Magnitude of Surgical Site Infection and Its Associated Factors Among Patients Who Underwent a Surgical Procedure at Debre Tabor General Hospital, Northwest Ethiopia

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Abstract

Background: Surgical site infections are the commonest nosocomial infections and responsible for considerable morbidity and mortality as well as increased hospitalizations and treatment cost related to surgical operations. The aim of this study was to determine the magnitude and factors associated with surgical site infections at the surgical ward of Debre Tabor General Hospital, Northwest Ethiopia.

Method: Institution based cross-sectional study was conducted on patients who underwent a surgical procedure at Debre Tabor General Hospital in 2020. The sample size was determined using the single population proportion formula. Data were entered and analyzed using SPSS version 21 software. Bivariate and multivariate logistic regressions analysis were employed. The odds ratio and its 95% confidence interval were taken to test the association between the dependent and independent variables. A P-value of less than 0.05 will be considered statistically significant.

Result: In this study, a total of 191 patients have participated in the study yielding a response rate of 100%. The mean age of the respondents was 2.5 (SD ±0.68) years. The most age group 115(60.2%) resides at the age group greater than 40 years. More than one half(62.3) of the surgical clients were females. Most of the clients were farmers(32.5%) and unable to read and write(41.9) based on the occupation**.** The magnitude of surgical site infection in this study was found to be 11.5% (95% CI: 7.8%, 15.9%). The factors existence of comorbidity and antibiotic prophylaxis was given were found to be significantly associated with the magnitude of surgical site infection.

Conclusion: The magnitude of surgical site infection in this study was high. Proper management of patients with co-morbidity especially those with diabetes mellitus, proper administration of anesthesia, and delivering intravenous antimicrobial prophylaxis before surgery as ordered would significantly reduce the incidence of surgical site infection.

Background

Surgical site infection (SSI) refers to infections that took place within 30 days of an operative procedure and may extend to more than 30 days according to the surgical procedure [1]. Surgical site infection is one of the common problems in a hospital setting. Reports from the World Health Organization in 2009 showed that 23% of surgical patients worldwide developed SSIs [2]. It is the 3rd commonly reported nosocomial infection accounting for 10–40% of all nosocomial infections[3, 4]. It accounts for 3.7 million excess hospital stay days, more than it costs $1.6 billion in excess costs annually and 3.57 extra drug usage [5].

Globally, SSI rates are 2.5–41.9% [6]. Approximately 2–5% of surgical patients worldwide have developed SSIs [7]. The incidence of SSIs is higher in developing countries relative to developed nations [8]. SSIs are preventable complications following surgery and imposes a significant burden in terms of patient morbidity, mortality and increased cost of treatment. Patients who develop SSIs are up to 60% more likely

to spend time in an intensive care unit, 5 times more likely to be readmitted to the hospital, and 2 times more likely to die compared with patients without SSIs [9].

Surgical site infections are the most frequent type of HAI in low and middle-income countries (LMICs) and affect up to one-third of patients who have undergone a surgical procedure[10]. In LMICs, the pooled incidence of SSI was 11.8 per 100 surgical procedures [11]. In Africa, SSIs were the leading infections in hospitals and incidence ranged from 2.5%-30.9% [12]. A study conducted in the southern part of Ethiopia showed that SSI was found to be 13% [1]. The study done in Northern Tanzania showed that there were 20.0% of surgical site infections [5].

A prospective observational study done in India showed that surgical site infection rate was 13.04% in patients receiving inappropriate chemoprophylaxis; this study revealed that there was no significant difference for SSI rate between gender, types of anesthesia, and between open and laparoscopic surgery, while emergency surgery showed significantly higher SSI rate as compared to the elective surgery [13]. The study in Tanzania revealed that the presence of pre-morbid, use of iodine alone in skin preparation, duration of operation ≥ 3 hours and cigarette smoking were factors for surgical site infection (SSI) [5]. The study done in Southern part of Ethiopia, Sodo hospital showed that, Patients younger than 40 years old, being illiterate, history of previous hospitalization prolonged preoperative hospital stay (> 7 days) and admitted on the wing side of the hospital were found to be significant factors for surgical site infection [1]

Materials And Methods

Study Area and period

The study was conducted in Debre Tabor General Hospital, Northwest Ethiopia to assess the magnitude and associated factor of postoperative surgical site infection among patients visiting Debre Tabor General Hospital from March 1–30/2020. Debre Tabor is the capital of South Gondar Zone which is 666kms far from Addis Ababa, the capital city of Ethiopia and 100kms away from Bahir Dar, the capital city of Amhara regional state.

