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Original Research Article

Evaluation of patient related modifiable and non-modifiable risk factors in causation of surgical site infection in various abdominal surgeries

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ABSTRACT

Background: Surgical Site Infection (SSI) is second commonest nosocomial complication in surgical speciality. Majority of surgical wounds are contaminated by microbes, but in most cases, infection does not develop because innate host defense are quite efficient in elimination of contaminants. The objective of this study was to evaluate patient related risk factors in causation 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. This observational study was comprised of 952 subjects. 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 age, sex, distribution of cases based on case scenario (elective v/s emergency), wound class, type of surgery (laparoscopic v/s open), smoking, diabetes, duration of surgery, complete hemogram before and after blood transfusion, number of blood transfusions, albumin, blood sugar level, discharge from surgical site, number of days of drains, stoma and hospital stay.
Conclusions: Surgical site infection in emergency cases were found to be higher as compared to elective cases. Occurrence of SSI proportionately increased with degree of contamination, duration of surgery and age of patients. Laparoscopic procedures showed fewer incidences of surgical site infection as compared to open procedures. Various factors showed statistically significant association with surgical site infections were diabetes, smoking, blood transfusions, haemoglobin and albumin levels. Presence of stomas and drains were associated with increased incidence of SSI but could not be proven statistically.

Keywords: Contaminants, Infection, Nosocomial, Surgical wounds

INTRODUCTION

Surgical site infection (SSI) was second commonest nosocomial complication in surgical speciality. Goal of surgery was to achieve healing by primary intention with minimal edema, no serous discharge or infection, without separation of wound edges and with minimal scar formation. Though many factors influence surgical wound healing, the level of bacterial burden was most significant risk factor.[1] Majority of surgical wounds are contaminated by microbes, but in most cases, infection does not develop because innate host defenses are quite efficient in the elimination of contaminants.[2]

Advances in infection control practices include improved operation room ventilation, sterilization method, barriers,

surgical technique, and availability of antimicrobial prophylaxis. Despite of these activities, SSI remains a substantial cause of morbidity and mortality among hospitalized patients. This may be partially explained by emergence of antimicrobial resistant pathogens and an increase number of surgical patients who are elderly and/or have a wide variety of chronic or immune-compromising disease. To reduce risk of SSI, a systematic but realistic approach must be applied with awareness that this risk was influenced by characteristics of patients, operation, personnel, and hospital. An estimated 40% to 60% SSI are preventable with appropriate use of prophylactic antibiotics.[3] However inappropriate use of broad-spectrum antibiotics, or prolonged courses of prophylactic antibodies, puts all the patients at even greater infection risk because of the development of antibiotic resistant pathogens.[4] the objective of study was to evaluate patient related modifiable and non-modifiable risk factors in causation of 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 l-year 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/0 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

- *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 exudating from the wound.

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 age, sex, distribution of cases based on case scenario (elective v/s emergency), wound class, type of surgery (laparoscopic v/s open), smoking, diabetes, duration of surgery, complete hemogram before and after blood transfusion, number of blood transfusion, albumin, blood sugar level, discharge from surgical site, number of days of drains, stoma and hospital stay. Statistical analysis was done using SPSS (Statistical Package for Social Sciences) software.

RESULTS

This observational study was comprised of 952 subjects in which 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 was significantly more in emergency cases. On statistical analysis it was found that occurrence of SSI was significantly more in emergency cases (X^2=23.95 and p<0.000001) which was highly significant.

Table 1: Non-modifiable risk factors.

Characteristics	No. of patients		No. of SSI		%
Age Group (in years)					
1-10	42		3		7.2
11-20	60		4		6.8
21-30	246		23		10.3
31-40	256		25		10.1
41-50	166		16		10.8
51-60	108		24		22.2
>60	74		17		23.1
Sex					
Males	496		72		14.5
Females	456		40		8.7
Distribution of cases based on Case scenario					
Emergency	252		60		23.8
Elective	700		52		7.4
Wound class					
Total emergency elective					
Clean	298	0	298	11	3.69
Clean contaminated	416	30	386	33	7.9
Contaminated	104	88	16	22	21.1
Dirty	134	134	0	46	34.3

All patients who were l year 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. On statistical analysis it was found significant if comparison was done between age groups below 50years. and above 50years (X=32.45, P=<0.0005).

