

Incidence of Surgical Site Infection and Associated Risk Factors among Patients Admitted at Felege Hiwot Comprehensive Specialized Hospital, Bahir Dar, Northwest Ethiopia

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Abstract

Introduction: Surgical site infection (SSI) is an infection which occurs after invasive surgical procedure. According to the US center for disease control definition, only infections occurring within 30 days of surgery (or within a year in the case of implants) are classified as SSIs. SSI is a common public health problem in both developing and developed countries. **Purpose:** The objective of this study was to assess the incidence and associated risk factors of SSI in Felege Hiwot Comprehensive Specialized Hospital. **Method:** An institution-based prospective cohort study design was conducted from October 2019 to December 2019. All patients with major operations (elective and emergency) during the study period were included in the study. **Result:** The overall incidence rate of surgical site infection was 14.4%. Based on the ASA scoring 228 (53.8%) of the wounds was class I. The majority 72.2 % (306) of wounds were clean followed by 22.6% (96) clean contaminated. Alcohol consumption, class of wound and BMI were found to be statistically significant risk factors associated with the development of surgical site infection. **Conclusion :** Even though there are different preventive measures are being implemented in the hospital, the incidence of surgical site infection is found to be higher in our hospital.

Keywords: surgical site infection, Bahir Dar, Ethiopia.

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Introduction

Surgical site infections (SSIs) are a type of health care associated infections, which is caused by bacteria that occurs at or near surgical incision within 30 days of operation or after 1 year if implant is placed[1]. SSIs have a significant effect on quality of life for the patient. They are associated with considerable morbidity and extended hospital stay resulting in a significant financial burden to health care seekers and the country in general. It is increasingly recognized as a measure of the quality of patient care by both healthcare providers and the public [2, 3].

WHO review showed that in developing countries, 11% of patients infected in the surgical process. In Africa, up to 20% of women who have a caesarean section develop a wound infection. But surgical site infections are not just a problem for poor countries. In the United States, patients cost an additional US\$ 10 billion per year for their extra days in hospital because of SSI [1,4]. A systematic review on the incidence and economic burden of SSIs in India has also showed a prevalence of 9 - 23% and GI surgery had high incidence of SSIs, the additional cost for extra days in hospital because of SSIs was high[5].

SSIs are the single most common class of complications that can reach excessive level, attracting very little attention. A systematic review article on Health-care-associated infection in Africa demonstrated a prevalence of nosocomial infections varying from 3 -21% with SSIs occurring for 5 -34% [6]. Studies in different African countries also showed the prevalence of SSIs seems high. The prevalence of SSI in Cameroon 9.16% [7] ,in Sudan 9% [8]. Dares Salaam, Tanzania was 35.6% [9].

However, little is known about determinants of SSIs because of the paucity of studies and the diversity of methods used. A study done in Cameroon point out that environmental factors such as the hospital, the type of surgical ward and surgical factors, the wound class contamination, the status of surgery and the type of surgery were significantly associated to SSI occurrence [7]. While study in Sudan showed, the patient's body mass index, co morbidity, presence of diabetes and laparoscopic surgical technique were significantly associated with SSI [8]. On the other hand study done in Dares Salaam, Tanzania revealed that wound class, abdominal surgeries, emergency procedures and HIV infection increased the risk of SSI [9].

In Ethiopia, incidence rate of SSIs ranges from 10.9 to 75% [10, 11, 12, 13 14]. Advanced age, underlying

disease, extended preoperative and postoperative hospital stay, longer duration of surgery and administering antimicrobial prophylaxis were the most likely risk factors for SSIs [11, 12].

SSI is increasingly recognized as a measure of the quality of patient care by both healthcare providers and the public. Periodic studies to determine the risk of SSIs and identification of risk factors for SSIs should be encountered the development of national recommendations for the prevention and control of SSIs [2].

Though, most of the studies have been done on Health care associated infections (HAIs) generally, with few studies actually focusing on SSI in Africa. This study is therefore carried out to determine the incidence and associated risk factors of surgical site infection among patients in a tertiary care center in North West Ethiopia.

