TASHKENT MEDICAL ACADEMY

100 TMA ANNIVERSARY

Journal of Educational and Scientific Medicine

Issue 3 (1) | 2022

OAK.uz

Google Scholar

Supreme Attestation Commission at the Cabinet Ministers of the Republic of Uzbekistan

ISSN: 2181-3175

Journal of Education & Scientific Medicine

ISSN 2181-3175

Tashkent Medical Academy

Research Article

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Surgical Site Infection in Abdominal Surgeries: A Clinical Study

Amit Agrawal[1], R. P. Singh[2]

[1]*Assistant Professor, Department of General Surgery, JLN Hospital and Research Center, Bhilai (C.G.)., India*
[2]*Joint Director, Department of General Surgery, JLN Hospital and Research Center, Bhilai (C.G.)., India*

Abstract

A prospective study of incisional surgical site infection in abdominal surgeries was conducted to find out incidence, common predisposing factors and microbiological profile. 375 patients who underwent abdominal surgeries were studied in a span of 1 year. They were divided into two groups – group 1 – 316 cases who did not develop Surgical Site Infection (SSI), the 2nd group – 59 cases that developed SSI. These patients were studied by interviewing and examination according to a set proforma. The results were statistically analyzed by comparing averages using Chi square chart for finding significance of difference where applicable. The overall SSI incidence was 15.7 % (59/375). In elective surgeries, the SSI rate was 5.7% and in emergency surgeries, it was 28.6%. It was found that SSI increased with increasing age linearly. Other significant factors involved were increasing class of wound (dirty > clean wound class), increased preoperative stay, presence of remote site infection, increased duration of surgery and use of drains. E. coli was found to be the most common organism causing SSI in abdominal operations. SSI can be reduced by decreasing the preoperative hospital stay, appropriate antibiotic administration policies, preoperative control of remote site infections, adequate preoperative patient preparation, reducing the duration of surgery to minimum, judicious use of drains and intraoperative maintenance of asepsis and following operation theatre discipline properly.

Corresponding author: Dr. Amit Agrawal, HIG, C/72, Shailendera Nagar, Raipur (C.G.)-492001. Email: doc.amitagrawal@gmail.com

Received: June 06, 2022, **Accepted:** June 15, 2022, **Published:** June 20, 2022

Keywords: abdominal surgeries, infection, SSI, surgical site infection

INTRODUCTION

Surgical Site Infection is defined as postoperative infection at any level (incisional or deep) of specific procedure that may at any time from 0 - 30 days of a procedure or up to 1year after a procedure that has involved the implantation of foreign material. It is classified as superficial incisional, deep incisional and organ space SSI.

Even in this era of improved antibiotics, surgical site infections could not be eradicated and are responsible for major morbidity in postoperative surgical patients. The surgical site infection rates are still up to 20% in intra-abdominal procedures and range from 3.4% - 36.1% in different studies.

MATERIAL & METHODS

The study was carried out on 375 patients divided into two groups, group 1- without SSI – 316 cases, group 2- with SSI – 59 cases. Exclusion Criteria were: Those operated outside the department of General Surgery, where peritoneum was not opened, where wound was not primarily closed, surgeries lasting more than 2.5 hours, patients who died intra operatively or postoperatively within 30 days of surgery, those who developed organ space SSI and where prosthesis was used.

The patients were studied by interviewing, examination and laboratory investigations noted in a set proforma. These wounds were classified into clean, clean contaminated, contaminated and dirty wounds according to National Nosocomial Infection Surveillance (NNIS) criteria (figure 1) and the SSI were diagnosed according to World Health Organization (WHO) working group definition and Center for Disease Control, National Nosocomial Infection Surveillance criteria for defining SSI [9,13].

All the patients undergoing elective surgery were given prophylactic antibiotics within 1 hour of commencement of surgery. Patients were followed up to 30 days postoperatively in wards or Outpatient department (OPD).

