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Surgical Site Infection at Suez Canal University Hospital: An Observational Cohort Study

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Abstract

Background: Surgical Site Infections (SSI) are one of the most common problems during abdominal surgery. SSI is related to extended length of stay in the hospital, an affected quality life, an increased death rate, and additional expenses. The definition of SSIs can vary from a simple wound discharge with no problems to serious conditions that are fatal. In this study, we sought to assess the prevalence, risk factors, and causative organisms of SSIs after abdominal operations at the Suez Health Insurance Hospital and Suez Canal University Hospitals.

Methods: This is an observational prospective cross-sectional study conducted with more than 200 patients with abdominal operations who were randomly selected from participating hospitals.

Results: SSIs occurred in 11% of the patients (11 out of 100) in the Suez Canal Hospitals group, and 89% of the patients in the Suez Canal Hospitals group were free of SSIs. In the Suez Insurance Hospital (SIH) group, 15% of the patients (15 out of 100) experienced SSIs, whereas 85% of the patients in the SIH group were free of SSI. There was virtually no statistically considerable distinction around the occurrence of SSIs among both groups, although severe inflammation was observed more often in the SIH group.

Conclusions: More and more, SSIs are thought to be a measure of the quality of proper patient care by surgeons, infection control providers, health care organizers, and the community. Although SSIs cannot be completely eliminated, a decrease in the contamination rate toward a minimal degree could have significant positive effects, such as reduction of postoperative morbidity and fatality, as well as a reduction in the waste of medical care sources. Pre-existing health problems that extend the operating period, wound type, and wound contaminants firmly predispose to wound infection.

Keywords: Abdominal surgeries; Cross sectional; Surgical site infections

Abbreviations

SCH: Suez Canal University Hospitals; SIH: Suez Insurance Hospital; SSI: Surgical Site Infections

Background

Surgical Site Infections (SSI) are one of the most common problems encountered during abdominal surgical procedures. SSIs are related to extended length of stay in the hospital, an affected quality of life, an increased death rate, and additional expenses [1]. Some SSIs are superficial and are limited to the skin and subcutaneous tissue; others are deep incisional SSIs affecting the fascia and muscle layers; and still others, organ or space SSIs are associated with the organs and body spaces. Many of these infections grow throughout the 1 month after surgery or, in the case of implants, 1 year after implant [2]. It has been observed that a patient's chance of infection after a surgical procedure largely depends on the hospital in which the operation was conducted. This may also be affected by operative management and other elements affecting the level of quality of medical care [3]. Signs and symptoms of SSIs are purulent discharge from the incision or around the placement place of a drain, or possibly distributing cellulites around the incision. Generally, elevated white blood cell count, increased pain or heat with tenderness, pyrexia, or dehiscence at the incision site indicate infection [4]. Other indicators of infection are culture positive drainage and a physician diagnosis of infection with prescription of antibiotics [5]. Additional medical consequences of SSIs comprise scarring, which is cosmetically undesirable; expression of hypertrophic or keloid chronic soreness and irritation; limitations in movement, especially around certain joints; and a considerable influence on psychological wellness. SSI may double the duration of a patient's stay at a medical center, thus also increasing the expenses related to medical care [6].

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Table 1: Surgical characteristics of enrolled patients.

		Diabetic		Non-diabetic			P value
		(n = 30)		(n = 70)			
		No. of patients	%	No. of patients	%	X^2	
Procedure or diagnosis	Laparoscopic cholecystectomy	6	20	3	4.3		
	Lipoma	1	3.3	5	7.14		
	Open cholecystectomy	6	20	2	2.9		
	Cancer colon	1	3.3	7	10		
	Appendectomy	2	6.7	14	20		
	Inguinal hernia	9	30	14	20	31.568	0.001*
	Hysterectomy	1	3.3	3	4.3		
	Umbilical Hernia	3	3.3	2	2.9		
	Splenectomy	1	3.3	3	4.3		
	Incisional hernia	0	0	2	2.9		
	Varicocele	0	0	9	12.9		
	Desmoid tumor	0	0	6	8.6		

