The Egyptian Journal of Hospital Medicine (October 2022) Vol. 89 (2), Page 7309- 7313

Surgical Site Infections: A Study of Incidence and Risk Factors in Abdominal Surgeries

Mohammed Abd Al-Fattah
Department of General Surgery, Al Azhar University, Cairo
E mail: Dr.mohamed19831983@gmail.com, Phone number: +20 109 633 6992

ABSTRACT

Background: One of the most significant causes of healthcare-associated infections, which result in significant morbidity, death, and high costs to the health care system, is surgical site infections (SSI).

Aim: This research aims to examine SSI incidence and risk variables after abdominal operations.

Methods: This was a prospective case series study, descriptive type, for (70) cases divided into 2 categories: 40 cases of elective abdominal surgeries and 30 cases of emergency abdominal surgeries.

Results: SSI incidence was nil among the age group 10:20 years old. On the other hand, it was highest among the age group 51:60 years with incidence of 50%. There was a gradual increase of SSI incidence with advancement of age. SSI occurrence was found to be higher in cigarette smokers to nonsmokers (26.7% to 10.9%), also it was higher in tramadol abusers to free patients (13.3% to 1.8%).

Conclusion: In our study, diabetes, smoking and advancement in age had a great impact on the incidence of SSI in abdominal operations. Incidence of SSI is higher in emergency surgeries and in class II wounds.

Keywords: Surgical Site Infections; Incidence; Abdominal Surgeries.

INTRODUCTION

Infections that develop in the incision left behind by an invasive surgical operation are known as surgical site infections (SSI) [(1)]. These infections may damage the deep tissue around the surgical site or the incision up to 30 days following the procedure [(2)].

Three distinct anatomic degrees of infection are characterized by the criteria used to identify surgical site infections. These types of SSI are superficial incisional, deep incisional, and organ/space infected sites [(3)].

Because they raise healthcare expenses, extend hospital stays, and enhance postoperative mortality and morbidity; the negative impacts of SSI on the healthcare system, patients, and those who care for them serve as more evidence of the need for prevention [(4)]. The linked connection between SSI and the rising antimicrobial resistance burden, which is made worse by the improper administration of antibiotics during surgical prophylaxis and subpar infection prevention and control procedures, complicates the issue [(5)].

One of the most significant contributors to infections related to healthcare is SSI. The incidence of SSI has been proven to be about 5% across all invasive surgical procedures, and they have been reported to contribute up to 15-20% of nosocomial infections. The total incidence of wound infections after upper and lower gastrointestinal surgery after laparotomies has been reported to be 15% [(6)].

Both the nature of the surgical operation and the patient's risk factors affect the likelihood that SSI may manifest. The kind of technique, the surgeon's experience, the length of the process, the use of foreign objects or implanted devices, and the degree of tissue damage are all features of a surgical procedure. Diabetes, cigarette use, obesity, malnutrition, and the use of systemic steroids or other immunosuppressive medications are examples of patient risk factors [(7)]. The risk of SSI is influenced by a variety of patient-related and procedure-related variables; therefore, prophylaxis calls for a "bundle" strategy that
pays systematic attention to a number of risk factors in .order to lower the likelihood of bacterial contamination and strengthen the patient's defenses [(7)].

Patients, healthcare workers, and administrators should all be very concerned with the prevention and treatment of SSI. Pre, intra, and postoperative risk factor management should be a part of SSI prevention [(8)].

Controlling intraoperative risk factors by maintaining patient homeostasis and routine staff use of efficient operating room safety practices are the two key intraoperative aspects involved in the prevention of SSI [(9)]. The subjective evaluation of the wound's discomfort, tenderness, swelling, erythema, and purulent discharge that appear at least 48 hours after surgery and within 30 days is crucial to the diagnosis [(10)].

The aim of this work is to study the incidence and risk factors in developing SSI in abdominal surgeries.

PATIENTS AND METHODS

This was a prospective case series study, descriptive type, which was done for (70) cases who were divided into 2 categories: 40 cases of elective abdominal surgeries and 30 cases of emergency abdominal surgeries.

Inclusion criteria: Clean abdominal surgeries [class I operative wounds] and clean contaminated abdominal surgeries [class II operative wounds].

