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One-Year Experience with Surgical Site Infection in Nassiryia Teaching Hospital: Pattern and Hospital Readmission Rate: A Prospective Study

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ABSTRACT

Background: Surgical site infection (SSI) remains one of the most common postoperative complications, contributing significantly to patient morbidity, prolonged hospital stay, and healthcare costs. Understanding local SSI patterns is essential for improving surgical outcomes. *Purpose:* to investigate SSI in Nassiryia teaching hospital in terms of pattern and hospital readmission rate.
Methods: This prospective study included 300 patients who underwent various surgical procedures. Data on demographic characteristics, comorbidities, surgical details, prophylactic antibiotic use, wound classification, and postoperative outcomes were collected. The association between patient/surgical factors and SSI was analyzed using appropriate statistical methods.
Results: Out of 300 patients, 47(15.67%) developed SSIs. Superficial infections accounted for 59.57%, while 40.43% were deep infections. The highest SSI rates were observed among patients aged 46–65 years and those with diabetes, hypertension, malignancy, or on regular medication (especially antidiabetics). Emergency procedures, contaminated/dirty wounds, and certain types of surgery were significantly associated with higher infection risk. The use of prophylactic antibiotics showed no significant impact on SSI reduction. The hospital readmission rate due to SSI was 1.67%, aligning with international benchmarks.
Conclusion: The study identified multiple modifiable and non-modifiable risk factors associated with SSIs. Targeted infection control strategies, improved antibiotic stewardship, and enhanced postoperative surveillance are essential to reduce the burden of SSIs and associated hospital readmissions.
Keywords: SSI, Readmission Rate, dirty wounds, contamination, antibiotics

INTRODUCTION

Healthcare-associated infections (HAI) represent one of the most significant threats to patient health and continue to constitute a substantial challenge for healthcare providers on a global scale (1). Primarily, these infections are attributed to microorganisms exhibiting antimicrobial resistance (2).

Among the various forms of HAI, SSI stands out as one of the most frequently documented types. SSIs may manifest within a timeframe of 30 to 90 days post-surgical intervention and are classified as infections involving incisions, organ

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spaces, and organs, characterized by exceptionally high rates of morbidity and mortality (3). SSIs rank as the second most prevalent category, following urinary tract infections, with an occurrence rate of 14% to 16% (4). Patients undergoing surgical procedures often present with intricate comorbidities, thereby complicating the management of SSIs and escalating healthcare costs, particularly with the emergence of antimicrobial-resistant pathogens (5,6).

The ramifications of SSIs extend broadly, impacting both patients and healthcare systems, as they are associated with pain, prolonged hospitalizations, and lost productivity. For instance, SSIs can extend the duration of hospital stays by an average of 10 days. Likewise, they contribute to a surge in therapeutic expenses and the overall cost of surgical procedures, increasing by 300% to 400% (7), while also elevating the likelihood of hospital readmissions and compromising health outcomes (8). Nevertheless, due to inadequate infection prevention measures, the incidence of SSI is significantly higher in low- and middle-income countries compared to their high-income counterparts (9).

The risk factors linked to the onset of an SSI are influenced by specific patient characteristics and clinical conditions, in addition to the nature of the surgical intervention performed (10). Despite the extensive body of clinical research highlighting these risk factors for SSIs following abdominal surgeries, it remains challenging to maintain meticulous detail and to adequately adjust for all variables when estimating specific risk factors (11). A thorough and nuanced evaluation of the multifactorial nature of these risk factors may facilitate enhancements in the quality of surgical care.

Factors that precipitate the occurrence of SSIs are determined by patient-dependent variables (such as age, body mass index, malnutrition, smoking, etc.), surgical parameters (including surgical site, technique, duration, and contamination level of the wound), and environmental influences (12).

The present study aimed to investigate SSI in Nassiryia teaching hospital in terms of pattern and hospital readmission rate.

METHOD

Study Population

This is a prospective study including a total of 300 patients undergoing different surgeries at surgical wards or emergency department at Nassiryia Teaching Hospital ulcer during the period 1st January 2024 to 31st December 2024. The study population for the current study was all adult patients (age ≥ 18 years) who underwent either elective or emergency surgical procedures at general surgery and gynecology/obstetric wards. Patients who had initial diagnosis of SSIs and underwent surgery involving permanent implants or those with psychiatric chief complaint were excluded from the study. The study was approved by Iraqi Council for Medical Specializations.

