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ANALYZING THE RISK FACTORS AND PREVENTION STRATEGIES FOR SURGICAL SITE INFECTIONS

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Abstract: Background: Surgical site infection is prevalent in Iraq and among the most common healthcare-associated illnesses. Although surgical techniques have advanced and the implementation of optimal infection control measures has improved, surgical site infections continue to be the most common cause of infections acquired in hospitals. Objective: This study aimed to Analyse the risk factors and the role of prevention in the treatment of surgical site infections. Patients and methods: We conducted a cross-sectional study on surgical patients who developed postoperative surgical site infections. The study included 85 patients ages 30 to 60 years, from April 8, 2022, to September 25, 2023. The patients were divided into two groups: hemorrhoid surgery (23 cases), cholecystectomy surgery (40 cases), and appendicitis surgery (22 cases). One group consisted of scheduled surgeries, while the other group consisted of emergency surgeries. This study documented the clinical results of patients before, during, and after surgery. The recorded data consisted of the duration of the surgery, the nature of the wound, the site of the surgical procedure, the need for blood transfusion, and the administration of antibiotics, specifically ampicillin, ceftriaxone, and metronidazole.

Additionally, the study examined the postoperative use of antibiotics. This study used a Cox regression analysis to assess the risk variables impacting patients and their association for surgical site infection. Results: Our clinical findings indicate that 60 patients had surgery lasting less than 1 hour, whereas 25 patients had surgery lasting more than 1 hour. The wound types consisted of clean wounds in 71 patients as well as contaminated wounds in 14 patients. The surgery site was categorised as abdominal with 85 cases. The proportion of patients who received antibiotics consisted of 40 patients treated with ampicillin and 45 patients treated with ceftriaxone & metrindazole. The ratio of patients who used antibiotics following surgery was 27.06%. The number of cases admitted in the intensive care unit amounted to 20 patients, while the mortality rate at 2.35%. Conclusion: The results of our study have clearly shown the effectiveness of antibiotic

prophylaxis for preventing surgical site infections. This strategy effectively decreases the occurrence of infections in the site of surgery and lessens the related risk.

Key words: Surgical site infection; Hemorrhoid surgery; Cholecystectomy surgery; Appendicitis surgery; and Risk factors outcomes.

Introduction

Surgical site infection is prevalent in Iraq and among the most common healthcare-associated illnesses [1]. It is a possible complication that might occur with any surgical operation. Epidemiological data indicates that about 2-5% of surgical patients globally have had surgical site infections [2,3]. Nevertheless, there is a disparity in the occurrence rates between developed and developing nations, with a higher number of afflicted people in developing countries compared to developed ones. [4,5]

The prevalence of surgical site infections (SSI) was 2.6% in the United States (USA), 1.6% among Germany, while 2.9% in various settings throughout European nations [6]. However, in a developing nation, it is twice as high as in a developed one [7]. The mean prevalence of surgical site infections (SSI) in China remained at 4.5% among patients who had abdominal surgery [8]. Studies conducted in Sub-Saharan Africa have shown that the prevalence of SSI (Surgical Site Infections) ranges from 11 to 18% [9]. The prevalence of surgical site infections was ranged between 12.3% and 25.22% in Ethiopia, where the incidence of surgical site infections different can depend on the kind of operation with orthopaedic surgery that had the greatest risk that follow cardiac and intra-abdominal surgery. [10,11]

Presently, the existing evidence indicates that Surgical Site Infections (SSIs) have a direct impact on prolonging the duration of hospitalisation, increasing the incidence of readmission, causing illness and death, and imposing significant financial burdens on both people and communities [12]. Patients diagnosed with a surgical site infection (SSI) have an average of 7-11 extra days in the hospital after their operation and face a risk of mortality that is 2-11 times greater compared to those without an SSI [13]. Patients who have surgical site infections (SSIs) have a significantly increased likelihood of spending time in an intensive care unit, with up to a 60% higher probability [14]. Additionally, they are five times more probable to be readmitted and twice as likely to die. [15]