Exclusion criteria: Contaminated abdominal surgeries [class III operative wounds], dirty abdominal surgeries [class IV operative wounds], COPD, corticosteroids dependent patients, immunosuppressed patients, obesity body mass index (BMI) >40, malnutrition (BMI<18.5) and jaundice (bilirubin>1.2).

Received: 15/7/2022
Accepted: 18/9/2022

Study procedures:

After admission, a brief history was obtained, and patients had a physical examination. Only critically needed investigations were completed in order to make the best management decisions. The trial was open to patients who needed abdominal surgery and met the inclusion requirements. The investigator filled out data collecting forms, which were made to include all the areas that needed to be researched. All patients had postoperative care and were extensively watched for a month after surgery. During this time, if any symptoms or indications of infection occurred, appropriate investigations were launched to determine the kind and severity of the illness. If any pus accumulation was seen, it was drained and submitted for a culture and sensitivity test. As soon as the results of the culture and sensitivity test were received, the antibiotic was modified as appropriate.

Ethical Approval:

The study was approved by the Ethics Board of Al-Azhar University and the patients were given all the information they need about the trial. An informed written consent was taken from each participant in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis

IBM SPSS version 22.0 was used to analyses computer-generated data. To express quantitative data, percentages and numbers were employed. Before utilizing the median in nonparametric analysis or the interquartile range in parametric analysis, it was required to perform Kolmogorov-Smirnov tests to ensure that the data were normal. We used the (0.05) significance threshold to establish the significance of the findings. The Chi-Square test is used to compare two or more groups. The Monte Carlo test may be used to adjust for any number of cells with a count less than 5. Fischer Chi-Square adjustment was applied to tables demonstrating non continuous data.

RESULTS

This research was done to find the incidence and risk factors for SSI after abdominal surgeries, which may assist lower the rate of SSI. Seventy patients with abdominal operations were randomly selected.

The age groups were classified into five age intervals; the most frequent age group was 31:40 years which constituted 27.1% of the study group, while the least frequent age group was 21:30 years which constituted 14.3% of the study group (Figure 1) (Mean age was: 38.21 years). Male to female presentation was 36:34 patients respectively. Out of 70 patients, only 12 patients had co-morbidities including DM, Br. Asthma, HTN (hypertension) and IHD (ischemic heart disease).

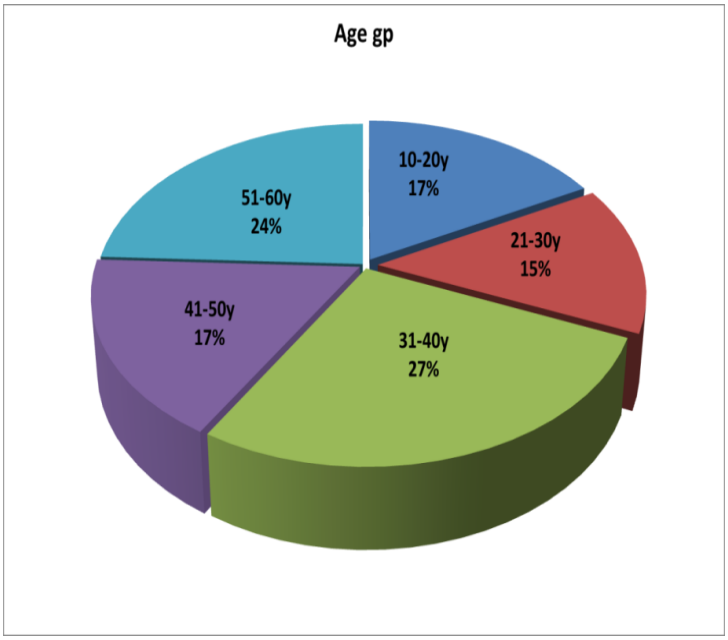

Figure (1): age groups of the patients

SSI incidence was nil among the age group 10:20 years old 0%. On the other hand, it was highest among the age group 51:60 years with incidence 50%. There was a gradual increase of SSI incidence with advancement of age (Table 1). SSI occurrence was found to be higher in cigarette smokers to nonsmokers (26.7% to 10.9% respectively), also it was higher in tramadol abusers to free patients (13.3% to 1.8% respectively). Regarding co-morbidities found, DM only of all the co-morbidities occurred in SSI patients with incidence of occurrence 26.7%.