Total number of male patients were 496 (52%) and the total number of the female patients were 456 (48%).

Table 2: Distribution of SSI among smokers and non-smokers (modifiable risk factors).

	Smokers						Non-smokers					
	Male			Female			Male			Female		
	Total	SSI	%	Total	SSI	%	Total	SSI	%	Total	SSI	%
Elective	174	32	18.3	15	3	20	160	7	4.3	351	10	2.8
Emergency	102	32	31.3	37	12	32.4	60	10	16.6	53	6	11.3
Total	276	64	49.6	52	15	52.4	220	17	20.9	404	16	14.1

Rate of SSI in males and females was statistically not significant. (X^2=3.78, p value<0.052). Percentage of total cases that got infected was 11.7%. The 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%. On statistical analysis of data it was found that the difference between clean and clean contaminated was not significant (1=0.65, p>0.4215) while between clean and contaminated was highly significant (1=10.25, p<0.003). Difference between the clean contaminated and contaminated was significant contaminated and dirty was significant (X^2=20.62. p<0.00000056).

Difference between the contaminated and dirty was not significant=1.19, p<0.2753). Percentage of surgical wounds in smokers getting infected in emergency and elective procedures were statistically significant. Furthermore, a decreased incidence of infections was found in elective setting when cassation of smoking was done for 1week before surgery.

Table 3: Distribution of SSI among diabetics and non-diabetics (modifiable risk factors).

		No of cases	HbAlc (6-7gm/dl)	No. of SSI	% of infection
Diabetic	Elective	56	Level raised=38	8	21.05
			Level normal=18	2	11.1
	Emergency	16	Uncontrolled sugar i.e. >200mg/dl=10	8	80
			Controlled sugar i.e. <200mg/dl=6	4	66
Non diabetic	Elective	644		42	6.5
	Emergency	236		48	20.3

Presence of diabetes increased the occurrence of wound infections. Percentage of surgical wounds in diabetics with raised HbA1c getting infected in elective surgeries were 21.05% and the normal HbA1c were 11.1% which was statistically highly significant.

In emergency operations the difference in wound infection was seen among those in which blood sugar was controlled (66%) and not controlled (80%).

A decreased incidence of infections was found in diabetic patients undergoing elective surgery compared to emergency surgery. Statically it was significant in both elective and emergency cases and p value was found to be <0.0056. Albumin level was highly associated with surgical site infection. Albumin level less than 2.5 showed high incidence of SSI and above it had less incidence of SSI. Haemoglobin level have shown to be highly associated with occurrence of SSI.

Patients with haemoglobin level less than 8.0gm/dl showed 29% of SSI. Even after blood transfusion, patients with haemoglobin level less than 8.0gm/dl had high occurrence of SSI. Number of blood transfusions was also associated to be the factor in causation of SSI.

Presence of abdominal drains for the number of days had not shown any variation to cause the SSI. Number of

cases with ileostomy and colostomy are highly associated with SSI. Difference in laparoscopy and open procedures were taken only in 2 procedures which were commonly practiced i.e. cholecystectomy and appendectomy. It was observed that, when procedure-wise risk of SSI was analysed, the risk was found to be higher in the contaminated cases and the emergency surgeries.

Table 4: Modifiable risk factors.

