

Original article:

Factors influencing wound infections in emergency and elective laparotomies- a prospective study

***Dr Kishan , *Dr P Praveen kumar**

*ASSISTANT PROFESSOR , DEPARTMENT OF GENERAL SURGERY , OSMANIA MEDICAL COLLEGE , HYDERABAD ,
TELANGANA

CORRESPONDING AUTHOR : DR KISHAN

ABSTRACT

Background; surgical site infections are a common cause of morbidity and mortality following major abdominal surgeries. Infections can occur in emergency and elective surgeries and can occur in superficial skin and subcutaneous planes to deep infections and can occur very early in the post.op period to very late after discharge of patients. Many comorbid conditions are associated with development of infections and timely recognition and intervention is important to prevent serious complications and death.

Methods; a prospective study was done in 450 patients who developed Surgical site infections following elective and emergency laparotomies . All the patients were selected randomly .Incidence and type of Surgical site infections (SSI) following various procedures, the risk factors for SSI, the causative organisms , their sensitivity patterns and the outcomes of treatment and associated comorbid factors which influence its outcome were studied and analysed.

Results; in this study SSI rate for emergency laparotomies was 28.5% , for elective laparotomies it was 16.6 % .The most common surgery to be infected were laparotomy for late intestinal perforation (48.27%), open cholecystectomy (48%), open appendicectomy (44.7 %). Most were superficial infections and resolved with appropriate antibiotics and local drainage procedures. most common causative organism for wound infection was *Methicillin Resistant Staphylococcus Aureus*.

Conclusions; Emergency laparotomies are more likely to develop SSI than elective laparotomies., Diabetes mellitus was the most common co-morbidity encountered. Increased age, , diabetes mellitus, obesity, , immunocompromised states, ASA grade 3 or 4 , and long duration surgery , longer pre op stay in the hospital were the risk factors identified. Signs of systemic inflammation may be masked by the prolonged use of antibiotics. Most infections were superficial and managed with local and wound drainage and other procedures.

Keywords : surgical site infection ,laparotomies, health care associated infections, MRSA, ASA score

INTRODUCTION

Surgical infection, particularly surgical site infection (SSI), is an important and serious complication of any major surgery. Infections that occur in the wound created by an invasive surgical procedure are generally referred to as surgical site infections (SSIs). SSIs are one of the most important causes of healthcare – associated infections (HCAIs), second only to

urinary tract infection (UTI) in incidence. A prevalence survey suggested that approximately 8% of patients in hospital in the UK have HCAI. SSIs accounted for 14% of these infections and nearly 5% of patients who had undergone a surgical procedure were found to have developed an SSI.¹

According to a report by the International Nosocomial Infection Control Consortium (INICC) in 2012, overall 1.4 million people worldwide were suffering from nosocomial infections, and in India alone, the rate was over 25 per cent, with SSI occupying a significant share. SSIs are associated with considerable morbidity and over one - third of postoperative deaths are related, at least in part, to SSIs.² SSI can range from a fairly minor wound discharge to a life-threatening condition. SSI is, a preventable HCAI, that can double the length of hospital stay and increase the costs of healthcare, There are, in addition, indirect costs due to loss of productivity, patient dissatisfaction and litigation, and reduced quality of life.^{4,5}

Abdominal surgical site infections are among the most common infectious complications in hospitalised patients and are associated with serious consequences SSIs involve at any level (incisional or deep) of a specific procedure. SSIs frequently affect mainly the superficial tissues, but organ / space infections can occur. The majority of SSIs become apparent within 30 days of an operative procedure and most often between the 5th and 10th postoperative days. However, where a prosthetic implant is used, SSIs affecting the deeper tissues may occur several months after the operation.

AIM AND OBJECTIVES

- To determine the incidence and types of surgical site infections (SSIs) following elective and emergency laparotomies.
- To study the associated risk factors encountered in patients who developed SSI.

- To study the causative organisms, their sensitivity patterns and the outcomes following treatment.

MATERIALS AND METHODS

Patients admitted to the surgical wards for elective surgery ,and emergency ward for emergency surgery were included in this study, the study is conducted over a period of three years in 450 patients. All patients randomly selected after obtaining informed consent.