Study Design

The institution-based cross-sectional study design was employed.

Population

Source Population

All patients who have undergone surgery from Debre Tabor General Hospital.

Study Population

Selected patients who have undergone surgery from Debre Tabor General Hospital.

Study Variables

Dependent Variable

- Magnitude of post-surgery surgical site infection

Independent Variables

- Age group (in a years) of caregivers
- Sex of child
- Educational level
- Religion

Sample Size Determination

The sample size is determined by using single population proportion calculation formula. In a study done in Wolaita Sodo University Teaching and Referral Hospital, South Ethiopia, 13% developed surgical site infection (p) (27).By considering 95% confidence interval (CI) and 5% marginal error the, sample size is calculated as follows;

$$n = \frac{(Z\alpha/2)2\ p\ (1-p)}{d2}$$

Where

Therefore, total sample size = 174 + non-respondent rate (10%)

= 174 + 17 = 191

Sampling Technique

Systematic random sampling technique and proportional allocation were applied.

Data Collection Instruments

Data were collected by using structured self-administered questionnaire by three trained nurses

Data Quality Control

The training was given to data collectors and supervisors. Pre-testing was done to keep data quality. Daily cleaning of the questionnaire and strict follow up by the supervisor was doing.

Ethical Consideration

Ethical clearance was obtained from the Amhara Public Health Institute. All the study participants were informed about the objective of the study and their verbal informed consent was obtained. Additionally, confidentiality and privacy of the information were be kept anonymously.

Data Processing and Analysis

The collected data were checked for completeness and cleanness and then entered into SPSS version 21 software for analysis. Descriptive statistics was done to describe the study variables. Bivariate analysis was performed to select candidate variables for multivariable logistic regression analysis. All independent variables with a p-value less than 0.2 will be taken as candidates for multivariable logistic regression analysis. Finally, a p-value of less than 0.05 at 95% CI was used to declare statistical significance. The AOR from multivariable logistic regression was used to measure the strength of association.

Results

socio-demographic characteristics of clients undergoing surgery

In this study, a total of 191 patients have participated in the study yielding a response rate of 100%. The mean age of the respondents was 2.5 (SD ± 0.68) years. The most age group 115(60.2%) resides at the age group greater than 40 years. More than one half(62.3) of the surgical clients were females. Most of the clients were farmers(32.5%) and unable to read and write(41.9) based on the occupation (Table 1).

Table 1
SOCIO-DEMOGRAPHIC CHARACTERISTICS OF PATIENTS WHO UNDERGONE SURGICAL PROCEDURES AT DEBRE TABOR GENERAL HOSPITAL, NORTHWEST ETHIOPIA (N = 191)

Variables		Frequency(n = 191)	Percent (%)
Age in years	1–18	20	10.5
	19–40	56	29.3
	> 40	115	60.2
Sex	Male	72	37.7
	female	119	62.3
Educational status	Unable to write and read	80	41.9
	Able to write and read	44	23.0
	Primary school	18	9.4
	Secondary school	26	13.6
	Certificate of and above	23	12.0
Occupation	Housewife	29	15.2
	Merchant	20	10.5
	Student	19	9.9
	Daily laborer	47	24.6
	Employed	7	3.7
	Unemployed	7	3.7
	Farmer	62	32.5
Residence	Rural	51	26.7
	Urban	140	73.3

SURGICAL PROCEDURE RELATED FACTORS ON PATIENTS WHO UNDERGONE SURGERY

The majority of the clients176(92.1%) had no previous history of hospitalization and preoperative hospital stay. Nearly three quarter(70.7%) of the clients had undergone elective surgery. Most of them(95.3%) had no co-morbidity and were given prophylaxis antibiotics(88%). (Table:2)

Table 2
SURGICAL PROCEDURE RELATED FACTORS ON PATIENTS WHO UNDERGONE SURGERY AT DEBRE TABOR GENERAL HOSPITAL, NORTHWEST ETHIOPIA (N = 191)

Variables	Response	Frequency (n = 191)	Percent
History of previous hospitalization	Yes	15	7.9
	No	176	92.1
Pre-operative hospital stay	No admission	176	92.1
	< 7 days	8	4.2
	7 days	7	3.7
Type of surgical procedure done	Emergency	56	29.3
	Elective	135	70.7
Site of surgery	Abdominal	109	57.1
	Extremity	24	12.6
	Thorax	12	6.3
	Neck	27	14.1
	Others	19	9.9
Duration of surgery	< 1 hour	55	28.8
	1–2 hours	120	62.8
	3–4 hours	10	5.2
	> 4 hours	6	3.1
Presence of co-morbidity	Yes	9	4.7
	No	182	95.3
Type of co-morbidity	Diabetes mellitus	5	2.6
	Hypertension	2	1.0
	HIV/AIDS	2	1.0
	None	182	95.3
Wound care given as ordered	Yes	189	99.0
	No	2	1.0
Frequency of wound care given	Once-daily	39	20.4
	2 times daily	128	67.0

