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Risk factors influencing surgical site infectio in elective abdominal surgery

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Abstract

Surgical site infection (SSI) represents most common subtype of healthcare-associated infections (HAIs). The risk of developing SSI is dependent upon various patient factors and procedure related factors. Identification of risk factors with appropriate preoperative history & physical examination is critical because many of patient comorbidities are non-modifiable, there can be substantial increase in SSI risk.

Keywords: SSI risk, Surgical, Diabetes mellitus

Introduction

Before the antisepsis era risk of surgery was exceedingly high due to the enormous rates of surgical infection. Studies suggest that 40-60% of these infections are preventable. Risk factors of SSI can be categorized into microbial factors, patient factors and perioperative factors. The basic principle for management of these patient related risk factors is preoperative optimization.

Patient factors {1}	Operative factors {1}
Age	Skin antisepsis
Duration of surgical scrub	Preoperative skin preparation
Nutritional status	Duration of operation
Diabetes	Antimicrobial prophylaxis
Smoking	Operating room ventilation
Obesity	Inadequate sterilization of instruments
Coexistent infections at a remote body site	Foreign material in the surgical site
Colonization with microorganisms	Surgical drains
Altered immune response	Surgical technique
Length of preoperative stay	

The term risk factor in surgery 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 predictor.

Diabetes mellitus: Elevated serum glucose in both the preoperative and postoperative periods has been associated with increased risk of SSI. There is no convincing evidence, however, that strict glycemic control beyond usual care (<200 mg/dL) is protective against SSI {2}. Hyperglycemia has been shown to alter chemotaxis, pseudopod formation, phagocytosis,

and oxidative burst, which prevent the early killing of bacteria that entered the wound during surgery {3}.

Obesity

Obesity is another well-established risk factor for SSI. Several investigators have shown that obesity leads to a twofold to sixfold increased rate of SSI compared with that in non obese patient. Decreased blood supply to the wound prevents the necessary cells, e.g. neutrophils and macrophages, from reaching the wound site to protect against infection.

Smoking

Smoking causes peripheral tissue hypoxia, decreased collagen synthesis, and interferes with the oxidative killing mechanisms of host neutrophils.

Hair removal

Do not remove unless presence of hair will interfere with the operation {1}; if hair removal is necessary, remove byclippingjust before operation and do not shave. If hair is removed, however, electric clippers should be used; razors have been linked to increased SSI rates{1}.

Mechanical bowel preparation (MBP)**:** Despite emerging evidence against usefulness of MBP from several randomized controlled trials and meta-analyses regarding this practice, MBP still continues to hold an accepted place among surgeons.

Materials and methods

This prospective study was carried out in the department of General Surgery at Dr RPGMC Tanda from December 2014 to March 2016.Total three hundred cases of elective abdominal surgery were included to study various risk factors influencing surgical site infection.

Inclusion criteria

1. All consecutive patients admitted under surgery department for elective abdominal operations.

Exclusion criteria

a) Patients undergoing reoperation.

b) Patients where implants in the form of mesh were used.

c) Patients operated for emergency surgical conditions.

Preoperative preparation

(i) Preparation of the operative site was done by shaving of hair at surgical site, cleaning and draping .

(ii) Antibiotic prophylaxis was given in clean and clean contaminated elective surgery. In biliary surgery intravenous cefuroxime was given as prophylactic antibiotic.

iii) In colorectal surgery bowel preparation was done by starting patient on low or no residue clear liquid diet 48 hours before surgery, polyethylene glycol solution night before surgery and systemic antibiotic prophylaxis day before surgery.

iv) In obstructive jaundice patients, coagulation profile study was done. These patients were given injection vitamin K, 10 milligram, intramuscularly once daily for three days. Proper hydration of the patients was done with intravenous fluids i.e. 5% dextrose and ringer lactate. Prophylactic antibiotics were also given.

v) In diabetic patients goal was to maintain fasting blood glucose levels less than 140mg/dl.

vi) Patients on oral hypoglycemic agents with acceptable glycemic control and requiring nil per oral for a day or so, were managed by withholding morning dose of oral hypoglycemic agents on the day of surgery and oral hypoglycemic agents were started with next meal.

vii) Patients of Type2 diabetes, who were controlled on insulin preoperatively were managed by omitting morning dose of insulin and sliding scale regimen {2}. Glucose levels were checked every two hours intra operatively and six hours.

SSI was recorded as per Anatomic SSI classifications {3}:

Superficial incisional SSI: Infection occurs within 30 days after the operation and infection involves only skin and subcutaneous tissue of the incision and at least one of the following:

1. Purulent drainage, with or without laboratory confirmation, from the superficial incision.
2. Organism isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
3. At least one of the following sign or symptoms of infection: pain or tenderness, localized swelling, redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture negative.
4. Diagnosis of superficial incisional SSI by the surgeon or attending physician.