Data Collection

Collected information included: demographic data: age, sex, past medical history and drug history. Clinical data: prophylactic antibiotic, type of surgery, drain use, ward, class of wound and SSI. Incidence of SSI was based on culture positive results and/or physician diagnosis.

Follow up

All patients were evaluated and followed up for 30 days postoperatively starting from the date of operation to determine the incidence of SSI.

Statistical Analysis

All data were analyzed with statistical package for social sciences (SPSS) software (version 26). Descriptive statistics were used to present the data. Continuous variables are presented as mean± SD, and categorical variables were presented as frequencies and percentages. Categorical variables were expressed as number and percentage and analyzed with Chi-square test. A value of $P < 0.05$ was considered statistically significant.

RESULTS

Demographic Characteristics of the Patients

The demographic characteristics of the 300 patients who underwent various surgical procedures reveal a wide age distribution, with a mean age of 35.19±15.63 years, ranging from 5 to 80 years. Most patients (43.7%) were aged between 26 and 45 years. Females constituted the majority of the cohort, accounting for 68%, whereas males made up 32%. Regarding past medical history, 87.7% of the patients had no recorded comorbidities. In terms of drug history, 88.3% of patients reported no regular medication use. Among those on treatment, 6% were receiving antidiabetic drugs, 5.3% were on anti-hypertensive and 0.3% had a history of chemotherapy (*table 1*).

Table 1- Demographic characteristics of the patients (n=300)

Variables	Category	No. (%)
Age (years)	Mean±SD	35.19±15.63
	Range	5-80
	5.0-25	93(31)
	26-45	131(43.7)
	46-65	63(21)
	66-80	13(4.3)
Sex	Male	96(32)
	Female	204(68)
Past medical history	Negative	263(87.7)
	DM	16(5.3)
	HTN	17(5.7)
	Malignancy	4(1.3)
Drug history	None	265(88.3)
	Antidiabetic	18(6)
	Anti HTN	16(5.3)
	Chemotherapy	1(0.3)

Table 2 - Clinical characteristics of the patients (n=300)

Variables	Category	No. (%)
Prophylactic antibiotic	No	23(7.7)
	Yes	277(92.3)
Type of surgery	Laparoscopic cholecystectomy	64(21.3)
	Appendectomy	50(16.7)
	Hernia	47(15.7)
	Thyroidectomy	29(9.7)
	Breast mass	33(11)
	Stitch sinus	7(2.3)
	Hydrocele	7(2.3)
	Ovarian cyst	5(1.7)
	Hysterectomy	5(1.7)
	Others	53(17.7)
Drain	Yes	133(44.3)
	No	167(55.7)
Ward	Elective	255(85)
	Emergency	45(15)
Class of wound	Clean	144(48)
	Clean-contaminated	137(45.7)
	Contaminated	10(3.3)
	Dirty	9(3)
SSI	No	253(84.33)
	Yes	47(15.67)

Clinical Characteristics of the Patients

The vast majority (92.3%) received prophylactic antibiotics. Laparoscopic cholecystectomy was the most commonly performed surgery (21.3%). Surgical drains were used in 44.3% of cases. Elective surgeries made up the majority at 85%. Regarding wound classification, 48% of wounds were clean, 45.7% were clean-contaminated, and smaller proportions were contaminated (3.3%) or dirty (3%) as shown in *table 2*. There was no colorectal surgery reported in this study.

Incidence of SSI

Out of a total of 300 patients, SSI occurred in 47 patients, representing an incidence rate of 15.67%, whereas the remaining 253 patients (84.33%) did not develop SSI (*fig. 1*).

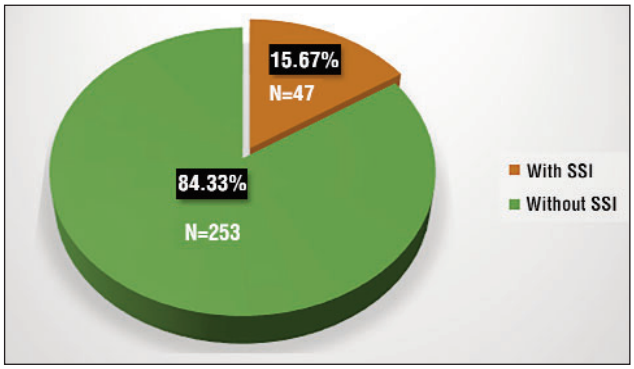

Figure 1 - Incidence of SSI among patients admitted to general surgery ward.