Materials and Methods

Study area and design

A hospital based prospective cohort study was conducted from October 2019 to December 2019 at Felege Hiwot Comprehensive Specialized Hospital (FHCSH) in Bahirdar, North West Ethiopia. The hospital has 18 departments, with a total of 465 beds. It provides different specialized services in different departments for more than 1500 clients per a day. The hospital accepts referred patients from different parts of the country and serves as a main referral center for patients living in the North Western part of Ethiopia.

All patients who under gone elective or emergency clean and clean-contaminated surgery and admitted in surgical, gynecology and obstetrics wards for more than 48 hour in the hospital during the study period were included in the study.

Patients not willing to participate on the study, those undergone re-operation and who have contaminated and dirty operations, neonates and enrolled patients who showed signs and symptoms of infection within the first 48 hours of admission and patients admitted for less than 48 h were excluded from the study.

Sample size and sampling procedure

The minimum sample size was determined using a single population proportion formula $[n = \frac{(Z\alpha/2)^2 * P(1-P)}{d^2}]$ by assuming a 95% confidence level of $Z_{\alpha/2} = 1.96$, marginal of error 5%, and proportion of surgical site infection of 50%. And by considering a 10% non-response rate and incorporating minor adjustment for maintaining uniformity in field operation, a total of 424 individuals who full fill the inclusion criteria were participate during the study period.

Data collection instruments and procedure

A pre-tested and structured checklist was developed and used for the collection of data on socio-demographic characteristics, clinical profiles and surgical procedure relating characteristics and other variables of interest on the incidence and associated risk factors through face to face interview and patient card review.

The list of all patients along with their valuable information's was obtained from each ward. All individuals who are included in the study were followed for the development of SSI and surgical sites was evaluated on the third day of admission, third and fifth post postoperative day and on the day of discharge. During discharge the patient get an appointment. All suspected surgical sites was evaluated irrespective of the day of operation, until it healed or progressed to infection. Patients who developed infection after discharge until 30 days after surgery was identified in outpatient and follow up clinics of each department. Regular checkup was done on the patients whether they present or absent on the appointment day to reduce the loss to follow up.

Variables

Surgical site infection following surgical procedures was the outcome variable and Socio-demographic variables (age, sex, residence, and average monthly income), body mass index, life style, clinical characteristics (wound type, place of ward, comorbidities, operation type), procedure done by, length of hospital stay and duration of operation were independent variables.

Data processing and analysis

The collected data were edited, coded and entered into Epi-info version 7 and export to SPSS version 20 software for further data management and analysis. Descriptive statistics were computed to determine frequencies and summary statistics (mean, standard deviation, and percentage). Bivariate logistic regression analysis was done after dichotomizing the dependent variables. Crude and adjusted odds ratios (OR) with a 95% CI were computed to assess the strength of association between the independent and outcome variable. Variables with a p-value of less than 0.05 were considered as statistically significant determinant for surgical site infections.

Operational definition

For the purpose of this study the following operational definitions and terms was used.

Surgical site infection is defined as a wound infection with redness, swelling, pain, temperature above 38°C,

during the 30 days after operation. Only infections occurring within 30 days of surgery and after 48 hours of admission were classified as SSIs [15].

American Society of Anesthesiologist (ASA) score-I: Normal healthy patient.

ASA score-II: Patient with mild systemic disease that is not incapacitating.

ASA score-III: Patient with severe systemic disease that limits activity but is not incapacitating.

Clean Operations: in which no inflammation is encountered and the respiratory, alimentary or genitourinary tracts are not entered. There is no break in aseptic operating procedure

Clean-contaminated operations: in which the respiratory, alimentary or genitourinary tracts are entered but without significant spillage (without visible contamination).

Contaminated operations: where acute inflammation (without pus) is encountered, or where there is visible contamination of the wound. Examples include gross spillage from a hollow viscous during the operation or compound/open injuries operated within four hrs.

Dirty Operations: in the presence of pus, where there is a previously perforated hollow viscous, or compound/open injuries more than four hours old [16].