In the United States, it represents 33.7% of the total yearly expenses associated to hospitals and results in an extra 11 days in hospital stay per patient [16]. Confirmed risk factors for surgical site infections (SSIs) encompass various factors such as age, gender, immune status, perioperative hyperglycemia, pre-existing diabetes, obesity, malnutrition, recent smoking, pre-existing infection in a different part of the body, colonisation with microorganisms, perioperative hypothermia, improper antibiotic usage, inappropriate pre- and intra-operative techniques, wound type, emergency surgery, and extended surgical duration [17]. The aetiology of SSIs may be attributed to microorganisms originating from the patient's endogenous skin flora as well as the external environment [18]. In both scenarios, there is a potential for bacteria to attach to surgical tools and subsequently contaminate the incision site, especially during surgical operations that involve contamination [19]. Most of these illnesses are caused by bacteria that are resistant to many drugs. [20]

Patients and methods

We conducted a cross-sectional study of patients who underwent surgical operations in both hemorrhoid surgery, cholecystectomy surgery, and appendicitis surgery and were exposed to postoperative surgical site infection, which included 85 patients whose ages ranged between 30 and 60 years in the period from 8 April 2022 to 25 September 2023. Clinical and demographic data of the patients were collected in terms of age, sex, ASA score, smoking status, marital status, education level, employment status, comorbidities, use of preoperative antimicrobial prophylaxis, duration of antimicrobial prophylaxis, and income status.

These results determined the surgical procedures that all patients underwent, which included hemorrhoid surgery (23 cases), cholecystectomy surgery (40 cases), and appendicitis surgery (22 cases), where one group was scheduled, and the other group was emergency.

Moreover, this study recorded the clinical outcomes of patients during and after the operation for all patients undergoing surgery, which included the duration of surgery, type of wound, location of the surgical site, blood transfusion, and types of antibiotics, which included both ampicillin and ceftriaxone. Metrendazole, postoperative antibiotic use, length of hospital stays due to surgical site infections [days], admission to the intensive care unit, and mortality rate. Also, our study performed a Kaplan-Meier survival curve analysis of the cumulative survival of surgical patients with surgical site infections within 30 days.

In addition, this study was conducted by performing Cox regression analysis, which evaluated the risk factors affecting patients and associated with surgical site infection. This study also determined the relationship between positive results and surgical site infections. Our study excluded data related to patients who had undergone previous surgeries, patients younger than 30 years or older than 60 years, patients with terminal diseases, and patients with a body mass index of more than 35 kg/m2. Patient data were analyzed and designed using the SPSS program, version 22.0.

Results

Table 1: Pre-operative and demographic characteristics observed in this study.

Characteristics	Number of patients [85]	Percentage [%]
Age, years		
30 – 39	23	27.06%
40 – 49	17	20.0%
50 - 60	45	52.94%
Sex		
Males	29	34.12
Females	56	65.88
BMI [Kg/m2]		
28 – 31	23	27.06%
32 - 35	62	72.94%

ASA score		
< 3	80	94.12%
≥ 3	5	5.88%
Smoking status		
Yes	3	3.53%
No	82	96.47%
Marital status		
Single	8	9.41%
Married	73	85.88%
Divorced	4	4.71%
Education status		
Primary	9	10.59%
Secondary	4	4.71%
College/university	72	84.71%
Employment status		
Employer	65	76.47%
Un-employer	20	23.53%
Comorbidities		
Hypertension	43	50.59%
Diabetes Mellitus	38	44.71%
Cardiac disease	34	40.00%
HIV	5	5.88%
Sepsis	51	60.00%
Pneumonia	11	12.94%
Preoperative antimicrobial prophylaxis use		
Yes	54	63.53%
No	31	36.47%
Duration of antimicrobial prophylaxis		
within less than 24 hours	4	4.71%
within more than 24 hours	81	95.29%
Income status, $		
< 600	34	40.00%
601 – 800	20	23.53%
> 800	31	36.47%

Table 2: Determine the surgeries undergone by all patients in this study.

Surgeries	Number of patients [85]	Percentage [%]
Hemorrhoid surgery	23	27.06%
Scheduled	19	82.61%
Emergent	4	17.39%
Cholecystectomy surgery	40	47.06%
Scheduled	29	72.50%
Emergent	11	27.50%
Appendicitis surgery	22	25.88%
Scheduled	3	13.64%
Emergent	19	86.36%

Table 3: Intraoperative and postoperative clinical outcomes.