Association of Demographic Factors with SSI

Analysis of demographic characteristics showed a statistically significant association between age and the incidence of SSI (p=0.004). Past medical history showed a highly significant association with SSI development (p<0.001). Among those with SSI, 31.91% had DM, 8.51% had hypertension, and 4.26% had malignancy, compared to much lower rates among patients without SSI. Similarly, drug history was significantly associated with infection (p<0.001); 34.04% of patients with SSI were on antidiabetic medications and 8.51% on anti-hypertensive, while the majority of those without SSI (94.47%) had no history of drug use (*table 3*).

Association of Clinical Factors with SSI

Type of surgery showed a highly significant association (p<0.001), with appendectomy (27.66%) and procedures categorized as "others" (36.17%) contributing most frequently to SSIs. The urgency of surgery showed a significant correlation (p=0.002), with emergency procedures associated with a higher SSI rate (29.79%) compared to elective surgeries (12.25%). Wound classification was strongly associated with SSI development (p<0.001); clean wounds accounted for only 29.79% of SSIs, while contaminated and dirty wounds comprised a disproportionately higher percentage (14.89% each) as shown in *table 4*.

Table 3 - Association of demographic characteristics with SSI

Variables	Without SSI (n=253)	With SSI (n=47)	p-value
Age, years			0.004
5.0-25	64(25.3)	9(19.15)	
26-45	114(45.06)	17(36.17)	
46-65	44(17.39)	19(40.43)	
66-80	11(4.35)	2(4.26)	
Sex			0.989
Male	81(32.02)	15(31.91)	
Female	172(67.98)	32(68.09)	
Past medical history			<0.001
Negative	237(93.68)	26(55.32)	
DM	1(0.4)	15(31.91)	
HTN	13(5.14)	4(8.51)	
Malignancy	2(0.8)	2(4.26)	
Drug history			<0.001
None	239(94.47)	26(55.32)	
Antidiabetic	2(0.8)	16 (34.04)	
Anti HTN	12(4.74)	4 (8.51)	
Chemotherapy	0	1 (2.13)	

No.(%)

Table 4 - Association of clinical factors with SSI

Variables	Without SSI (n=253)	With SSI (n=47)	p-value
Prophylactic antibiotic			0.152
No	17(6.72)	6 (12.77)	
Yes	236(93.38)	41 (87.23)	
Type of surgery			<0.001
Lap cholecystectomy	61(24.11)	3(6.38)	
Appendectomy	37(14.62)	13(27.66)	
Hernia	44(17.39)	3(6.38)	
Thyroidectomy	25(9.88)	4(8.51)	
Breast mass	29(11.46)	4(8.51)	
Stitch sinus	4(1.58)	3(6.38)	
Hydrocele	7(2.77)	0	
Ovarian cyst	5(1.98)	0	
Hysterectomy	5(1.98)	0	
Others	36(14.23%)	17(36.17)	
Drain			0.958
Yes	112(44.27)	21 (44.68)	
No	141(55.73)	26 (55.32)	
Wards			0.002
Elective	222(87.75)	33 (70.21)	
Emergency	31(12.25)	14 (29.79)	
Class of wound			<0.001
Clean	130(51.38)	14 (29.79)	
Clean-contaminated	118(46.64)	19 (40.43)	
Contaminated	3(1.19)	7 (14.89)	
Dirty	2(0.8)	7 (14.89)	

No.(%)

Type of SSI

SSI 47 patients. Of those, 28 patients (59.57%) had superficial infections while 19 patients (40.34%) had deep infections (*fig. 2*).

Hospital readmission

Out of 300 included patients, only 5 patients (1.67%) required hospital readmission due to complications in surgical wounds (*fig. 3*). Those patients were treated with high doses of antibiotic and discharged well.