Table 1: Relation between age groups and incidence of SSI

Age groups	Surgical site infections (SSI)				χ^2	P
	No:62		Yes:8			
	No	%	No	%		
10-20y	12	19%	0	0.0%	4.157	0.385
21-30y	9	14.5%	1	12.5%		
31-40y	17	27.3%	2	25%		
41-50y	11	17.7%	1	12.5%.		
51-60y	13	20.0%	4	50%		

2 types of anesthesia were found (general and spinal), spinal anesthesia predominates with incidence of 62.9% (44 cases). Wound classes included in the study were I and II; class II wounds were the most prevalent with incidence 52.9% (37 cases).

Incidence of SSI occurrence in case of spinal anesthesia was 62.5% (5 cases) and in case of general anesthesia was 37.5% (3). SSI incidence in class II was 75% (6 cases) and was 25% in class I (2 cases).

The research included a variety of procedural kinds; appendectomy was the most encountered procedure with incidence of 22.8% (16 patients) with 2 of 16 patient had infection (Table 2).

Table 2: types of the operations and relation between operations and incidence of SSI

	Surgical site infections (SSI)				χ2	P
	no (n = 62)		yes (n = 8)			
	No	%	No	%		
Operation						
Inguinal hernioplasty	11	17.6%	0	0.0%		
Umbilical hernioplasty	10	16%	1	12.5%		
Incisional hernioplasty	6	9.6%	1	12.5%		
Dermolipectomy	8	12.9	1	12.5		
Cholecystectomy	2	3.1%	0	0%	5.077	0.749
Appendectomy	14	22.5%	2	25%		
Splenectomy	3	4.8%	0	0%		
Exploration internal hemorrhage	2	3.1%	1	12.5%		
Irreducible inguinal hernioplasty	6	9.6%	2	25%		

The research included a variety of incision types ; inguinal incision was the most encountered incision with incidence of 25%(19 patients) with 2 of 19 patients had infection (table 3)

Table 3: Relation between type of incision and incidence of SSI

	Surgical site infections (SSI)				χ2	P
	no (n = 62)		yes (n = 8)			
	No	%	No	%		
Incision						
Inguinal	17	23.6%	2	25%		
Lower abdominal (Dermolipectomy incision)	8	12.9%	1	12.5%		
Transverse supraumbilical	10	18.2%	1	12.5%		
Midline	8	12.9%%	2	25%	6.229	0.398
Left subcostal	3	4.7%	0	0%		
Right Subcostal	2	3.1%	0	0%		
McBurney (grid iron)	14	22.5%%	2	25%		

SSI was found to be higher in emergency surgeries with incidence of 62.5% (5 cases) than elective surgeries with incidence of 37.5% (3 cases) (Table 4).

Table 4: Relation between type of surgery and incidence of SSI

	Surgical site infections (SSI)				χ2	P
	no (n=62)		yes (n=8)			
	No	%	No	%		
Type of Surgery						
Elective	40	64.5%	5	62.5%	0.013	0.911
Emergency	22	35.5%	3	37.5%		

Regarding to the causative organism; Pseudomonas was the most isolated micro-organism which was constituted 3 out of 8 cases and a percent of 37.5% followed by E coli, Klebsiella then CONS.

Table 5: Causative organisms

	Surgical site infections (SSI)				χ2	P
	No		Yes			
	No	%	No	%		
Organism						
Negative	62	100.0%	0	0.0%		
E coli	0	0.0%	2	25%		
Pseudomonas	0	0.0%	3	37.5%	70.000	<0.001*
Klebsiella	0	0.0%	2	25%		
CONS	0	0.0%	1	12.5%		

*: Significant CONS: Coagulase-negative staphylococci

Regarding to antibiotics efficacy; the most effective antibiotic was imipenem with followed by amikacin, vancomycin then cefoxitin. On the other hand; there were ineffective antibiotics such as cefepime, cephradine, cefuroxime, oxacillin and amoxicillin.