Methods

This study was conducted as an observational cohort study. Patients enrolled in the study were recruited from Suez Health Insurance Hospital (SIH) and Suez Canal University Hospitals (SCH) from January 2018 to June 2019. The inclusion criteria were (1) age older than 18 years; (2) clean emergency abdominal operation (category 1 surgical wound); (3) clean contaminated emergency abdominal operation (category 2 surgical wound); (4) no evidence of infection such as fever or elevated total leucocytic count or any localization of infection based on history, examination, or investigations; and (5) elective abdominal surgery (reducible hernia, lipoma, cholecystectomy, etc. The exclusion criteria were: Traumatic contaminated emergency abdominal operation (category 3 and 4 surgical wounds), immunocompromised patients such as those on corticosteroids or other immunosuppressant, morbid obesity (body mass index, >40), malnutrition (body mass index, <18.5), and evidence of infection in the patient or major system affection such as liver cell failure or renal failure.

Study Procedures

After providing consent, all patients who met the inclusion criteria underwent the following during the month after surgery:

1. Full history before surgery, including personal history, complaints, history of presenting illness, past history, family history, and socio-economic history.

2. General and systematic examination, including general preoperative examination and a weekly postoperative examination, as well as early and late wound assessment.

3. Laboratory investigations were carried out quickly to take appropriate action regarding management. Patients in need of urgent abdominal operation who met the inclusion criteria were included in the study Investigations were repeated if signs of inflammation appeared. Necessary investigations included complete blood count, C-reactive protein before and after the operation, liver function tests (enzymes, bilirubin, albumin, international normalized ratio), and creatinine.

4. Swab from surgical site postoperatively when there were signs of infection (redness, heat, swelling, or discharge).

5. Information collection documents developed by the researcher, designed to cover all aspects to be studied.

6. Culture and sensitivity of the collected swabs.

7. All patients were observed closely daily until the 10th postoperative day. In cases in which any signs of symptoms of infection were observed, appropriate investigation was implemented to determine whether there was an infection and to evaluate the type and seriousness of the problem. In cases when any sort of collection of pus was recognized, it was initially drained and sampled for culture and sensitivity test.

Ethical Considerations

All participants received clarification regarding the research and about the investigative and surgical treatments, as well as disadvantages, predicted outcomes, and potential problems. Patients who provided consent were included in this research. The study did not entail any extra investigation or risk of substantial danger. There was no financial incentive for participation.

Data management and statistical analysis

Data entry, processing, and statistical analysis were conducted using MedCalc (version 18.2.1; MedCalc, Ostend, Belgium). Tests of significance (Kruskal–Wallis, Wilcoxon's, χ2, logistic regression analysis, and Spearman's correlation) were used.

Results

Different types of procedures were included in the study, including open and laparoscopic cholecystectomy. Inguinal hernia and appendectomy were the most common procedure in both groups. Incisional hernia, varicocele, desmoid tumor in the non-diabetic group was the only variable with a high statistically significant difference in procedure or diagnosis between the groups (Table 1). SSIs occurred in 20% (6 out of 30 patients) of the diabetic group, and in 7.1% (5 out of 70 patients) in the non-diabetic group. By comparison, 92.9% (65 of 70 patients) in the non-diabetic group experienced no SSIs. There was no statistically significant difference in the incidence of SSIs between the 2 groups, although severe inflammation was more

Table 2: Incidence of SSI.

		Diabetic (n=30)		Non -diabetic (n=70)		X^2	*P* value
		No. of patients	**%**	**No. of patients**	**%**		
Inflammation	**Mild**	3	10	3	4.3	3.836	**.280**
	Moderate	1	3.3	1	1.4		
	Severe (specific type, necrotizing fasciitis)	2	6.7	1	1.4		
	No	24	80	65	92.9		

Table 3: Comparison between the diabetic and SCH groups regarding age in SIH.