Details of the patients who developed SSI were recorded in a proforma which included information with regard to history, clinical examination and perioperative management organisms isolated ,their sensitivity patterns along with the mode of treatment and the outcomes .

Inclusion criteria :

1. Patients who underwent emergency and elective laparotomies.

Exclusion criteria :

1. Surgery other than laparotomies.

All patients received a prophylactic antibiotic at the time of incision . The antibiotic given was a third generation cephalosporin, given intravenously. Along with metronidazole .Surgical site was cleansed with povidone iodine and surgical spirit. Sterile dressings were changed after 48 hrs .in patients diagnosed to have SSI, pus for culture and sensitivity was taken using a sterile swab and sent to lab.

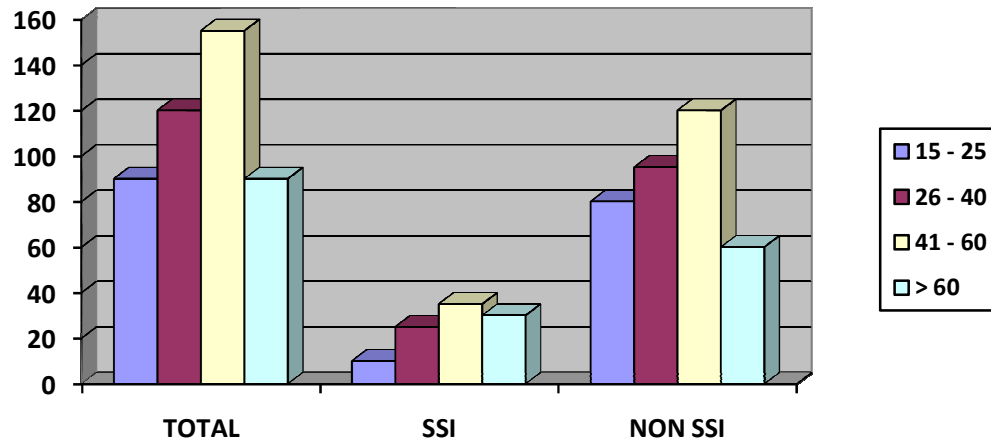
RESULTS AND OBSERVATIONS

Of the 450 patients who underwent laparotomies. 240 had elective procedures and 210 underwent emergency procedures. Data has been recorded and analysed as follows.

Age :

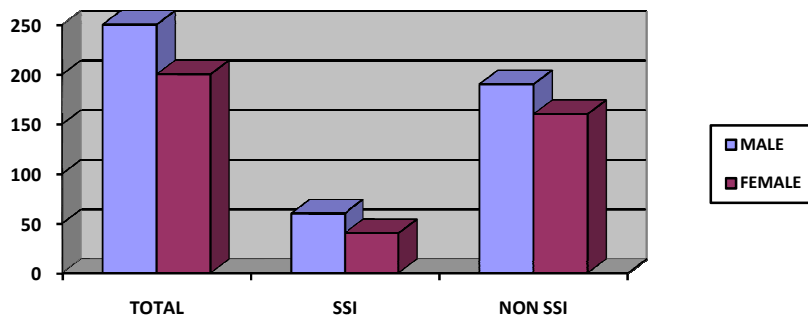
Age distribution

Age group	TOTAL	SSI	NON SSI
	No.	No.	No.
15 – 25 years	90	10(11.1%)	80
26 – 40 years	120	25(20.83%)	95
41 – 60 years	150	35(23.3%)	115
> 60 years	90	30(33.3%)	60



2. Sex :-

	TOTAL	SSI	NON SSI
MALE	250	60(24%)	190
FEMALE	200	40(20%)	160



3. Pre-operative risk classification (ASA score) :

Each patient's pre-operative physical condition was assessed as per The American Society of Anaesthesiologists (ASA) classification of physical status score and the observations are recorded in the following table

	TOTAL		WITH SSI		W/O SSI	
CLASS I	223	49.5%	43	19.2% n 223	180	80.71% n 223
CLASS II	177	39.3%	37	20.9% n 177	140	69.5% n 177
CLASS III	27	6 %	8	29.6% n 27	19	70.3% n 27
CLASS IV	23	5.1%	12	52.1% n 23	11	47.8% n 23

5. Co-morbidities :

The comorbidities which were included in this studies were

- 1) diabetes mellitus
- 2) obesity
- 3) HB < 10 gm %
- 4) COPD .