Variables	Number of patients [85]	Percentage [%]
Duration of surgery (hours)		
<1 h	60	70.59%
≥1 h	25	29.41%
Type of wound		
Clean	71	83.53%
Contaminated	14	16.47%
Location of surgical site		
Abdominal	85	100%
Blood transfusion		
Yes	17	20.00%
No	68	80.00%
Types of Antibiotics		
Ampicillin	80	94.12%

Ceftriaxone & Metrindazole	5	5.88%
Antibiotic use post-surgery		
Yes	23	27.06%
No	62	72.94%
Hospital stays due to surgical site infections [days]		
< 9	20	23.53%
10 – 20	56	65.88%
> 20	9	10.59%
ICU admission		
Yes	20	23.53%
No	65	76.47%
Mortality rate		
Yes	2	2.35%
No	83	97.65%

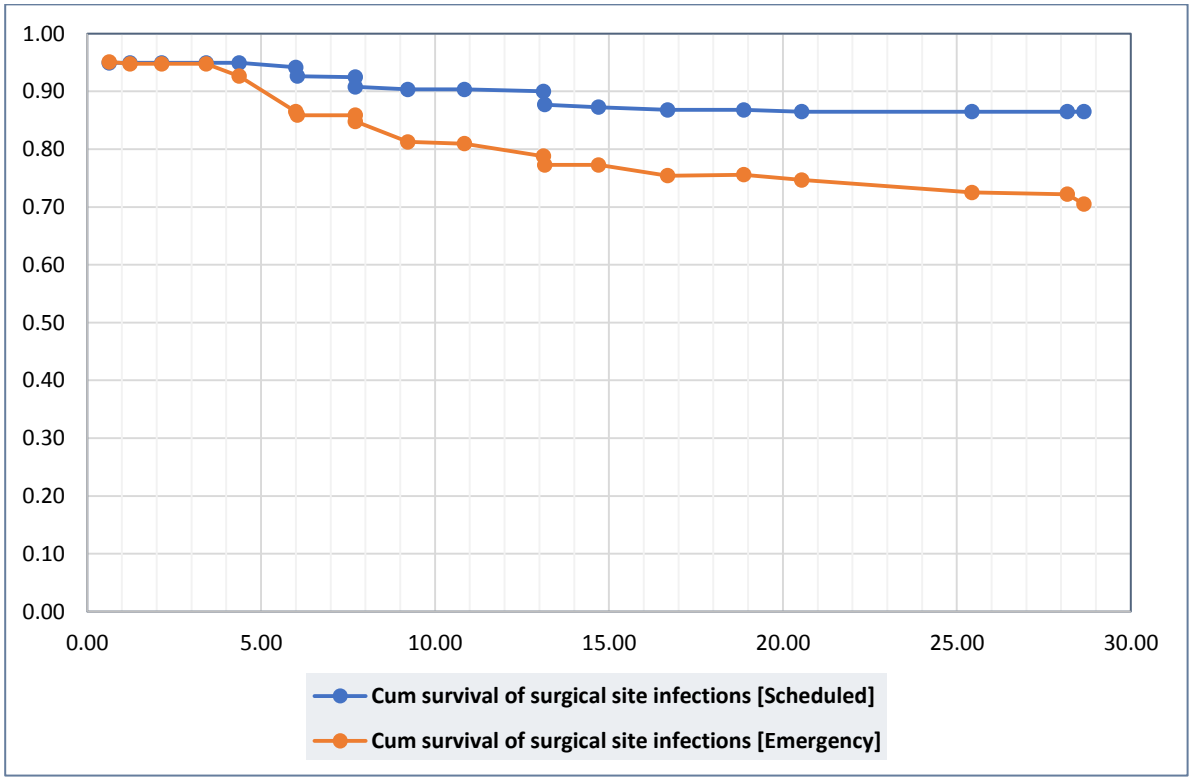


Figure 1: Kaplan - Meier survival curve of cum survival of surgeries with surgical site infections within 30 days.

Table 4: Cox regression analysis associated with risk factors of surgical site infection.

Variables	CHR [95% CI]	P-value
Age [50 – 60 years]	1.4 [0.5 – 2.7]	0.026
Females	1.75 [0.82 – 3.51]	0.127
Location of surgical site		
Abdominal	2.75 [1.45 – 7.82]	0.0275
Operative time [hours]	1.17 [0.60 – 4.82]	0.0281
Duration of antimicrobial prophylaxis		
within more than 24 hours	6.8 [0.92 – 49.54]	0.264
Hypertension	1.02 [0.36 – 3.62]	0.151
Sepsis	2.31 [0.27 – 4.81]	0.145
Smoking	2.4 [1.06 – 5.89]	0.261
Type of wound		
Clean	2.68 [0.51 – 2.94]	0.144
Contaminated	3.6 [2.01 – 8.76]	0.138
Antimicrobial prophylaxis use	4.6 [0.56 – 5.81]	0.260
Hospital stays due to surgical site infections [days]	0.86 [1.52 – 2.75]	0.468
BMI [32 – 35], [Kg/m2]	1.7 [0.46 – 3.68]	0.045

Table 5: Determine the correlation between positive outcomes and surgical site infections.

