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Original Research Article

Evaluation of various pre and postoperative parameters associated with types of surgical site infections in abdominal surgeries

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ABSTRACT

Background: Surgical Site Infections (SSIs) contributing to substantial rate of mortality, significant morbidity, considerable prolongation in length of hospitalization and added treatment expenses. The Centers for Disease Control and Prevention (CDC) has classified Surgical site infections (SSI) into superficial, deep, or organ/space SSIs. The objective of study was to evaluate pattern of surgical site infection in various abdominal surgeries.
Methods: All patients who admitted in surgical OPD/emergency and undergoing abdominal surgical procedures were included in study. Patients were observed in wards and during follow up to assess signs and symptoms of surgical site infection.
Results: Result were analysed in terms of etiology, distribution of cases based on case scenario, wound type, clinical features, number of re-explorations done after development of SSI, type of surgery (laparoscopic v/s open), type of organisms cultured, mortality, co-morbid condition, number of extra days in hospital after SSI and average amount spent after SSI.
Conclusions: Surgical site infection is associated with high incidence of morbidity in terms of treatment cost and hospital stay. Average hospital stay, expenditure, co-morbidities and mortality were more in organ/space SSI. Superficial SSI is most common in both laparoscopy and open procedures. Deep and organ/space SSI not seen with laparoscopy. Superficial SSI were more common in clean and clean contaminated cases while superficial SSI was more common in contaminated and dirty cases. In superficial and deep SSI staphylococcus aureus was more common whereas in organ/space SSI *E. coli* and *pseudomonas* were common bacterial isolates.

Keywords: Hospitalization, Infections, Morbidity

INTRODUCTION

Surgical site infections are defined as infections that occur 30days after surgery with no implant or within one year if an implant is placed and infection appears to be related to surgery.[1]

The Centers for Disease Control and Prevention (CDC) has classified Surgical site infections (SSI) into superficial, deep, or organ/space SSIs.[2] Superficial incisional SSI involves only skin and subcutaneous tissue of incision, deep incisional SSI involves deep tissues, such as fascial and muscle layers and organ/space SSI involves organs and spaces other than the incision, which was opened or manipulated during operation.

Surgical Site Infections (SSIs) contributing to substantial rate of mortality, significant morbidity, considerable prolongation in length of hospitalization and added treatment expenses. SSIs were estimated approximately 31% of all health care associated infections which contributed 20% postsurgical readmissions as well.[3] Rate

of SSIs is reported in numerous literatures in the range of 2.5-41.9%.[4] Patients of SSIs have 2-11 times greater risk of death as compared to the patients having no SSI.[5]

Superficial incisional SSI is more common than deep incisional SSI and organ/space SSI. Superficial incisional SSI accounts for more than half of all SSIs for all categories of surgery. Literature Survey conducted by Isik O et al, reports the incident rate in superficial incision is found to be 42.19% which is more frequent followed next in frequency by deep incision having an SSI 40.1% while organ space shows 17.71% rate of infection.[6] *Staphylococcus aureus* (*S. aureus*) was the most common pathogen followed by *Escherichia coli* and Coagulase Negative *Staphylococcus*.[7] CDC also defined the most common pathogen associated with SSI is *S. aureus*. The objective of this study was to evaluate and compare superficial, deep and organ-space surgical site infection in various abdominal surgeries.

METHODS

This study was a prospective study. It was carried out for a period of approximately two years from September 2010 to July 2012 in the Department of General Surgery of Subharti Medical College and associated CSSH, Meerut, after approval from the ethical committee and obtaining written and informed consent from the patients.

All the patients of age 1year and above who were admitted in surgical OPD/emergency and undergoing abdominal surgical procedures were included in study. All the patients who died after surgical procedures, left against medical advice and who did not come back and could not be followed were excluded from the study.

After admission complete and detailed history was taken which included history of present complaints, previous h/o any surgery, personal h/o smoking, diabetes, hypertension. All elective cases underwent part preparation and prophylactic antibiotics prior to induction was given. In emergency abdominal surgeries all patients were given antibiotics along with resuscitation of patient. Each patient undergoing surgery elective or emergency abdominal surgery were observed in the wards and carefully assessed each day for the signs and symptoms of surgical site infection till the day of discharge.