DISCUSSION

The present study aimed to investigate SSI in Nassiryia teaching hospital in terms of pattern and

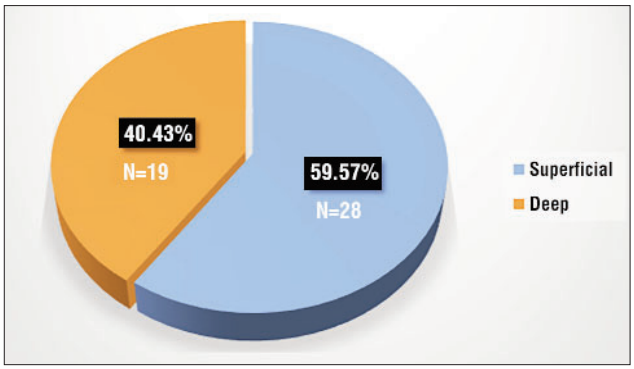

Figure 2 - Distribution of patients according to the type of SSI

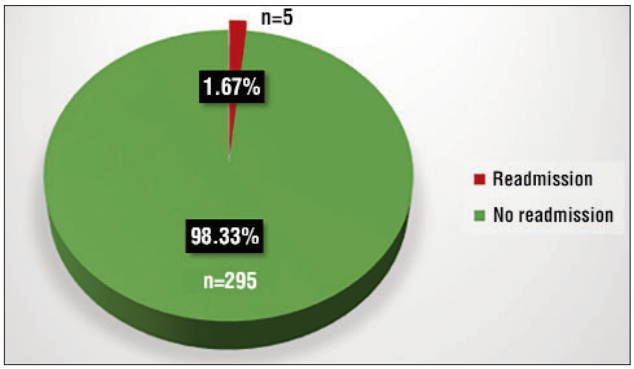

Figure 3 - Hospital readmission rate among patients admitted to general surgery ward at Nassiryia teaching hospital

hospital readmission rate. According to the result of the study, the incidence rate of SSI was 15.67%. This rate lies with the global incidence. Several studies worldwide indicated that SSI ranges from 11.76% to 35.5% (13-16). In a Turkish study including 422 consecutive patients who underwent emergency and elective surgeries, Duran et al. (17) reported an incidence rate of 15.16% of SSI. In Ethiopia, Misha et al. (14) included a total of 251 patients who were followed up for about two years. Over this follow up period about 53 patients were develop SSI.

This difference in the incidence could be ascribed to many factors before, during, and after surgery, like improper operation theater sterilization, surgical techniques, skin preparation, post-surgical follow up period, the method of wound closure, and antibiotic prophylaxis after certain types of surgery.

In the present study, age was statistically associated with incidence of SSI with the highest age at risk between 46 and 65-year, whereas no sex difference was demonstrated. Past medical history showed a highly significant association with SSI development particularly with DM and those on antidiabetic, antihypertensive and chemotherapy medications showed greater incidence of SSI.

Several publications have linked older age to SSI occurrence (18,19). and they explained that by factors indirectly related to age such as increased prevalence of comorbid conditions and a decreased host response to bacterial invasion in older patients. However, this result should be interpreted with caution as it is unlikely that older age has a direct and independent relationship due to the number of confounding factors associated with the ageing process that might lead to poorer wound healing. In a study including 144,485 surgical patients, Kaye et al. (20) found that increasing age independently predicted an increased SSI risk until the age of 65 years, but for ages above 65 years a further increase in age was associated with a decreased SSI risk. The authors speculated that this may be related to a surgical selection bias or a 'hardy survivor' effect. This effect describes the tendency that people who survive to an older age may have a genetic composition that enables them to better mitigate health threats compared with the general population (21).

In contrast to the present study, two studies identified male sex as an independent risk factor for development of SSI in the multivariate model (22-24). It was assumed that androgens have a proinflammatory effect on wounds, which impairs re-epithelialization process, whereas in women, estrogens have been shown to have an anti-inflammatory effect, which could account for the difference (25).

Most previous studies emphasized the role of DM in increasing the incidence of SSI (16,25). Hyperglycemia, a hallmark of diabetes, is linked with vascular stiffness, decelerated circulation, microvascular dysfunction, diminished tissue oxygenation, and reduced leukocyte migration to the wound site, thereby predisposing diabetic wounds to infections (26).

Furthermore, the role of inflammatory mediators in inducing insulin resistance and fostering hyperglycemia is noteworthy, as these mediators contribute to immune cell dysfunction through mitochondrial damage (27).

The association between chemotherapy and SSI remains controversial. It was reported that chemotherapy not only inhibits cell metabolism, rapid cell division, and angiogenesis but also delays wound healing and compromises the patient's immune function (28). In contrast, some authors have shown no significant association between chemotherapy and an increased risk of SSI (29).

This discrepancy between different studies could be attributed to several factors the most important of which are variation in underlying cancer, duration and type of chemotherapy and demographic characteristics of the patients (30).