Characteristics	No. of patients	No. of SSI	(%)
Albumin level			
=/>3.5	502	42	8.36
2.5-3.4	278	34	12.2
<2.5	172	36	20.9
No. of days of drains			
<3 days	369	36	9.7
>3 days - <5 days	123	15	12.1
>5 days - <8 days	156	18	11.5
>8 days	52	7	13.4
Stomas associated with SSI			
Elective	28	3	10.7
Emergency	40	14	35
Lap v/s Open			
Laparoscopic	196	3	1.5
Open	170	18	10.5
Duration of surgery			
< lhr	402	18	4.4
>l-<3hrs	244	21	8.6
>3-<5hrs	220	46	20.9
>5hrs	86	27	31.3
Haemoglobin before blood transfusion			
>10.0gm./dl	445	20	4.4
8- 10.0gm./dl	311	35	11.2
<8.0gm./dl	196	57	29
No. of transfusions			
2	68	5	7.35
3-4	97	12	12.3
>4	42	8	19
Haemoglobin after blood transfusion			
>10.0gm/dl	139	12	8.6
8.0-10.0gm/dl	48	13	27
<8.0gm/dl	20	7	35

DISCUSSION

In this study there had been statistically significant increase in SSIs after 50 years. Patel SM et al, showed patient age was a significant factor associated with SSI.[5] Potential explanation for this finding includes increasing immune dysfunction and accumulation of comorbid conditions with increasing age. Occurrences of SSIs were equal among both the genders.

Infection rate in this study was 11.7% and the individual distribution of SSIs occurrence based on wound class was clean (3.69%), clean contaminated (7.9%), contaminated (21.2%) and dirty infections (34.3%), which showed increasing trend of infection as the degree of contamination increases. Similar result showed by Hernandez K et al, overall incidence rate (IR) to be 26.7%. Infection rate was 13.9% for clean, 15.9% for clean contaminated, 13.5% for contaminated, and 42.7% for dirty interventions.[6]

Table 5: SSI in various abdominal surgeries.

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

SSIs in emergency cases (23.8%) were found to be higher compared to elective cases (7.4%). This was due to the high number of contaminated and dirty cases in emergency settings. Sørensen LT et al, also demonstrates a significantly higher number of incidences of post-operative tissue and wound complication in emergency (22.8%) as compared to elective surgery (9.5%).[7]

SSIs proportionately increased with the duration of surgery. Haley RW et al, found that surgeries longer than 2hours were predictive of wound infections.[8]

Diabetics had higher incidence of SSI than non-diabetics. HbA1c was biochemical parameter significantly associated with risk of SSI. Halkos ME showed that high HbA1c was highly associated with post-operative wound infection and morbidity.[9] Surgical site infection rate was much higher among the patients with haemoglobin less than 8.0gm/dl. Difference was also seen in patients who had blood transfusions. Patients who

underwent more than 4 (19%) transfusions were shown to have higher number of surgical site infections as compared to those who had 3/4 (12.3%) or 2 (7.35%) transfusions. Weber WP et al, also showed strong association of pre-operative anemia (less than 9.0gm/dl) and peri-operative blood transfusion (more than 3 units) with increased risk of surgical site infection.[10]

Hypoalbuminemia influence surgical site infections. Espandar R et al, also showed similar increase level of wound discharge in post-operative patients whose albumin level were less than normal prior to surgery.[11] Risk of SSI were much more in smokers as compared to non-smokers in both elective and emergency surgeries. Mawalla B showed strong association of smoking with surgical site infection. In their study of 456 patients which were smokers 26.2% developed surgical site infection as compared to 13.8% in those who were non-smokers.[12]

In this study presence of drain with progression of day was not associated with statistically significant surgical site infection. Study by Bucher BT et al, shows that use of surgical drains has been associated with an increased risk of SSI.[13]

Presence of ileostomy and colostomy has shown increased risk of SSI though it was not significant. In elective surgeries rate of SSI was 10.5% while in emergency cases the rate of SSI was 33.8%. Study resembles with results of Chu et al, which showed no significance of drain with SSI.[14]

Main reason given for the increase in the infection rate after stomas was the contamination of surgical wounds with the contents of the stomas. High number of infection rate in patients with stomas following emergency cases were mainly because of more infected cases in emergency settings.