DISCUSSION

Seventy patients with abdominal operations were randomly selected. Patients were selected according to fitting the inclusion criteria.

SSI occurred in 12.9% of the study group with count 8 of total 70 patients. Whereas; 87.1% of the study group were free of SSI with count 62 of total 70 patients.

The rate of SSI varies greatly worldwide. The current study showed that the overall rate of SSI in abdominal surgery was 12.9%. This is indeed a higher rate than the results of the study which took place at Cairo University and found an SSI incidence to be 9%[11] and lower rate than another study made in Egypt, in Alexandria with SSI incidence 17%[9]**.** Another recent international study took place in India found an SSI incidence of 12.6% [12]. Incidence rates for surgical site infections are 11.5% in Sierra Leone, another country. The WHO's worldwide estimates of 10.8% for the prevalence of SSI in low- and middle-income countries are comparable to the incidence of SSI found in this research [13]

This isn't always the case, however, since several wealthy nations have been shown to have high SSI prevalence rates. For instance, despite the use of evidence-based preventative strategies, the frequency of SSI in optional colon and rectal surgeries was significant (23.2% and 27.6%, respectively) [14].

Speaking of the age; all the patients were in the range of 10 to 60 years old, with the most frequent encountered age group 31:40 years old (27.1%) and least encountered age group 21:30 years old (14.3%), mean age was 38.21 years old **.** Incidence of SSI was highest within the age group 51:60 years old (50%) and lowest among the age group 10:20 years old (0 %). This conclusion is comparable to one from Duke University research by **Keith *et al.*** [15], which revealed that enhancing age independently predicted an increased risk of SSI until age 65 years.

Several co-morbidities were included in this study (DM, Br. asthma, HTN and IHD), the only association with SSI that could be deducted is that with DM patients, having an incidence of occurrence 26.7%. **Watanabe *et al.*** [6] found that SSI was 14.2% common in diabetic individuals. On the other hand, those with diabetes had a 31.25% incidence of SSI [16].

The present study focused on class I and II wounds, on comparing SSI rates in both, it was found to be higher in class II wounds 60% to 40%. **Soad *et al.*** [18] found the incidence of SSI to be 20.8% and 10.5% in class I and II respectively being higher in class I wounds unlike our study, while **Patel *et al.*** [18] published results of 3% to 11% respectively, which is more reliable for SSI incidence being higher in class II wounds, **Rochak *et al.*** [12] also found nearby incidence 3.8% to 13.9% respectively. **Zinn and Vangela,** [19] stated rates of SSI in class I wounds 2% or less, while in class II wounds 5-15%.

Regarding the causative organism; E. coli was the most isolated micro-organism which was constituted 53.3% of the infected cases followed by pseudomonas then CONS and Klebsiella.

Hemant *et al.* [16] revealed that the most common infections were those caused by Pseudomonas, Klebsiella, coagulase-positive Staphylococci, Escherichia coli, and diphtheroid infection, while the research done by **Nargis *et al.*** [11] revealed that the most frequent SSI isolates detected were E. coli (29.8%), followed by Staph. aureus (17.1%). Acinetobacter and Pseudomonas; each represented 12.8%. Klebsiella accounted for (10.6%), while each of Enterobacter, Citrobacter and Proteus accounted for 2%.

Speaking of the antibiotics' efficacy; some antibiotics were completely ineffective to organisms isolated such as cefepime, cephradine, cefuroxime, oxacillin and amoxicillin. While others have shown to be effective such as imipenem followed by amikacin, vancomycin then cefoxitin.

This observation may be a result of widespread antibiotic usage in the general population as well as the well-known high incidence of numerous antibiotic resistant nosocomial bacteria in our environment [18]. The high resistance to most antimicrobials identified is a reason for serious worry, making the decision to employ empiric antibiotics more challenging, although being constrained by the effect of preoperative antibiotic usage and the small range of antimicrobial sensitivity evaluated [18].

CONCLUSION

In our study, diabetes, smoking and advancement in age had a great effect on the incidence of SSI in abdominal operations. Incidence of SSI was higher in emergency surgeries and in class II wounds.