Operative wounds are classified based on the degree of microbial contamination which was developed by the US National Research Council group in 1964 [17]. This system of classification is widely used to predict the rate of surgical site infection. (Table -1)

Classification	Criteria
Clean	Elective, not emergency, non-traumatic, primarily closed; no acute inflammation; no break in technique; respiratory, gastrointestinal, biliary and genitourinary tracts not entered.
Clean-contaminated	Urgent or emergency case that is otherwise clean; elective opening of respiratory, gastrointestinal, biliary or genitourinary tract with minimal spillage (e.g. appendectomy) not encountering infected urine or bile; minor technique break.
Contaminated	Non-purulent inflammation; gross spillage from gastrointestinal tract; entry into biliary or genitourinary tract in the presence of infected bile or urine; major break in technique; penetrating trauma <4 hours old; chronic open wounds to be grafted or covered.
Dirty	Purulent inflammation (e.g. abscess); preoperative perforation of respiratory, gastrointestinal, biliary or genitourinary tract; penetrating trauma >4 hours old.

[Adapted from Berard F, Gandon J, Ann Surg 1964] [17]

Result

Socio-demographic characteristics

A total of 424 patients were undergone major operations and admitted in Surgical 65.6% (n=278) and Gynecology and obstetrics 34.4% (n=146) wards. The mean age of patients was 33.8 (SD = 16.8) years. The average monthly income was 2576 (SD = 1343) birr. The majority (58 %) of the patients BMI was under the category of normal with a mean of the 19.81± 2.86 kg/m². (Table -2)

Table 2 Socio-demographic characteristics of the patient in Felege Hiwot Comprehensive Specialized Hospital, Bahir Dar Ethiopia, December 2019 (n = 424)

Variables		Frequency	Percentage
Sex	Male	186	43.9
	Female	238	56.1
Age	≤19	59	13.9
	20-34	208	49.1
	≥35	157	37
Residence	Rural	242	57.1
	Urban	182	42.9
Income (birr/month)	≤ 1600	109	25.7
	1601-2500	117	27.6
	> 2500	198	46.7
Life style	Alcoholic	29	6.8
	Free	381	89.9
	Smoker and other	14	3.3
BMI	18.5-24.9	246	58
	<18.5	160	33.7
	25-30	18	4.2

Surgical procedure and Clinical characteristics of patients

Based on the ASA scoring 228 (53.8%) of the wounds were class I and 161 (38%) were class II. The majority 72.2 % (306) of these wounds were clean followed by 22.6% (96) clean contaminated. 95% (403) of the patient got antibiotics of which Ampicillin was administered for 34% (144) and Metronidazole with Ceftriaxone was given for 32.1% (136) of the patients. The majority type of surgery was abdominal surgery 40.8% (173) . (Table -3)

Table 3 Clinical characteristics of patients undergone a surgical procedure in Felege Hiwot Comprehensive Specialized Hospital, Bahir Dar Ethiopia, December, 2019 (n = 424)

Variables	Frequency	Percentage (%)	
ASA	Class I	228	53.8
	Class II	161	38
	Class III	29	6.8
	Class IV	6	1.4
Class of wound	Clean	306	72.2
	Clean contaminated	96	22.6
	Contaminated	22	5.2
Status of surgery	Emergency	261	61.6
	Elective	163	38.4
Preexisting disease	Yes	69	16.3
	No	355	83.7
Antibiotics given	Yes	403	95
	No	21	5
Antibiotics type	Ampicillin	144	34
	Ceftriaxone	66	15.6
	Metronidazole	27	6.4
	Ciprofloxacin	8	1.9
	Ceftriaxone + Metronidazole	136	32.1
	Ciprofloxacin + Metronidazole	14	3.3
Type of surgery	Other	8	1.9
	Abdominal	173	40.8
	CS	130	30.7
	Regional and other	45	10.6
	Neurosurgery	39	9.2
	Genitourinary	24	5.7
	Chest surgery	13	3.1
	Surgery done by	Surgeon	107
	Residents	272	64.2
	Gynecologist	20	4.7
	General practitioner	25	5.9

The overall incidence rate of surgical site infection were 14.4% ,of which 12.5% were during hospital admission and the incidence after discharge from the hospital within one month follow up were 1.9% .