CLASS	CRITERIA
Clean	No hollow viscous entered
	Primary wound closure
	No inflammation
	No breaks in aseptic technique
	Elective procedure
Clean-contaminated	Hollow viscous entered but controlled
	No inflammation
	Primary wound closure
	Minor break in aseptic technique
	Mechanical drain used
	Bowel preparation preoperatively
Contaminated	Uncontrolled spillage from viscous
	Inflammation apparent
	Open, traumatic wound
	Major break in aseptic technique
Dirty	Untreated, uncontrolled spillage from viscous
	Pus in operative wound
	Open suppurative wound
	Severe inflammation

Figure 1. Classification of wounds according to National Nosocomial Infection Surveillance System (Culver DH, Horan TC, Gaynes RP et al: Surgical wound infection rates by wound class, operative procedure and patient risk index. National Nosocomial Wound Surveillance System. Am J Med 91: 152S – 157S, 1991).

RESULT

The mean age of patients was 43.3 years. The youngest patient was 10 years of age and the oldest was 76 years of age. 59.5% patients were males. The overall incidence of SSI was 15.7%. In Elective surgeries it was 5.7% and in Emergency surgeries 28.6%. The age relationship of SSI was linear SSI increased with increasing age. In 0-30 years age group it was 10.9% while in >60 years age group it was 43.8% (table 1). There was no significant influence of gender on SSI. The incidence of SSI was minimum in clean wounds 3.6% followed by clean contaminated 10.7%, contaminated 20.3% and maximum in dirty wounds 53.8%.

Table 1

SSI relation to age, remote site infection, preoperative hospital stay

Characteristics		SSI/total	%
Age (yrs)	15-30	11/101	10.9
	30-45	15/103	14.6
	45-60	24/151	15.9
	>60	7/16	43.8
Remote site infection	Present	33/12	36.4
	Absent	47/342	13.7
Preoperative stay (days)	<1	39/272	14.3
	1 – 5	17/91	18.7
	>5	3/12	25

This was statistically significant with p-value of <0.001 in emergency surgeries and <0.05 in elective group. In elective surgeries group maximum SSI was found in colonic surgery – 14.3%, while minimum in cholecystectomy 2.2%.

In Emergency surgery group maximum incidence of SSI was observed in hepatobiliary surgeries 44.4% while minimum with appendicular pathology 19.4%.

The overall ratio of superficial to deep SSI was 2.2. Superficial SSI were more common than deep SSI in cleaner class of wound (12.2% superficial SSI and no deep SSI in clean class) while deep SSI were more common in dirtier class (50% deep and 29.3% superficial SSI in dirty wound class).

SSI were more common in patients with preexisting remote site infection (36.4% compared to 13.7% in those without it), which was statistically significant with p-value <0.001 (table 1). Drain usage was also associated with increased incidence of SSI with 23.6% SSI in those with drain use compared to 5.9% in those without, which was also statistically significant with p-value <0.001. SSI was more when preoperative hospital stay was more (14.3% in < 1day stay and 25% in those with > 5day stay) p-value <0.05.

The average day of appearance of SSI was 5.2 days. In 14.3% patients SSI appeared in less than 1 day and 25% in more than 5 days after surgery (table 1).

The most common organism isolated from peritoneal fluid cultures was E.coli 63.8%. Others: sterile culture 27.7%, Methicillin Resistant Staphylococcus Aureus (MRSA) 4.3%, Klebsiella 2.1%, mixed infection 2.1% (table 2).

The most common organism isolated from pus cultures was E.coli 57.6%. The other organisms were MRSA – 22%, klebsiella and non MRSA staphylococcus 3.4% each, non-hemolytic staphylococcus, pseudomonas sp. 1.7% each and mixed infection in 3.4% while sterile cultures were found in 6.8% samples (table 2).

Table 2

Microbial Cultures

Culture	Organism	+ve/total	%
Pus	E. Coli	34/59	57.6
	MRSA	13/59	22
	Sterile	4/59	6.8
	Others	12/59	20.3
Peritoneal fluid	E. Coli	30/47	63.8
	MRSA	2/47	4.3
	Sterile	13/47	27.7
	Others	2/47	4.2

Similar pus and peritoneal fluid cultures were found in 59.6% cases (table 3).

E.coli was more commonly associated with more contaminated wound class i.e. 71.4% cases in dirty wound class and nil in clean class. MRSA were more common in cleaner wound class compared to the dirty classes i.e. 60% MRSA in clean classes and 9.5% in dirty wound class.