Deep incisional SSI: Infection occurs within 30 days after the operation if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation and infection involves deep soft tissues (e.gfascial and muscle layers) of the incision and at least one of the following:

1. Purulent drainage from the deep incision but not from the organ/space component of the surgical site.
2. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38 degree), localized pain, or tenderness, unless site is culture negative.
3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosis of a deep incisional SSI by surgeon or attending physician.

Organ/Space SSI

Infection occurs within 30 days after the operation if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operation and infection involves any part of the anatomy (e.g. organ or spaces), other than the incision, which was opened or manipulated during an operation and at least one of the following:

1. Purulent drainage from a drain that is placed through a stab wound into the organ/ space.
2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space.
3. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosis of an organ/space SSI by a surgeon or attending physician.

Observations

The following observations were made. The age of the patients in our study ranged from1 to 82 years with a mean age of 42.7 years. (Table 1)

5. Purulent drainage, with or without laboratory confirmation, from the superficial incision.
6. Organism isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
7. At least one of the following sign or symptoms of infection: pain or tenderness, localized swelling,

redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture negative.

8. Diagnosis of superficial incisional SSI by the surgeon or attending physician.

Deep incisional SSI

Infection occurs within 30 days after the operation if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation and infection involves deep soft tissues (e.gfascial and muscle layers) of the incision and at least one of the following:

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Observations

The following observations were made. The age of the patients in our study ranged from1 to 82 years with a mean age of 42.7 years. (Table 1**)**

Table 1: Age wise distribution of patients.

Age	Number	Percentage
0-10	12	4
11-20	10	3.3
21-30	37	12.4
31-40	78	26
41-50	84	28
51-60	47	15.6
61-70	21	7
>70	11	3.7
Total	300	100

The sex distribution of the study showed that out of 300 patients, 74(24.7%) were males and 226 (75.3%) were females.**(Table 2)**

Table 2: Sex distribution

Sex	No of Patients	Percentage
Male	74	24.7
Female	226	75.3

Out of 300 patients, 17(5.66 %) developed SSI. Out of these 17 cases, 10(58.8%) were superficial incisional SSI, 3(17.6%) deep incisional SSI and 4(23.6%) were of organ space SSI.(Table-3)

Table 3: Types of SSI

Types of SSI	No of SSI(n=17)	Percentage
Superficial incisional	10	58.8
Deep incisional	3	17.6
Organ space	4	23.6
Total	17	100

On Univariate analysis it was found that patient related various risk factors viz. anemia, old age, malignancy, preoperative hospital stay, obstructive jaundice and malnutrition had significant role in influencing SSI. Out of 220 (73.3%) patients with duration of surgery less than 60 minutes, SSI rate was found to be 2.7 % whereas 65 patients with duration of surgery between 61 to 120 minutes, SSI rate was 10.7% and in 15 patients with duration of surgery greater than 120 minutes SSI rate was 26.6%.(Table4)

Table 4: Univariate analysis of various risk factors

Risk factors		SSI present	SSI absent	p value
Age	< 64 years	13(4.76%)	260(95.23%)	0.000
	> 64 years	4(14.81%)	23 (85.19%)	
Anemia	>10 mg/dl	12(4.3%)	267 (95.7%)	0.003
	<10 mg/dl	5(45.45%)	6 (54.55%)	
Preoperative stay	< 5 days	9(3.82)	226 (96.18%)	0.009
	>5 days	8(12.30%)	57(87.70%)	
Malnutrition	NO	15(5.06%)	281(94.93%)	0.000
	YES (albumin < 3)	2(50%)	2(50%)	
Jaundice	NO	15(5.06%)	281(94.93%)	0.000
	YES	2(50%)	2(50%)	
Malignancy	NO	13(4.62%)	268(95.38%)	0.003
	YES	4(21.05%)	15(78.94%)	
Type 2 DM	NO	17(6.03%)	265(93.97%)	0.283
	YES	0	18(100%)	
Obesity	NO	16(5.6%)	265(84.4%)	0.864
	YES (BMI >30)	1(5.7%)	14(94.3%)	
Smoking	NO	15(5.19%)	274(84.81%)	0.617
	YES	2(18.2%)	9(81.8%)	
Sex	Male	8(10.81%)	66(89.19%)	0.055
	Female	9(3.98%)	217(96.02%)	
Duration of surgery	<60 min	6(2.72%)	214(97.27%)	0.000
	>60-120 min	7(10.76%)	58(89.24%)	
	>120 min	4(26.6%)	11(74.4%)	

12 patients out of 17 patients with SSI had comorbidities & risk factors for SSI, and there was no patient related comorbid risk factor or comorbidities in remaining 5 patients. Nine out of 12 i.e 75% patients had two or more than two risk factors whereas three had single risk factor.(Table 5)

Table 5: Risk factors and SSI

Patients with SSI	Risk factors in patients with SSI
Patient 1	Anemia, malignancy, preoperative stay >5 days, malnutrition
Patient 2	Anemia, jaundice, malignancy, preoperative stay >5 days, malnutrition
Patient 3	Anemia, malignancy, preoperative stay >5 days
Patient 4	Anemia, malnutrition, malignancy, preoperative stay > 5 days
Patient 5	Old age, preoperative stay >5 days
Patient 6	Old age , preoperative stay >5 days
Patient 7	Anemia, Old age
Patient 8	Old age, smoker
Patient 9	Old age, jaundice
Patient 10	Obesity
Patient 11-12	preoperative stay >5 days
Patient 13-17	5 patients 13-17 had no patient related risk factors.