General anesthesia was used for 67.9% (288) of the procedures and most of the patients 61.3% (260) stayed in the hospital less than 7 days followed by 35.8%(152) for 7- 21 days. 64.2% (272) of the procedures was done by resident students and only 9% (38) of the patient got blood transfusion. Most of the skin preparation technique was use Iodine 70.5% (299) and the average duration of the procedure was 1.31 ± 0.611 and median was 1 hour.

Factors associated with surgical site infection

On the bivariate logistic regression model seven variables were associated with the occurrence SSIs at $p < 0.2$. Sex ($p = 0.045$), place of residence ($p = 0.149$), BMI ($p = .000$), alcoholic lifestyle ($p = .039$), ward type ($p = .000$), clean contaminated and contaminated wound class ($p = .000$) and length of hospital stay more than 7 days ($p < .003$) were associated with the occurrence of SSIs. But only BMI, alcoholic life style and wound class showed statistically significant association with SSIs during the multivariable analysis. (Table- 4)

Table 4 Factors associated with SSIs among patients undergone a surgical procedure in Felege Hiwot Comprehensive Specialized Hospital, Bahir Dar Ethiopia, December, 2019 (n = 424)

Variables	Presence of SSI		Bivariate		Multivariate	
	Yes	No	COR(95%CI)	P-value	AOR(95%CI)	P-value
Sex						
Male	34	152	1	0.045*	1	
Female	27	211	1.748(1.012-3.019)		1.30(.651-2.489)	0.426
Residence						
Urban	21	161	.659(374-1.162)	.149*	1.075(.568-2.033)	0.825
Rural	40	202	1		1	
Age .246						
≤19	11	48	1.155(.530-2.515)	.717		
20-34	24	184	.657 (.361-1.195)	.169		
≥35	26	131	1			
Income (birr/month) .202						
≤ 1600	19	90	1.689(.869-3.282)	.122		
1601-2500	20	97	1.649(.857-3.173)	.134		
> 2500	22	176	1			
Life style .039* .038**						
Alcoholic	9	20	2.98(1.285- 6.908)	.011	3.436(1.288-9.170)	.014**
Smoker and other	2	12	1.103(.240- 5.076)	.900		
Free	50	331	1		1	
BMI .000* .025**						
18.5-24.9	40	120	1			
<18.5	20	226	.265(.149-.474)	.000	2.80(1.40 – 5.67)	.005**
25-30	1	17	.176(.023-1.368)	.097		
Operation ward type						
Surgery	55	223	5.76 (2.41-13.72)	.000*	1.736(0.630-4.784)	0.287
Guyniobs	6	140	1			
Wound class .000* .000**						
Clean	21	285	1		1	
Clean contaminated	31	65	6.473(3.496-11.984)	.000	5.316(2.7650-10.238)	.000**
Contaminated	9	13	9.396(3.603-24.502)	.000	6.457(2.332-17.881)	.000**
Preexisting disease						
Yes	12	57	1.315(.658-2.626)	.438		
No	49	306	1			
Procedure done by .764						
Surgeon	13	94	1.014(.266-3.867)	.984		
Resident	41	231	1.302(.372-4.54)	.680		
Gynecologist	4	16	1.833(.359-9.353)	.466		
General practitioner	3	22	1			

Variables	Presence of SSI		Bivariate		Multivariate	
	Yes	No	COR(95%CI)	P-value	AOR(95%CI)	P-value
Operation type						
Emergency	42	219	1.453 (.813-2.599)	.207		
Elective	19	144	1			
Length of hospital stay			.003*		.065	
<7day	26	234	1			
7-21 day	34	118	2.593(1.486-4.524)	.001		
>21 day	1	11	.818(.102-6.594)	.851		
Duration of operation			.410			
<1	51	275	1			
1-2	7	61	0.617(0.268-1.429)	.261		
>2	3	27	.599(0175-2.049)	.414		

NB: COR=crude odds ratio, AOR=adjusted odds ratio, *= significant association (on bivariate), **=significant association (on multivariate), 1.00= Reference

The result of this study showed that, patients with BMI < 18.5 (underweight) had 2.8 times more likely to develop SSI than patients who has BMI 18.5-24.9 (normal weight) [AOR= 2.80; 95% CI (1.40-5.67)]. Alcoholic Patients were 3.40 times more likely to develop SSIs compared with nonalcoholic patents, AOR = 3.436(95% CI [1.288–9.170]).