Patient's parameters noted

- Detailed clinical history-pain in abdomen (site, onset, migration, duration and severity), nausea, vomiting (duration, episodes, contents), fever (duration, grade, nature, associated with chills/ rigor) and anorexia. In case of female patient menstrual and obstetric history was also evaluated.
- Detailed clinical examination-general condition, pulse rate, respiratory rate, temperature, pallor, peristaltic movement, any obvious mass, hyperesthesia, abdominal tenderness (localized or diffuse), site, rebound tenderness, muscle guarding and rigidity.
- Local examination-wound assessed for pain or tenderness, induration, erythema, local warmth of the wound, fluid or pus exudation from the wound.

Ultrasound was done in all the patients with clinical suspicion of SSI. CT scan was done in patients where ultrasound was not helpful. After discharge patients were followed up on an outpatient basis once a week for 30days from the day of surgery.

Result were analysed in terms of etiology, distribution of cases based on case scenario, wound type, clinical features, number of re-explorations done after development of SSI, type of surgery (laparoscopic v/s open), type of organisms in culture, mortality, co-morbid condition, number of extra days in hospital after SSI and average amount spent after SSI.

RESULTS

This observational study was comprised of 952 subjects. Of these 952 subjects 700 were elective subjects and 252 were emergency subjects. Out of 700 cases in elective setting 52 got infected and out of 252 cases in the emergency setting 60 got infected. SSI is significantly more in emergency cases. Incidence of deep and organ/space SSI was more common in the emergency. No such predilection seen with superficial SSI.

Table 1 shows that all patients who were lyear and above were considered for study. There was vast difference among incidence of surgical site infection since rate increased after 50years of age which may be due to immune-compromised status. Majority of organ/space SSI seen in old patient after 50years. Out of all 112 cases in which SSI occurred, 60 were superficial SSI, 33 were deep SSI, and 19 were organ/space SSI. Incidence of deep SSI and organ/space SSI was more common in the contaminated and dirty groups. Incidence of superficial SSI in different wound group was found to be not significant. Men has got higher incidence of surgical site infection than women but it could not be proven significant (14% as compared to 8.7% in women).

In this study, percentage of total cases that got infected was 11.7%. Rate of SSI in clean cases was 3.69%, clean contaminated cases were 7.9%, contaminated cases 21.1% and in dirty cases was 34.3%. There was increase in severity of infection as the degree of contamination increases. Overall superficial infection was most common in all type of wound. Organ/space infection was common with emergency, dirty wound and with older age group.

Table 2 shows that when procedure-wise risk of SSI was analysed, the risk was found to be higher in the contaminated cases and the emergency surgeries. USG was done in all the patients and was helpful in detecting the site of collection. CT scan was done in 16 patients

where ultrasound was not able to detect the extent of pus. Table 3 shows that average increase in hospital stay in various wounds. In superficial wounds it was 5.28days, in deep wounds it was 8.96days and in organ /space wound it was 15.80days. Total average increase in number of days of patients with SSI was 11.4days. In terms of cost the superficial wound patients had to spent on an average Rs. 2624.1 extra in their management as compared to those without SSI. Deep wound had to spent Rs. 6462.99 more and organ/space on an average spent Rs. 11292.63 more. Average expenditure of patients with SSI increased to Rs. 8417. Total 14 cases were re-explored in which majority of cases were from organ/space SSI. Difference in laparoscopy and open procedures were taken only in 2 procedures which were commonly practiced i.e. cholecystectomy and appendectomy.

Table 1: Pre-operative variables.