The most common comorbidity with increased risk of development of SSI encountered in this study was diabetes mellitus . SSI developed in 46.6 % of diabetics.

Table : Association of co-morbid conditions with SSI

		TOTAL (N = 450)	SSI	W/O SSI	CHI SQUARE	P VALUE
DIABETES MELLITUS	present	150	70(46.6%)	80	77.09	0.0001
	absent	300	30	270		
OBESITY	Present	154	52(33.7%)	102	18.5	0.0001
	Absent	296	48	248		
HB < 10 GM %	present	132	45(34.1%)	67	24.3	0.0001
	absent	318	55	263		
COPD	present	70	27(38.5%)	43	12.82	0.0003
	absent	380	73	307		

6. Immunocompromised states

The immunocompromised states which were included in this study was 1)malignancy and 2) HIV/AIDS. Malignancy of various types was the most frequent condition causing immunosuppression encountered in this study, with most of these patients being operated for the cure or palliation of malignancy.

Table - : Association of immunocompromised states with SSI.

		TOTAL	WITH SSI	WITHOUT SSI	Chi square	P value
CANCER	present	52	18(34.6%)	34	5.22	0.02
	absent	398	82	316		
HIV / AIDS	present	40	15(37.5%)	25	5.92	0.01
	absent	410	85	325		

The incidence of SSI among cancer patients is 34.6% and among HIV/AIDS patients is 37.5%.

B. Perioperative factors :

1. Incidence of SSI in various surgical procedures :

The incidence of SSI in laparotomies was 22.2%. The various surgeries performed and the incidence of SSI following each procedure in this study is given in the following table.

Table - : Incidence of SSI in various surgeries

SURGERY	NO OF CASES	NO OF INFECTED CASES	PERCENTAGE
BLUNT INJURY SPLENECTOMY	22	2	9.09 %
BLUNT INJURY LAVAGE (HEMOPERITONEUM)	25	3	12 %
INCISIONAL HERNIA	14	2	14.2%
UMBILICAL HERNIA	12	1	8.3%
ADHESIONLYSIS FOR ACUTE INTESTINAL OBSTRUCTION	12	2	16.6%
APPENDICECTOMY FOR ACUTE APPENDICITES	38	17	44.7%
ELECTIVCE RESECTION & ANASTOMOSIS FOR CA COLON.	17	2	11.76%
COLOSTOMY FOR CA COLON	16	1	6.25%
RESECTION & ANASTOMOSIS FOR SMALL BOWEL PATHOLOGY	17	2	11.7%
GB STONE	25	12	48%

WHIPPLES PROCEDURE	5	1	20%
REVERSAL OF STOMA	35	7	20%
FEEDING JEJUNOSTOMY	32	3	9.37%
BILIARY STRICTURE	15	2	13.3%
CBD STONE	35	5	14.2%
LPJ	17	2	11.7%
INTESTINAL OBSTRUCTION WITHOUT GANGRENE	15	5	33.3%
EARLY INTESTINAL PERFORATION	26	7	26.92%
RESECTION & ANASTOMOSIS INTUSSUSCEPTION	5	1	20%
SECONDARY SUTURING FOR BURST ABD	5	1	20%
INTESTINAL OBSTRUCTION WITH GANGRENE	14	4	28.57%
LATE INTESTINAL PERFORATION	29	14	48.27%
RUPTURE LIVER ABCESS	4	1	25%
RUPTURE SPLENIC ABCESS	5	1	20%
LAVAGE FOR PYOPERITONEUM	10	2	20%

2. Incidence of SSI in various types of wound :

The surgical wounds included in the study were classified as per the CDC wound classification system, relating to the type of operative procedure and the degree of contamination during surgery.