In the present study, prophylactic antibiotic use was not significantly associated with a reduction in SSIs. This finding is consistent with the results of several meta-analyses and systematic reviews, which have reported no significant benefit of antibiotic prophylaxis in preventing SSIs across various surgical settings (31,32).

However, contrasting evidence exists in the literature. Some systematic reviews and meta-analyses have demonstrated a beneficial effect of prophylactic antibiotics compared to placebo, particularly in the context of elective clean and clean/contaminated plastic surgeries (21,33). These discrepancies may reflect differences in surgical types, patient populations, timing and choice of antibiotics, and institutional infection control practices.

The findings of the present study thus contribute to the ongoing debate regarding the efficacy of antibiotic prophylaxis and underscore the need for procedure-specific guidelines that consider both the benefits and potential drawbacks of routine antibiotic use.

Regarding type of operation, the present study showed that patients underwent appendectomy was more prone to SSI compared to other types of surgical procedures and those with emergency procedures have higher SSI rate compared to elective surgeries. Literatures stated that the rates of SSI are much higher with abdominal surgery than with other types of surgery (34). In addition, appendectomy is regarded as an emergency procedure and such operations often can introduce bacteria into the surgical site or create a more contaminated environment. Furthermore, emergency cases may experience delays in administering prophylactic antibiotics, increasing the risk of infection,. Additionally, emergency surgeries may involve longer operative times, potentially increasing the duration of exposure to bacteria and the risk of SSI (35).

In contrast, elective surgeries allow for careful planning and preparation, including proper sterilization, antibiotic prophylaxis, and wound classification, elective surgeries are typically performed in a controlled environment with minimal risk of contamination, wounds in elective surgeries are more likely to be classified as clean or clean-contaminated, reducing the risk of SSI, and finally elective surgeries often involve prophylactic antibiotic administration, minimizing the risk of infection (36).

In the present study, the association between the type of surgical wound and the incidence of SSIs was direct: the more contaminated the wound class, the elevated the risk of infection. Numerous studies have shown that the "dirty" or "infected" wound class is a major risk factor for SSIs when compared to other wound classes. This is to be expected, as a higher bacterial load increases the likelihood of developing an SSI (37).

In the present study, superficial SSIs accounted for 59.57%, while deep SSIs comprised 40.34% of the total cases. These results are consistent with a study conducted in Ethiopia involving 357 surgical procedures, where superficial SSIs constituted 58% and deep SSIs 42% of cases (38). This similarity may reflect comparable surgical practices, infection control measures, or patient risk profiles in similar resource-limited settings.

However, the current findings contradict those of an Italian study, which reported a lower proportion of superficial SSIs (26.8%) and a higher proportion of deep SSIs (48.8%) (39). The discrepancy could be attributed to differences in healthcare infrastructure, diagnostic criteria, types of surgeries performed, or postoperative surveillance systems. In high-income settings like Italy, more rigorous diagnostic protocols may lead to a higher detection rate of deep infections, or the surgical case mix may involve more procedures with higher inherent risks for deep infections.

In the present study, the hospital readmission rate due SSI was 1.67%, which falls within the range of rates reported globally. For instance, a large-scale study from the United States involving 59,088 patients across 525 hospitals reported readmission rates for SSIs ranging from 1.45% to 6.34% (40). This suggests that the readmission rate observed in the current study aligns with international standards, particularly at the lower end of the spectrum.

Furthermore, an Italian study documented a readmission rate of 3.8% among their patients with SSIs, which is notably higher than the rate found in the current study. This variation may be influenced by differences in healthcare systems, patient follow-up protocols, infection surveillance practices, and the complexity of surgical procedures undertaken in different settings (39).

CONCLUSION

SSIs occurred in 15.67% of patients undergoing surgery, with a superficial infection being the most common type. The readmission rate due to SSI-related complications is relatively low, aligning with interna-

tional reports. Middle aged patients with comorbid conditions, and individuals on antidiabetic or antihypertensive medications are more likely to develop SSIs. Type of surgery, wound class, and urgency of the procedure are significantly linked to infection risk.

Limitations

This study may be limited by its observational nature. Data on SSI may have been underreported, particularly in cases of delayed presentation or treatment at outside facilities. The reliance on medical records and documentation for comorbidities and medication use may introduce reporting or classification bias. Additionally, potential confounders such as perioperative antibiotic use, surgical technique, and intraoperative contamination were not fully controlled. Variability in postoperative follow-up duration could also influence the detection rate of SSIs.

Conflicts of Interest

The authors declare no conflict of interest regarding this article.

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