Laparoscopic procedures accounted for 1.5% of SSI compared to 9.4% in open procedures. In recent study by Suh YJ et al, showed vast difference in SSI between open (10.6%) and laparoscopic appendectomy (2.1%).[15]

CONCLUSION

Surgical site infection in emergency cases were found to be higher as compared to elective cases. Occurrence of SSI proportionately increased with degree of contamination, duration of surgery and age of patients. Laparoscopic procedures showed fewer incidences of surgical site infection as compared to open procedures. Various factors showed statistically significant association with surgical site infections were diabetes, smoking, blood transfusions, haemoglobin and albumin levels. Presence of stomas and drains were associated with increased incidence of SSI but could not be proven statistically.

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REFERENCES

1. Cruse PJ, Foord R. The epidemiology of wound infection: a 10-year prospective study of 62,939 wounds. Surg Clin North Am. 1980;60(1):27-40.
2. Burke JF. The effective period of preventive antibiotic action in experimental incisions and dermal lesions. Surg. 1961;50(1):161-8.
3. Page CP, Bohnen JM, Fletcher JR, McManus AT, Solomkin JS, Wittmann DH. Antimicrobial prophylaxis for surgical wounds: guidelines for clinical care. Arch Surg. 1993;128(1):79-88.
4. Dahms RA, Johnson EM, Statz CL, Lee JT, Dunn DL and Beilman GJ. Third generation cephalosporin and vancomycin as risk factor for post-operative vancomycin resistant enterococcus infection. Arch Surg. 1998:1343-46.
5. Patel SM, Patel MH, Patel SD, Soni ST, Kinariwala DM, Vegad MM. Surgical site infections: Incidence and risk factors in a tertiary care hospital, Western India. Natl J Community Med. 2012;3:193-6.
6. Hernandez K, Ramos E, Seas C, Henostroza G, Gotuzzo E. Incidence of and risk factors for surgical-site infections in a Peruvian hospital. Infection Control Hosp Epidemiol. 2005;26:473-7.
7. Sørensen LT, Hemmingsen U, Kallehave F, Wille-Jørgensen P, Kjærgaard J, Møller LN, et al. Risk factors for tissue and wound complications in gastrointestinal surgery. Ann Surg. 2005;241(4):654-58.
8. Haley RW, Hooton TM, Culver DH, Stanley RC, Emori TG, Hardison CD et al. Nosocomial infections in US hospitals, 1975-1976: estimated frequency by selected characteristics of patients. Am J Med. 1981;70(4):947-59.
9. Halkos ME. Reduced preoperative haemoglobin HbAiC level is associated with SSI and morbidity. Ann J. 2010;192(5):46-7.
10. Weber WP, Zwahlen M, Reck S, Misteli H, Rosenthal R, Buser AS, et al. The association of preoperative anemia and perioperative allogeneic blood transfusion with the risk of surgical site infection. Transfusion. 2009;49(9):1964-70.
11. Espandar R, Farhud AR, Yazdanian S. Hypoalbuminemia as a cause of post-surgical wound discharge after orthopaedic surgery. In Orthopaedic Proceedings. Brit Editorial Soc Bone Joint Surg. 2011;93:122-122.
12. Mawalla B, Mshana SE, Chalya PL, Imirzalioglu C, Mahalu W. Predictors of surgical site infections among patients undergoing major surgery at Bugando Medical Centre in Northwestern Tanzania. BMC Surg. 2011;11(1):3-5.
13. Bucher BT, Guth RM, Elward AM, Hamilton NA, Dillon PA, Warner BW, et al. Risk factors and

outcomes of surgical site infection in children. J Am Coll Surg. 2011;212:1033-8.
14. Chu DI, Schlieve CR, Colibaseanu DT, Simpson PJ, Wagie AE, Cima RR, et al. Surgical site infections (SSIs) after stoma reversal (SR): risk factors, implications, and protective strategies. Journal of Gastrointestinal Surgery. 2015 Feb 1;19(2):327-34.
15. Suh YJ, Jeong SY, Park KJ, Park JG, Kang SB, Kim DW, et al. Comparison of surgical-site infection between open and laparoscopic appendectomy. J Korean Surg Soc. 2012. Jan;82(1):35-9.

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