	TOTAL	WITH SSI		WITHOUT SSI
CLEAN	85	10 (n = 85)	11.7%	75
CLEAN CONTAMINATED	252	54(n= 252)	21.4%	198
CONTAMINATED	51	14 (n = 51)	27.4%	37
DIRTY-INFECTED	62	22 (n = 62)	35.4%	40

Other risk factors :

The various peri operative risk factors which were included in our study were

1. Pre operative stay < 5 days or > 5 days.
2. Duration of surgery <2 hrs or > 2hrs .
3. Foreign material in suture site [suture only or suture + drain].
4. Wound irrigation with povodine iodine or saline.

DURATION OF SURGERY :-

- Duration of surgery < 2 hrs total 224 patients out of which 41 (18.3 %) developed SSI.
- Duration of surgery > 2 hrs total 226 patients out of which 59 (26.1%) developed SSI.

WOUND IRRIGATION :-

- For 274 patients povidine iodine was used as a wound irrigation out of which 37 (13.5%) developed SSI.
- For 176 patients only saline was used as a wound irrigation out of which 63 (35.7%) developed SSI.

Surgical site infection :

1. Time of diagnosis of SSI :

17 of the 100 patients in this study were diagnosed with SSI as early as the 3rd post-operative day and majority were diagnosed on the 4th and 5th post-operative days. No case was diagnosed with SSI after the 9th post-operative day in this study.

Time of diagnosis (P.O.D.)*	Total 100
3 rd day	17
4 th day	30
5 th day	32
6 th day	10
> 6 th day	11

2. Type of SSI :

65 % of the cases had a superficial incisional SSI.

22% of cases had deep incisional SSI .

13 % of cases had organ / space infections .

3. Clinical manifestations :

More than 50 % of the cases presented with features of inflammation at the surgical site. Systemic symptoms like fever and raised acute phase reactants were seen in fewer than 20 - 30 % of the cases, probably masked by the prolonged use of antibiotics post-operatively.

Symptoms and signs of SSI

Feature	No. of patients
Local features of inflammation only	55 (55 %)
Local features with fever	30 (30 %)
Local features and fever with raised TC ± raised ESR	15 (15 %)

Pus for culture and sensitivity - organisms isolated and their sensitivity patterns :

The most commonly implicated organism in this study was MRSA (Methicillin Resistant Staphylococcus Aureus), accounting for 25 % of the cases of SSI, followed by E.Coli and Klebsiella species, which accounted 23% and 18% respectively . Other organisms were Proteus species and Pseudomonas aerus

Organisms implicated in abdominal SSI and their sensitivity pattern

Organism	Percentage	Sensitivity
MRSA	25 %	Vancomycin,linezolid
E.coli	23 %	Gentamicin, Amikacin
Klebsiella species	18 %	Amikacin, Cefoperazone + Sulbactam, Ceftazidime + Sulbactam
Proteus species	16 %	Amikacin, Doxycycline, Ciprofloxacin
Pseudomonas aeruginosa	12 %	Cefotaxime, Ceftazidime + Sulbactam
Staphylococcus aureus	6 %	Piperacillin + Tazobactam, Ciprofloxacin

Outcome :

patients were assessed every day at bedside before discharge or once in 3 days after discharge initially and then after 2 weeks of discharge. 20 % of the patients had persistent infection characterised by persistent purulent discharge and / or systemic signs of inflammation despite intervention. Pus for culture and sensitivity was ordered again for these patients and the antibiotic changed as per the report.

4 of the patients developed burst abdomen during the post-operative period . These patients were re-admitted emergency surgery done



DISCUSSION

Surgical site infection (SSI) is a common complication following abdominal surgery and is the third most frequent health-care associated infection, accounting for serious consequences in terms of morbidity, mortality and increased health-care costs². Various risk factors have been identified, pertaining to patient characteristics and aspects of perioperative management. Timely recognition of SSI and appropriate management can hasten post-

operative recovery and prevent the development of adverse outcomes like burst abdomen and incisional hernia or even death. The overall incidence of SSI for all surgeries performed during the study period was 22.2%. Different studies have shown rates ranging from 6.09 to 38.7%, with the majority of studies having a rate of 14 – 17%. The rate of SSI for surgeries in the present study was slightly higher than that seen other studies. similar studies conducted in other developing countries,