Regarding wound type, patients with contaminated wound are 6.5 times more likely to develop surgical site infection than patients with clean wounds [AOR= 6.457; 95% CI (2.332-17.881)]. In addition, patients with clean contaminated wound are 5.3 times more likely to develop surgical site infection than patients with clean wounds [AOR= 5.316; 95% CI (2.765-10.235)].

Discussion

The incidence rate of surgical site infections (14.4% including SSI developed after discharge) reported in this study is higher than that of the study reported by Wondemagegn et.al [11] and Demisew et.al. [10] where the rate of infection reported were 10.9% and 11.4% respectively. This might be due to the follow up in the current study was done one month including after discharge. However, this finding was lower than that of a study conducted at Hawassa hospital, Ethiopia (19.1%) [12], Nigeria 38.1% [18] and Mekele, Ethiopia 75% [14]. It might be due to differences in infection prevention and control policy between countries and hospitals, study methods, the study population and socio-demographic characteristics of patients.

In this study, alcohol consumption, class of wound and BMI was found to be the risk factors significantly associated with the development of surgical site infection. Patients with clean contaminated and contaminated wound had higher risk to develop surgical site infection than patients with clean wounds. This finding is in line with a study conducted at Jimma University Specialized Hospital, Felege-Hiwot Specialized hospitals and Ayder Teaching and Referral Hospital, Mekelle, in Ethiopia[10, 11,14].This might be due to the fact that contaminated wounds have more likely to develop infections than clean wounds . In contrast to this, in studies done at Hawassa, Ethiopia revealed the SSIs incidence was higher in clean wounds than clean contaminated and contaminated wound[12]. The result of this study was in line with a study done in Cameron [7].

This study also revealed that, underweight patients found to be another factor for the development of SSI than patients who has normal weight. Similar result was found in a study done in Sudan [8].

While age, sex, average monthly income, pre-operative antibiotic prophylaxis, length of time from admission to discharge, preexisting disease ,operation type the person who perform procedure ,type of operation and duration time for operation were not statistically associated with the risk of developing SSI . This is not in lines with studies done Africa. A study done in Cameron, the hospital, the type of surgical ward and surgical factors, the wound class contamination, the status of surgery and the type of surgery [7] in Sudan , co morbidity, presence of diabetes and laparoscopic surgical technique [8] in Dares Salaam, Tanzania wound class, abdominal surgeries, emergency procedures and HIV infection increased the risk of SSI [9].

Conclusion

The incidence of surgical site infection in surgical gynecology and obstetrics patients was high. Patients with clean contaminated and contaminated wound, underweight patients and alcoholic patients were at high risk to develop SSI.

Data Availability

The authors confirm that data used to support the findings of this study are available from the corresponding author upon request.

Conflicts Of Interest

“The author(s) declare(s) that there is no conflict of interest regarding the publication of this article.”

Funding Statement

The research did not receive specific funding, but was performed as part of the employment of the authors in Bahir Dar University.

Ethical statement

The ethical approval was obtained from the Research and Ethical Review Committee and Institutional Review Board of Bahir Dar University, College of Health Sciences. Permission to conduct the study was obtained from Felege Hiwot comprehensive specialized hospital.

Participation was completely voluntary and participants were informed that, they had the right to refuse or participate in the study after purpose, duration, benefit and possible risks of participation was presented for each participant.

Data anonymity and confidentiality was kept throughout the study. Moreover, both written and verbal informed consent was obtained prior to collect data. The collected data were used only for the intended purpose of the study.

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