	SCH (n=100)	SIH (n=100)	*t* test	*P* value
Age, yr Mean ± SD	41.1 ± 12.01	41.4 ± 10.09	−0.160	**0.377**

		SCH (n=100)		SIH (n=100)			*P* value
		No. of patients	**%**	**No. of patients**	**%**	X^2	
Sex	**Female**	50	50	52	52	0.080	0.777
	Male	50	50	48	48		
Comorbidities	**Asthma**	20	20	25	25	0.731	0.991
	DVT	5	5	3	3		
	HTN-RHD	32	32	35	35		
	HCV	10	10	7	7		
	Free	33	33	30	30		

common in the diabetic group (Table 2). Regarding the causative organism, *Staphylococcus aureus*, *Escherichia coli*, and *Streptococci* were the micro-organisms most often isolated (3 out of 6; 50%). It was also noted that *S. aureus* was the most isolated micro-organism in the diabetic group, accounting for 3 out of 6 (50%) positive organisms in that group. However, in the non-diabetic group, *S. aureus* was the most isolated micro-organism, which constituted 4 out of 6 (66.7%) positive organisms. There was no statistically significant difference in the causative organisms and culture between the groups (Figure 1). The patients were classified into diabetic and non-diabetic groups according to presentation. Different types of procedures were included in the study, including laparoscopic cholecystectomy, inguinal hernia and appendectomy, and hysterectomy, which was the most common procedure in both groups. There were no statistically significant differences in procedure or diagnosis between the groups (Figure 2). Appearance of discharge from the wound was recorded in all patients with SSIs (6 of 6 cases) in the diabetic group and 5 patients in the non-diabetic group. It was found that purulent discharge is the most common to appear in both groups. There was no statistically significant difference in discharge type between the groups.

Regarding the causative organism, *S. aureus* and *Streptococci* were the most isolated micro-organisms, accounting for 3 out of 6 (50%) positive organisms. It was noted that *S. aureus* was the most isolated micro-organism, accounting for 5 out of 5 (100%) positive organisms in the diabetic group. However, in the non-diabetic group, *S. aureus* and *Streptococci* were the only isolated micro-organisms, accounting for all 5 (100%) positive organisms. There was no statistically significant difference in causative organism in culture between the 2 groups (Figure 3). The mean age of the patients from SCH was 41.1 ± 12.01 years, compared with 41.4 ± 10.09 years for the patients from SIH. There was no statistically significant difference in age between the 2 groups. There was also no statistically significant difference in sex or comorbidities between the groups (Table 3). SSIs occurred in 11% (11 out of 100) of patients in the SCH group, and 89% of patients

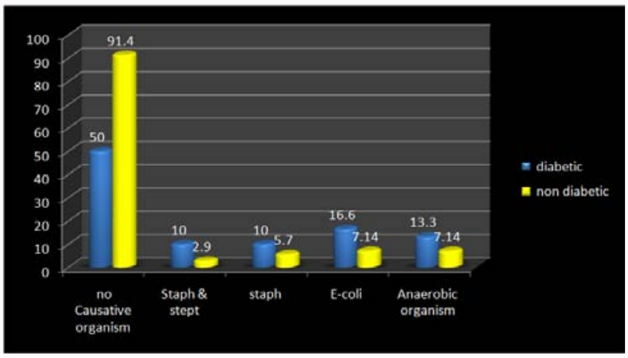

Figure 1: Causative organisms in culture.

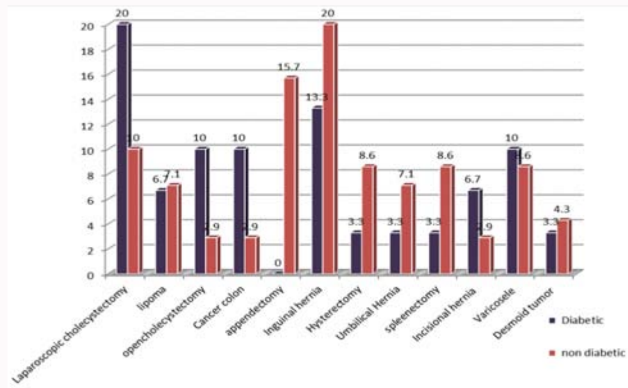

Figure 2: Surgical characteristics of the enrolled patients.