Variables	**Positive outcomes**	+	-
R	1	+ 0.92	- 0.153
Sig		0.001	0.23
N	85 [100%]		

Discussion

The clinical results were recorded that patients in the age group between 50 - 60 years were the highest who underwent surgery at a rate of 52.94% and that the number of female cases was 56 while males were 29 cases, and the body mass index between 32 - 35 was 62 patients, and smokers were 96.47% of non-smokers were 3.53%, and the percentage of patients who used herbal medicines was 2.35%, and the most frequent comorbidities were hypertension with 43 patients, diabetes in 38 patients, and sepsis in 51 patients. The rate of patients using antimicrobial prophylaxis before surgery was 63.53%; the percentage of patients who took antimicrobial prophylaxis for less than 24 hours was 4.71%, while the percentage of patients who took antimicrobial prophylaxis for more than 24 hours was 95.29%.

Our results determined the surgeries that patients underwent, as the percentage of patients who underwent surgery in hemorrhoid surgery included 23, where 19 cases were scheduled, and 4 cases were emergent, while the rate of patients who underwent surgery in the cholecystectomy surgery include 40 cases, where 29 cases were scheduled, and 11 cases were emergent, rate of patients who undergone appendicitis surgery included 22 cases where scheduled included 3 cases and emergent included 19 cases.

Regarding the results during surgery, these results recorded the clinical data of the patients during surgery, where the duration of surgery within less than 1 hour was 60 patients, the duration of surgery within more than 1 hour was 25 patients, type of wound included Clean with 71 patients and contaminated with 14 patients, location of the surgical site was identified as Extremity with 34 patients and Abdominal with 51 patients.

In addition, the percentage of patients who received a blood transfusion was 17 patients, the percentage of patients who took antibiotics was Ampicillin with 80 patients and Ceftriaxone & Metrindazole with 5, and the percentage of patients who used antibiotics after surgery was 27.06%, and the hospital stay due to surgical site infections was < 9 days with 20 patients, (10 - 20) days with 56 patients, and > 20 days was nine days, and the number of cases admitted to the intensive care unit was 20 patients, and the mortality rate was 10.59%. This study recorded risk factors: age, diabetes, blood pressure, smoking, surgical site, duration of operation, type of wound, and duration of antibiotic use.

Prior studies have reached a consensus indicating surgical site infection has a substantial impact on patients' recuperation and results after surgery. It has the potential to impede the healing process of wounds, heighten the likelihood of wound infection, extend the duration of hospital stays, and result in elevated healthcare expenses. Furthermore, patients may encounter pain, unease, and restricted movement, impacting their overall quality of life. [21]

Surgical interventions expose the body to possible germs, hence increasing the risk of surgical site infections (SSI) [22]. Antimicrobial prophylaxis functions can be specified, targeting bacteria that correlate to surgical infections, therefore diminishing the amount present at the surgical site. [23]

Furthermore, some studies have noticed the need to choose antibiotics for the most probable diseases while considering local antibiotic recommendations that reduce the occurrence of antibiotic resistance. [24]

Other studies recommended the administration of an antibacterial narrow-spectrum antibiotic that had excellent tissue penetration and had negative outcomes [25]. A French study found out that it is advisable to provide additional doses of antibiotics during lengthy surgical operations, including substantial blood loss, in order to ensure that therapeutic levels are maintained throughout the surgery. [26]

Conclusion

Surgical site infection has a substantial impact on patients' postoperative recovery and results. It may impede the healing process of wounds, elevate the likelihood of wound infection, extend the duration of hospitalisation, and result in escalated healthcare expenses. Furthermore, patients may encounter pain, discomfort, and restricted movement, which may have a negative impact on their overall quality of life. The findings of our study highlighted the influence of many risk factors on the occurrence of surgical site infection, including variables such as older age, obesity, smoking, diabetes, prolonged surgical duration, and contamination of the surgical site. The clinical outcomes of our study have unequivocally shown the efficacy of antibiotic prophylaxis in the prevention of surgical site infections. This intervention significantly reduces the incidence of infections at the surgical site and mitigates the associated risk.

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