DECLARATIONS:

- **Consent for publication:** I attest that all authors have agreed to submit the work.
- **Availability of data and material:** Available
- **Competing interests:** None
- **Funding:** No fund
- **Conflicts of interest:** no conflicts of interest.

REFERENCES

1. **Smyth E, McIlvenny G, Enstone J *et al.* (**2008**):** Four Country Healthcare Associated Infection Prevalence Survey 2006: Journal of Hospital Infection, 69: 230-48.
2. **Dellinger E, Hausmann S, Bratzler D *et al.* (**2005**):** Hospitals collaborate to decrease surgical site infections. Am J Surg., 190: 9–15.
3. **Doharty G, Way L (**2006**):** Current Surgical Diagnosis, 12th ed. McGraw Hill, USA. https://books.google.com/books/about/Current_Surgical_Diagnosis..
4. **Badia J (2017):** Impact of surgical site infection on healthcare costs and patient outcomes: a systematic

review in six European countries. J Hosp Infect., 2017;96(1):1–15. https://doi.org/10.1016/j.jhin.2017.03.004.

5. **WHO (2016):** Global action plan on antimicrobial resistance. Available from https://www.who.int/publications/i/item/9789241509763
6. **Watanabe A, Kohnoe S, Shimabukuro R *et al.* (**2008**):** Risk factors associated with surgical site infection in upper and lower gastrointestinal surgery. Surgery Today, 38(5): 404-412.
7. **Anderson D, Kaye K, Classen D *et al.* (2008):** Strategies to prevent surgical site infections in acute care hospitals. Infect Control Hosp Epidemiol,, (s51-s61): 29.
8. **Teija-Kaisa A, Eija M, Marja S *et al.* (**2013**):** Risk factors for surgical site infection in breast surgery. J Clin Nurs., 22(7/8): 948-57.
9. **Brick N (2013):** Cochrane Nursing Corner: Perioperative glycaemic control regimens for preventing surgical infections in adults. AORN., 93(4): 491–2.
10. **Orsted H, Keast D, Kuhnke J *et al.* (2010):** Best practice recommendations for the prevention and management of open surgical wounds. Wound Care Canada, 346: (1) 8.
11. **Labib N, El-Lawindi M, Abdelaziz S *et al.* (2012):** Incidence and predictors of surgical site infections at Cairo University Hospitals. The Egyptian Journal of Community Medicine, 30(1): 39-58.
12. **Rochak G, Ashwani K, Harinder p, Sourabh K (2015):** Surgical site infection in general surgery. International Journal of Scientific Research in Knowledge, 3(8): 198-203.
13. **Sulaiman L, Le Y, Stephen S *et al*. (2022):** Incidence and risk factors of surgical site infections and related antibiotic resistance in Freetown, Sierra Leone: a prospective cohort study. Antimicrobial Resistance & Infection Control, 11: 39
14. **Serra-Aracil X, Garcia-Domingo M, Pares D *et al.* (2011):** Surgical site infection in elective operations for colorectal cancer after the application of preventive measures. Arch Surg., 146(5):606-12. doi: 10.1001/archsurg.2011.90.
15. **Keith S, Kristine S, Carl P *et al.* (2005):** The Effect of Increasing Age on the Risk of Surgical Site Infection. The Journal of Infectious Diseases, 191(7):1056-62.
16. **Hemant B, Basavaraj K, Kruthika R *et al*. (2016):** Abdominal surgical site infection occurrence and risk factors in Krishna Institute of Medical Science, Karad. International Journal of Scientific Study. DOI: 10.17354/ijss/2016/56
17. **Soad H, Tamer S, Elham H *et al.* (2012):** Incidence and modifiable risk factors of surveillance of surgical site infections in Egypt: A prospective study. American Journal of Infection Control, 40(5): 426-30.
18. **Patel S, Patel M, Patel S *et al.* (2012):** Surgical site infections: Incidence and risk factors in a tertiary care hospital, Western India. https://www.yeastgenome.org/reference/S000154411
19. **Zinn J, Vangela S (2014):** Quality-improvement initiative: Classifying and documenting surgical wounds. https://www.researchgate.net/profile/Jennifer-Fencl/publication.