Characteristics	No. of patients			No. of SSI	%	Superficial	Deep	Organ/space
Age Group (in years)								
1-10	42			3	7.2	1	1	1
11-20	60			4	6.8	3	1	-
21-30	246			23	10.3	18	05	-
31-40	256			25	10.1	15	09	1
41-50	166			16	10.8	08	5	3
51-60	108			24	22.2	11	5	8
>60	74			17	23.1	4	7	6
Sex								
Males	496			72	14.5	40	20	12
Females	456			40	8.7	20	13	07
Distribution of cases based on case scenario								
Emergency	252			60	23.8	27	20	13
Elective	700			52	7.4	33	13	06
Wound class and SSI								
	Total	Emergency	Elective					
Clean	298	0	298	11	3.69	11	00	00
Clean contaminated	416	30	386	33	7.9	17	14	02
Contaminated	104	88	16	22	21.1	10	06	06
Dirty	134	134	0	46	34.3	22	13	11

Table 2: Etiology of SSI in various abdominal surgeries.

Procedure	Total cases	SSI	%	Superficial	Deep	Organ/space
Cholecystectomy	243	7	2.8	6	1	0
Hemioplasty	154	4	2.5	2	1	1
Appendectomy	123	13	10.3	10	2	1
Hepatobiliary surgery including extended cholecystectomy, hepaticojejunostomy	70	8	11.4	6	1	1
Incisional hernia	60	6	10	5	1	0
Biliary peritonitis	22	7	31.8	2	3	2
Perforation repair	89	27	30.3	13	11	3
Liver abscess	12	5	41.6	1	2	2
Blunt trauma with solid organ injury	33	4	12.1	2	1	1
Blunt trauma with hollow viscus injury	22	8	36.3	2	4	2
Pancreatic resection including distal pancreatectomy, pancreatico-jejunostomy	19	4	21.05	2	1	1
Colorectal surgery	32	7	21.8	3	2	2
Elective small bowel resections including tubercular stricture, mesenteric cyst	42	5	11.9	3	1	1
Emergency small bowel resections including mesenteric tear, gangrenous bowel, volvulus	31	7	22.5	3	2	2
Total	952	112	11.7	60	33	19

Table 3: Post-operative variables.

Characteristics	Superficial	Deep	Organ/space
Number of cases	60	33	19
Number of cases re-exploration	00	3	11
Clinical features			
Pus discharge	60	27	0
Fever	28	19	12
Tachycardia	29	24	19
Tachypnoea	0	0	12
Distension of abdomen	0	0	11
Hypotension/shock	0	0	9
Bowel sound absent	15	8	19
Distribution of bacterial isolates			
Staph aureus	43	12	01
Klebsiella	5	6	-
Pseudomonas	2	-	06
Sterile	10	8	01
E. coli	-	7	11
Mortality	00	01 (3.77%)	05 (26.7%)
No. of extra days in hospital	5.28	8.96	15.8
Average amount spent after SSI (Rs.)	2624.1	6462.49	11292.63
Laparoscopic v/s Open			
Laparoscopic	3	-	-
Open	14	03	01
Associated co-morbid condition			
Bronchial asthma	-	01	-
Smoking	-	-	4
Albumin <2.5gm/dl	-	-	2
Haemoglobin <8gm/dl	-	-	15
Age > 50years	-	-	14
>2 blood transfusions	-	-	13

Superficial SSI were most common in both laparoscopy and open procedures. Deep and organ/space SSI not seen with laparoscopy. Gram positive organism were more in number. There were 52%-gram positive organism and 48% Gram negative organism in this study.

Commonest was *Staphylococcus aureus* (57.1%), followed by *E. coli* (18.9%), *Klebsiella* (11.4%) and *Pseudomonas* (8.6%). Organ/space type of SSI was more associated with mortality of the patients which was 5 out of 19 cases (26.77%) while deep SSI had 1 death (due to bronchial Asthma) out of 33 cases (3.77%). No mortality occurred due to superficial SSI.

DISCUSSION

In this study, all wounds were classified according to CDC guidelines and treated accordingly.

- 1st category- Superficial SSI (60 cases)- dealt with pus drainage and daily dressings.
- 2nd category- Deep SSI (33 cases)- drainage of pus, excision of sinus, debridement and secondary suturing was done.
- 3rd category- Organ/space (19 cases)- 11 out of 19 patients underwent re-operation and rest of 8 had radiological intervention.