On multivariate analysis it was found that anemia and old age were statistically significant in causing SSI.(Table 6)

Table 6: Multivariate analysis of patient related risk factors

Risk factors		SSI+	SSI-	Odds ratio	95 % CI	P value
Age	< 64 years	13(4.76%)	260(95.23%)	1	1	0.014
	> 64 years	4(14.81%)	23 (85.19%)	3.069	0.75-12.4	
Anemia	>10 gm %	12(4.3%)	267 (95.7%)	1	1	0.000
	<10 gm %	5(45.45%)	6 (54.55%)	0.070	0.16-0.31	
Malignancy	NO	13(4.62%)	268(95.38%)	1	1	0.967
	YES	4(21.05%)	15(78.94%)	0.963	0.15-5.8	
Preoperative stay	< 5 days	9(3.82)	226 (96.18%)	1	1	0.204
	>5 days	8(12.30%)	57(87.70%)	2.23	0.64-7.72	
Malnutrition	NO	15(5.06%)	281(94.93%)	1		0.457
	YES	2(50%)	2(50%)	0.30	0.01—6.9	
Jaundice	NO	15(5.06%)	281(94.93%)	1		0.140
	YES	2(50%)	2(50%)	0.134	0.02-0.72	

Out of these 65 patients, where hair shaving was done, 9(13.8%) developed SSI whereas in remaining 235 patients without hair removal, 8 (3.4%) developed SSI.

MBP in 9 cases 3(33.3%) developed SSI.

DM 18 patients none developed SSI.

ABP 17 patients (5.6%) out of 300 developed SSI.

Obstructive jaundice out of 4 patients, 2(50%) developed SSI.

Table7: Preoperative preparation and SSI

Type of preparation	Patients with preoperative preparation			Patients without preoperative preparation		
	No of patients	No of SSI	%	No of patients	No of SSI	%
Hair shaving	65	9	13.8	235	8	3.4
Mechanical bowel preparation	9	3	33.3	0	0	0
Type 2 DM	18	0	0	0	0	0
Antibiotic prophylaxis	300	17	5.6	0	0	0
Obstructive jaundice	4	2	50	0	0	0

Discussion

Twelve out of 17 cases of SSI had comorbidities and risk factors for causing SSI. Majority of these patients 9/12 (75%) had more than one comorbidities or risk factors whereas 3/12(25%) had one risk factor for SSI. Afifi et al{6} &Siddique M et al{7} have also reported that SSI are influenced by multiple risk factors.

In our study SSI increased with old age& preoperative hospital staysimilar to study by Cruse and Foord{8,9}.The SSI rate was 45.4 % in anemia as compared to 4.1 % in non-anemic patients. Awan et al{10} and Saxena A et al{11} have also reported increased rate of SSI i.e 21.7% and 18% respectively in patients with anemia.

Diabetes mellitus has been reported to be one of the risk factors for SSI by various authors. Saxena et al{11} has also reported 24.3% SSI in diabetic patients and 13.2% SSI in non-diabetic patients, however in our study we did not observe any SSI in diabetic patients.

In our study we did not observe high rate of SSI in obesity however Awan et al{10} have reported high SSI rate in patients of obesity with BMI more than 35 kg/m^2.

In our study, preoperative hair shaving done in 65 patients, 13.5% (9/65) of these patients developed SSI whereas 3.8% (8/235) patients without hair shaving developed SSI.Afifi et al{4} &Awan et al.{10} have also reported higher SSI rate with preoperative shaving.

In our study SSI rate was 26.6% in patients with duration of surgery greater than 120 minutes. In the study conducted by Sahu S et al{12 }rate of SSI was higher when duration of surgery was greater than 1 hour which is in concordance to our study.

Conclusion

SSI represents significant source of preventable morbidity and mortality. This study reveals significant association of rate of SSI with class of wounds, type of surgery, duration of surgery, preoperative stay and various other patient related factors viz. anemia, jaundice, malnutrition, malignancy and old age. Patients with multiple risk factors were more susceptible to SSI. This study emphasis role of optimizing modifiable risk factors like blood sugar in perioperative period and smoking cessation 30 days prior to surgery. However obesity, old age as risk factors could not be found in present study probably due to nature of surgery.

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