one in Kosovo and another in Iran, the incidence of abdominal SSI was 12 % and 17 % respectively. the incidence of abdominal SSI was slightly higher than that of other developing countries, but much higher than that observed in developed countries like United Kingdom (3.1%) and the Netherlands (4.3%). The most common age group developing SSI was > 60 years, for both males and females. Most studies in literature show an increase in the incidence of SSI with increasing age, probably reflecting the deteriorating immune status and development of co-morbidities with age . SSI rates among males is 24% and among females is 20%. There is no statistical significance different of SSI among males and females. .The incidence of SSI among alcoholics is 26.19% and among non alcoholics is 18.75% with no statistical significance difference. The most common co-morbidity was Diabetes Mellitus, the rate of SSI among diabetics is 46.6% and among non diabetics is 10% which is significant .The other risk factors were Obesity, Hb < 10 gm%, COPD all of which showed statistically significant SSI rates. The two immunocompromised states such as cancer and hiv/aids showed statistically significant higher rates of SSI . Incidence of SSI increases with an increase of the ASA score, but in the present study, majority of the patients had an ASA score of 3 and 4, .. The incidence for SSI was 16.6 % for elective laparotomies and 28.57 % for emergency abdominal surgeries, which shows that emergency laparotomies were statistically far more likely to develop SSI than elective procedures (p value < 0.0001). This is in conformity with another study conducted at an Indian teaching hospital by Mahesh C B *et al* (p value < 0.002). The high rates of infection in emergency surgeries can be attributed to inadequate pre-operative

preparation, the underlying conditions and the greater frequency of contaminated or dirty wounds in emergency surgeries. 56 %(252 out of 450) of laparotomies were classified as clean-contaminated. These cases accounted for 54 %(54 out of 100) of SSI in this study. This may be due to the fact that a high proportion of laparotomies is occupied by clean-contaminated cases. Most common surgery to be infected were laparotomy for late intestinal perforation (48.27%), open cholecystectomy (48%), open appendectomy (44.7 %). Incidence of SSI for these surgeries was far higher than any noted in literature. This was probably due to the associated co-morbidities and the late presentation of patients with duodenal ulcer perforation in these parts, which converts a contaminated wound to a dirty wound, thus increasing the risk of SSI. . A review of literature suggests that the risk of infection increases when the duration of surgery exceeds 2 hours, although the type of surgery may vary. . Wound irrigation was regularly practised for wounds with a greater risk of contamination, which theoretically reduces the risk of SSI. Antibiotic prophylaxis was received by all the cases studied, which has consistently proven to reduce SSI rates in various studies world-wide. The most critical factors in the prevention of postoperative infections, the sound judgement and proper technique of the surgeon and surgical team, were difficult to quantify in this study. Majority of the patients in this study did not develop systemic signs of inflammation like fever or elevated cell counts. All the patients were given either oral or parenteral antibiotics, typically a third-generation cephalosporin or a quinolone, for an average of 5 days post-operatively. This practice, which was in some instances

inappropriate and injudicious, could have masked the development of systemic signs of inflammation. The most common organism implicated in this study was *MRSA*. found to be most sensitive to the aminoglycosides, followed by third generation cephalosporins. Superficial incisional infections were the most common in our study, an increased number of patients with SSI were also found to have diabetes mellitus, and old age as additional risk factors in the present study. In this study there were few cases of burst abdomen probably due to the fact that a majority of the infections were superficial incisional at the time of diagnosis and have been adequately controlled by timely intervention and institution of the appropriate antibiotic as suggested by the sensitivity pattern, before they could worsen

and cause deep incisional and organ / space infections

CONCLUSIONS

The incidence of SSIs following laparotomies is 22.2%. Emergency laparotomies were statistically more likely to develop SSI than elective laparotomies. A large share of abdominal SSIs was occupied by surgeries with clean-contaminated wounds, which is similar to other studies. It reflects the higher proportion of such cases in laparotomies. Diabetes mellitus was the most common co-morbidity encountered. Increasing age, smoking, diabetes mellitus, obesity, hb < 10 gm %, COPD, cancer, hiv/aids, ASA grade, Duration of surgery > 2hrs, wound irrigation with saline, pre op stay > 5 days were the risk factors identified. Signs of systemic inflammation may be masked by the prolonged use of antibiotics.

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