No cases with superficial wound were re-explored and all were managed with regular aseptic dressings after removing two stitches, one at each end. Thereafter wound was irrigated with normal saline or OXUM spray. Pus was sent for culture and sensitivity and antibiotics given accordingly.

In the deep infected cases, dressings along with cultures were done. One patient underwent radiological intervention and pus was aspirated out under sonographic vision. Two patients had sinus formation which was excised and sent for biopsy. Biopsy showed tubercular lesion so anti-tubercular treatment was started among these individuals. In one patient wound was lay open and daily dressing was done. 15 patients underwent PCD

catheterization, while rest 14 patients were managed conservatively by daily dressings in the ward.

Organ/space infections were highly associated with re-operation owing to 58.3%. 11 out of 19 patients with organ/space SSI were re-operated. Out of 11 patients, 8 were of anatomizes leak, 3 were Pyoperitonium. Eight patients were managed by aspiration of pus and PCD catheters through ultrasonography.[6] patients with organ space SSI had burst abdomen which were then managed by re- operation. Three patients had pelvic abscess for which aspiration was done through per rectal route.

Men has got higher incidence of surgical site infection than women it is mainly because number of emergency cases among males were more and number of clean cases in females were more in the study. Similarly, a study done by Scott JD et al, where he studied 9016 surgical patients out of which me had SSI rate of 16.2% and female had SSI of 11.7% and main reason given by them was also that males were higher in number in emergency cases.[8]

Organ/space was more common in contaminated and dirty cases. Difference in the patient's characteristics, distribution of surgical procedures and hospital settings may help explain this but the high incidence of SSI after clean procedure was striking. This may be explained by existence of bacteria resistance and co-morbid conditions of the patients. Comparison of various studies across the globe has been shown in which this study resembles the study conducted by Sangrasi AK et al, in Pakistan and Kaya E et al, in Turkey. [9,10]

Gram positive organism were more in number. There were 52% Gram positive organism and 48% Gram negative organism. Commonest was *Staphylococcus aureus* (57.1%), followed by *E. coli* (18.9%), *Klebsiella* (11.4%) and *Pseudomonas* (8.6%). In another Indian study in 2006 by Khan SA et al, *Escherichia coli* was the most common pathogen found (25%), followed by pseudomonas aeruginosa (20.83%) and coagulase positive Staphylococci (19.04%) in general surgical setup.[11]

Surgical site infection was associated with high incidence of morbidity among patients in terms of cost of treatment and hospital stay. In this study, the re-operation and radiological intervention was common cause of increase hospitalization and cost in a patient with organ/space infections. Intravenous injections and parenteral nutrition also lead to high morbidity in terms of expenditure. Total 14 cases were re-explored in which majority of cases were from organ/space SSI. A study by Astagneau P et al, in 2009 demonstrated the mortality because of SSI to be 2.8% and surgical site infection was also the main factor leading to increase hospital stay.[12] Organ/space type of SSI was more associated with mortality of the patients which was 5 out of 19 cases (26.77%) mainly because the patients in this group were highly associate with various co-morbid conditions, while deep SSI had 1 death (due to bronchial asthma) out of 33 cases (3.77%). No mortality occurred due to superficial SSI.

Laparoscopic procedures accounted for superficial infections only and no deep or organ/space infections were seen while there were 14 superficial, 3 deep and 1 organ/space infections seen in open procedures.

Organ/ space type of SSI more associated with mortality of the patients followed by Deep SSI. The main cause of death among these patients was associated co-morbid conditions. No mortality occurred due to superficial SSI.

CONCLUSION

Surgical site infection is associated with high incidence of morbidity in terms of treatment cost and hospital stay. Average hospital stay, expenditure, co-morbidities and mortality were more in organ/space SSI. Superficial SSI is most common in both laparoscopy and open procedures. Deep and organ/space SSI not seen with laparoscopy. Superficial SSI were more common in clean and clean contaminated cases while Superficial SSI was more common in contaminated and dirty cases. In superficial and deep, SSI *Staphylococcus aureus* was more common whereas in organ/space SSI *E. coli* and *pseudomonas* were common bacterial isolates.

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