in the SCH group did not experience an SSI. In the SIH group, 15% (15 out of 100) patients had an SSI, and 85% did not. There was no statistically significant difference in the incidence of SSIs between the groups, but severe inflammation occurred more often in the SIH group. Regarding the causative organisms, *S. aureus* and *Streptococci*

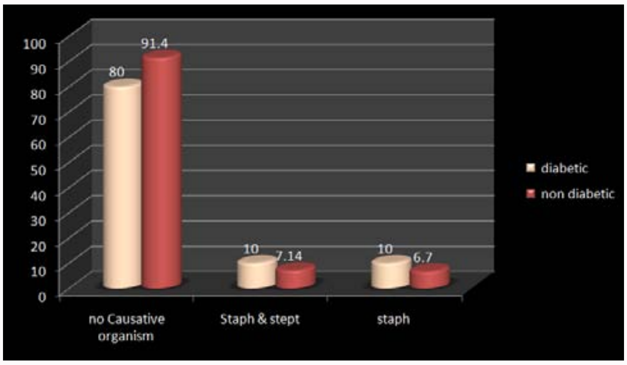

Figure 3: Causative organisms in culture in the Suez Health Insurance Hospital group.

Figure 4: Necrotizing fascitis on abdominal wall after hernia repair.

Figure 5: Wound infection after laparotomy for colon cancer.

were the most isolated micro-organisms, accounting for 6 out of 11 positive organisms (54.5%) in the SCH group. In the SIH group, *S. aureus* and *Streptococci* were also noted as the most isolated micro-organisms, accounting for 8 out of 11 (72.7%) positive organisms. There was no statistically significant difference in causative organism in culture between the 2 groups.