Table 3

Relationship of pus and peritoneal cultures

Relationship	No./total	%
Similar	28/47	59.6
Dissimilar	19/47	40.4

In the wound showing E.coli as organism in culture the SSI appeared beyond 5th postoperative day in most of the cases (73.5%) while MRSA positive cultures showed appearance of SSI before 5th postoperative day in most cases (84.6% cases).

DISCUSSION

The surgical craft always bears a risk of surgical site infection. The surgeon deals with infection in three scenarios. First a condition where infection already exists, second where significant factors required for infection are already present and third where surgery is performed for some disease not related to infection and this surgery leads to predisposition to infection. Large number of studies reported surgical site infection in abdominal surgeries between 3.4% and 36.1% [5, 9, 12, 15, 17, 18].

The findings in this study were overall infection rate of 15.7%. This matches the rate of developing countries and is higher compared to developed ones and less as compared to few Indian studies. This is due to the fact that in developed countries they have a systematic feedback of SSI rate and surveillance bodies such as hospitals in Europe Link for Infection Control through Surveillance (HELICS) in Europe and National Nosocomial Infection Surveillance System (NNIS) in United States of America whereas in our country we rely mainly on sporadic surveys which is not much reliable.

Further, financial constraints compared to developed countries, inadequately trained personnel working for infection control, overcrowded wards, ignorance in part of patients and their relatives and insufficient equipment and supplies are other major factors for this difference.

Multiple risk factors play role in development of SSI which can be broadly classified into – Bacterial factor, Patient factor and local wound factor. The interaction between these three determines the development of SSI and so it is difficult to prove an independent association of a specific factor for development of SSI particularly when looking at different groups of surgical patients. So there is difference in rates of SSI in different studies.

Present study shows increased incidence of SSI with age which is also noted in similar studies carried out earlier [3,5,12,15,18]. Also, the incidence of infection was found to be higher in emergency than elective surgeries which is similar to studies conducted by Kamath et al [18] and Razavi et al [15].

In the present study it was found that SSI developed more in patients on therapeutic antibiotic regimen as compared to those on prophylactic antibiotic regimen. This finding is comparable to earlier studies [6,11,12,16].

Also it was observed that increased preoperative hospital stay lead to higher incidence of SSI which was also noted by other researchers [1,2,8,10,12,14,15,18]. This increased incidence of SSI can be explained by – either more endogenous bacteria are present or commensal flora is replaced by hospital flora.

E. Coli was the most common organism associated with SSI and was most commonly associated with dirty wounds. Studies done by Lul Raka et al and M Fiorio et al also found E.coli as most common organism [5, 12]. In clean wounds, MRSA was most commonly found which is similar to findings of the study done by Liliani et al [10].

Duration of the surgery was also found to affect the incidence of SSI with maximum occurrence in operations requiring more than 2 hours and least in operations requiring less than one and a half hour. Various studies also found similar findings [10,12,15].

Doherty at al found that rate of development of SSI roughly doubles with every hour of operative time [7]. The reason appears to be that the operative time increases the chances of operative team puncturing its gloves, more bacteria accumulate in the wound, drying and maceration of the wound edges due to prolonged operative time can lead to interruption of the blood supply which compromises the microcirculation.

The incidence of SSI was found to be more in patients with remote site infection. Edwards LD found that preoperative remote site infection increases the risk of SSI by 3-5 folds [4].

The use of drains also showed the increased incidence of SSI. Kamath et al also found that incidence of SSI was 5.8 times more with drains [18].

CONCLUSION

The overall incidence of SSI in cases of abdominal surgeries was found to be 15.7% in our study. This however, can be reduced by decreasing the preoperative hospital stay, appropriate antibiotic administration policies, preoperative control of remote site infections, adequate preoperative patient preparation, reducing the duration of surgery to minimum, judicious use of drains and intraoperative maintenance of asepsis and following operation theatre discipline properly.

Further a dedicated system of infection surveillance which can be used for reporting data regarding nosocomial infections and their systematic review. This would help to individualize policies regarding nosocomial infection control in different setups.

Conflict of interest - The author declares no conflict of interest.

Financing - The study was performed without external funding.

Compliance with patient rights & principles of bioethics - All patients gave written informed consent to participate in the study.

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