in control group (p-value<0.00001) groups.

This difference was statistically significant in case and control group in males (p-value=0.00064) but not in females.

Table 3: Bacterial causes of SSI.

Micro-organism	Case N (%)	Control N (%)	P value
***S. aureus* (12)**	4 (44)	8 (38)	0.802
***E. coli* (14)**	4 (44)	10 (48)	0.484
***Klebsiella* (3)**	1 (12)	2 (9)	0.912
***Pseudomonas* (1)**	0	1 (5)	0.447

In present study it was observed that 46% (14 patients out of 30) of total infections were caused by *E. coli*. 40% (12 patients out of 30) cases were infected with *S. aureus*. *Klebsiella* infected 10% patients (3 out of 30) and Pseudomonas caused 3.3% (1 patient out of 30) infection. Most of the SSI in both the groups either case or control was caused by *E. coli* and *S. aureus* i.e. 86% followed by *Klebsiella* and *Pseudomonas* (Table 3).

Difference in the type of infecting micro-organisms in both case and control group, was however, statistically insignificant.

Occurrence of SSI was most commonly seen in duodenal perforation i.e. in 17 cases out of 28 cases (56.6%). Out of17 cases, 5 cases (20%) were of case group and 12 cases (34.3%) were of control group.

In present study most of the SSI occurred in the age group of 51-60 years of age i.e. 14 patients out of 30 cases of SSI (approximately 50%) followed by 18-30 years of age group in which 10 patients (33%) of SSI were present (Table 4).

Table 4: Distribution of SSI among the different age groups.

Age group (in years)	SSI		
	Case N (%)	Control N (%)	P value
18-30	3 (12)	7 (20)	0.645
31-40	1 (4)	1 (2.9)	0.681
41-50	1 (4)	3 (8.6)	0.624
51-60	4 (16)	10 (28.6)	0.483

However, the distribution of SSI among the age groups and between the control and the intervention group was statistically insignificant at p>0.05.

DISCUSSION

The incidence of SSIs has been estimated to be about 3% in the United States, although, the incidence varies greatly from less than 5% for clean surgery to more than 20% for emergency colon surgery, which is often performed in a dirty field. Moreover, the overall estimate is almost certainly an underestimate, considering that SSI after ambulatory surgery, which is almost 70% of all operations, is seldom reported.[1,7]

The mean age in this study was 41.3 years which is comparable with the study done by Kumar et al in which the mean age was 41.84 years and Jhobta et al in which the mean age was 36.8 years. Mean age of patients in case group was 39.08 years while mean age of patients in control group was 42.97 years. There was no significant statistical difference in the mean age of the patients in case and control group.[8,9]

In present study patients in age group of 18-30 years had 12% incidence of wound infection in case group and 20% incidence in control group. Patients in age group of 51-60 years had 16% surgical site infection rate in case group and 28.6% in control group. Patients in other age groups had much lower rates of SSI and shows that rate of wound infection is more in relatively younger and older populations as compared to middle ages. This is in accordance with the study done by Gupta et al which shows the peak incidence of 29% of SSI in age group of 17-30 years.[10] This is also in accordance with the study done by LekshmiPriya et al which shows the highest incidence of SSI (24.5%) in age group of 51-60 years.[1] Study done by Basith et al also supports our study and shows that age has a detrimental effect on the outcome of surgery with respect to SSI.[11] However, the distribution of SSI among the age groups and between the control and the interventional groups in our study was statistically insignificant. This might be due to the small sample size and needs further evaluation with greater sample size.

In present study, majority of patients had duodenal perforation (46.7%) followed by ileal perforation (20%). Next in line were appendicular perforation (17%), Jejunal

perforation (13%). Gastric perforation and colonic perforation were (2%) each of the total study population. Hence our study correlates well with the fact that overall most common perforation is the peptic ulcer perforation. Our present study is in accordance with the study done by Gupta et al in which most common site of perforation was first part of duodenum, which was similar to the study done by Jhobta et al.[9,10] Second most common site according to Gupta et al was ileal (20%) which was again similar to the study done by Jhobta et al in which the incidence of ileal perforation was 22%.[9,10]

According to Kumar et al, most common cause of perforation peritonitis was peptic ulcer perforation (36%) followed by typhoid ileal perforation (20%) followed by appendicular perforation (16%).[8]

In present study highest incidence of SSI was seen in gastro duodenal perforations, 37.1% in control group and 20% in case group. There was a statistically significant reduction of SSI in the intervention group in case of duodenal and appendicular perforations at $p<0.05$.

In present study, out of 35 patients in whom peritoneal lavage was done with normal saline, 21 i.e. 60% got superficial surgical site infection, while in case group i.e. in antibiotic lavage group, 36% (9 out of 25 patients) got infected wound. The difference between case and control group was statistically significant in case of males at p-value=0.00064. Also, the difference in the case group and control group among males and females with respect to the incidence of SSI was statistically significant at p-value=0.0001 and 0.00001 respectively but males were predominantly distributed in control group.

This shows that there is a significant reduction in the rate of SSI when antibiotics were used for intra-peritoneal lavage.

This is in accordance with the study done by Santhosh et al in whom there was a significant reduction in wound infection between patients of group 1 i.e. N.S. lavage group and group 2 i.e. N.S. + imipenem lavage group.[13]

In present study 46% of the total wound infections were caused by the normal gut flora, *E. coli*, followed by 40% infections caused by *Staph. aureus*, which colonises the skin of normal human beings. This is in accordance with the study done by Priya et al in which 70.27% of all SSI was caused by gram negative aerobic bacteria belonging to gut flora.[1] Also the study done by Ballus et al came to the same conclusion that *E. coli* and gram positive cocci were a frequent cause of SSI from positive culture isolates.[7]

CONCLUSION

This study concludes that there is almost 50% incidence of SSI in emergency laparotomy done for perforation peritonitis. The most common organism involved in superficial SSI in our study was gut flora (*E. coli*) followed by normal skin colonizer (*Staph. aureus*). Intraperitoneal antibiotic lavage has a significant role in reducing the rate of SSI especially in gastroduodenal perforations. SSI is more common in older age groups.

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