Discussion

SSIs are frequent hospital-acquired infections that are generally linked to significant rates of morbidity and fatality. It has been estimated that patients diagnosed with an SSI require a minimum extra 6 days in the hospital, thus increasing healthcare expenses. Abdominal operations in particular have been found to pose a high risk related to higher incidence rate of SSI [7]. Previous research has noted that diabetes mellitus is related to a 1.5 to 2.5 fold and possibly even a 4.9-fold, elevated risk for SSI [8]. Placement and lengthy use of an operative drain for 5 to 16 days and longer than 16 days was related to 1.84- and 2.14-fold higher risk, respectively [9]. A multivariate assessment revealed that age, incision contamination category, American Society of Anesthesiologists score, and operation period were risk factors for all selected procedures [10]. The categorization of operative wounds depending on the degree of microbial contamination shows that abdominal SSI rates range from 2% after "clean" surgical procedures to 4% to 10% after "clean-contaminated" surgical procedures. Rates for "contaminated" procedures can be higher than 10%, and may approach the "dirty" surgical class (>20%). Higher rates have been reported by prospective research in developing nations. A prolonged duration, even in a clean surgery, results in an elevated risk for contamination [11]. In a 6-month prospective surveillance study of SSIs in the period from January 2018 to June 2019, 200 patients who underwent urgent abdominal surgeries were randomly selected from the SIH and SCH. Patients with comorbidities or other risk factors that could hinder immunity or increase the risk of infection were excluded from the study. For this reason, patient selection was not easy. In terms of incidence of SSIs, the present study showed that SSIs occurred in 20% (6 out of 30 patients) in the diabetic group; 80% (24 out of 30) of patients in the diabetic group did not experience SSI. In the non-diabetic group, 7.1% (5 out of 70) of the patients had an SSI, whereas 92.9% (65 out of 70) did not. There was no statistically significant difference in incidence of SSIs between the groups, but severe inflammation was more common in the diabetic group. SSI occurred in 11% (11 out of 100 patients) in the SCH group; 89% of patients in the SCH group did not experience SSIs. In the SIH group, 15% (15 out of 100) patients) experienced SSIs and 85% did not. There was no statistically significant difference in incidence of SSIs between the groups, but severe inflammation was more common in the SIH group. This can be explained by the strict infection control measures at the university hospital. The mean age of patients in the SCH group was 41.1 ± 12.01 years compared with 41.4 ± 10.09 years in the SIH group. There was no statistically significant difference in age between the 2 groups. The mean age in the diabetic group was 45.7 ± 7.6 years compared with 39.5 ± 11.6 years in the non-diabetic group. There was a statistically significant difference in age between these 2 groups. This finding is similar to that from a study conducted at Duke University by Kaye et al. [13] stating that increasing age contributed to an elevated risk of SSI until the age of 65 years. Regarding sex distribution of the patients, men (30 patients) constituted 71.4% of the study participants, whereas females (12 patients) constituted 28.6% of the study participants. The SSI incidence by sex was 46.7% for men and 33.3% for women. This is much higher than the rates reported by a study in India, which showed that the male rate of SSI incidence was 18.2% and the female rate of SSI incidence was 5.9% [14]. Regarding procedure and incision, the present study included different types of procedures in the study, including laparoscopic cholecystectomy, and inguinal hernia and appendectomy. Hysterectomy was the most common procedure in both groups. There was no statistically significant difference in procedure or diagnosis between the groups. This finding is in agreement with a study conducted by Goyal [15], which also found the highest incidence of SSIs in laparotomies rather than other procedures (31.2%). Isgren et al. [16] however, reported that SSIs developed in 73 out of 287 patients (25.4%) during hospitalization. Regarding the causative organism, *S. aureus* and *Streptococci* were the most isolated micro-organism, constituting 3 out of 6 (50%) positive organisms. It was also noted that *S. aureus* was the most isolated micro-organism, constituting 3 out of 6 (50%) positive organisms in the diabetic group. In the non-diabetic group, *S. aureus* was the most isolated micro-organism, constituting 4 out of 6 (66.7%) positive organisms. There was no statistically significant difference in causative organism in culture between the groups. In addition, *S. aureus* and *Streptococci* were the most isolated micro-organism in the SCH group, constituting 6 out of 11 (54.5%) positive organisms. *S. aureus* and *Streptococci* were also the most isolated micro-organisms, constituting 8 out of 11 (72.7%) positive organisms in the SIH group. There was no statistically significant difference in causative organism in culture between these 2 groups. Isgren et al. [16] reported that frequent bacterial isolates were *E. coli* (59.5%), *Enterococcus* spp. (42.4%), and *S.* spp. (25.4%). Janugade [14] found that Pseudomonas infection was more prevalent, followed by Klebsiella, coagulase positive *staphylococci*, that *E. coli*, and diphtheroid infection. A study by Labib [17], found that the most frequent SSI isolates detected were *E. coli* (29.8%), followed by *S. aureus* (17.1%), *Acinetobacter* (12.8%), *Pseudomonas* (12.8%), *Klebsiella* (10.6%), *Enterobacter* (2%), *Citrobacter* (2%), and *Proteus* (2%). However, in another study of incidence and risk factors of SSIs in Egypt, *S. Aureus* was isolated most frequently, accounting for 42.6% of isolates. *K. pneumonia* accounted for 14.9%, CONS (10.6%), *Pseudomonas* (10.6%), *Enterococci* (6.4%), while *K. oxytoca* (4.3%), *E. coli* (4.3%), and *Candida albicans* (4.3%), and *Acinitobacter* (2%). We concluded that even though SSIs cannot be completely eliminated, a decrease in the infection rate would have great positive effects, by improving reduction of postoperative morbidity and fatality, along with reducing the waste of medical resources.

Conclusion

SSI is considered to be a measure of the quality of patient care by surgeons, infection control providers, health care organizers, and the community. Although SSIs cannot be eliminated entirely, a decrease in the infection rate towards would have considerable positive effects, by reducing postoperative morbidity and fatality, as well as reducing wastefulness of medical care resources. A pre-existing clinical condition, lengthy operative time, wound class, and wound contamination category firmly predispose to wound infection.

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