Variables	Response	Frequency (n = 191)	Percent
	3 and more times a day	22	11.5
	No care given	2	1.0
Type of anesthesia given	General	155	81.2
	Regional	36	18.8
Duration of anesthesia given	< 30 minute	41	21.5
	30–60 minutes	114	59.7
	60–90 minutes	20	10.5
	> 90 minutes	16	8.4
Antibiotic prophylaxis given	Yes	168	88.0
	No	23	12.0
Medication given as ordered	Yes	186	97.4
	No	5	2.6

Magnitude of surgical site infection

Despite improvements in operating room practices, instrument sterilization methods, better surgical technique, and the best efforts of infection prevention strategies, surgical site infections remain a major cause of hospital-acquired infections in the study area. Of the clients who undergone surgery 11.5% (95% CI: 7.8%, 15.9%) had surgical site infection.

Factors for surgical site infection

The multivariate analysis showed that the presence of comorbidity and antibiotics prophylaxis given were the major predictors of the magnitude of surgical site infection. On the other hand age, sex, type of comorbidity, medication given after surgery, duration of operation procedure and type anesthesia is given were found to be insignificant factors for surgical site infection (Table: 3).

Table 3
BIVARAIBLE AND MULTIVARIABLE ANALYSIS ON SURGICAL SITE INFECTION AMONG CLIENTS UNDERGOING SURGICAL INTERVENTION AT DEBRE TABOR GENERAL HOSPITAL NORTHWEST ETHIOPIA, 2020 (N = 191)

Variables	**Surgical site infection (SSI)**		**Crude OR (95% CI)**	**Adjusted OR (95% CI)**
	Yes (%)	**No (%)**		
sex				
Female	5(22.7%)	67(39.6%)	0.80 [0 .79, 6.34]	0.70 [0 .58, 6.94]
Male	17(77.3%)	102(60.4%)	1	1
Presence of comorbidity				
Yes	4(18.2%)	5(3%)	**-1.99 [0 .03, 0.56]***	**-2. 43 [0 .01, 0.61]****
No	18(81.8%)	164(97%)	1	1
Type of anesthesia				
General	12(54.5%)	143(84.6%)	**1.52 [1 .80, 11.70]****	0.35 [0 .34, 6.04]
Regional	10(45.5%)	26(15.4%)	1	1
Duration of anesthesia				
<30 minutes	12(54.5%)	29(17.2%)	-0.58 [0 .13, 2.32]	1.43 [0 .50, 35.10]
30–60 minutes	6(27.3%)	108(63.9%)	1.42 [0 .93, 18.63]	1.18 [0 .52, 20.65]
60–90 minutes	1(4.5%)	19(11.2%)	1.50 [0 .41, 46.93]	0.72 [0 .16, 26.67]
>90 minutes	3(13.6%)	13(7.7%)	1	1
Antibiotics prophylaxis given				
Yes	10(45.5%)	158(93.5%)	**2.85 [6 .10, 48.68]****	**3.23 [4 .83, 131.04]****
No	12(54.5%)	11(6.5%)	1	1
medication given after surgery				
yes	20(90.9%)	166(98.2%)	1.71 [0 .87, 35.13]	1.67 [0 .50, 56.78]
No	2(9.1%)	3(1.8%)	1	1

NB 1 = Reference, * =P value-<0.05, **=p-value < 0.01, Hosmier and Lemesho Goodness of fit test = 0.931

Discussion

This study result showed that the magnitude of surgical site infection was high; we found that 11.5% (95% CI: 7.8%, 15.9%) of the clients who undergone surgery had surgical site infection, which is in line with the report of the systematic review and meta-analysis in Ethiopia [12], the study done in Ethiopia like Jima University Hospital 11.4% [14].

The study result was lower than the studies done in Ethiopia like Wolita Sodo Teaching and referral hospital 13%[1] in Ayder hospital 75% [11], a systematic review and meta-analysis study 12.3% [6], the study done in primary hospital 20.6% [15] a prospective cohort study 19.1% [16] and the study in India 13.04% [13], in Tanzania Bugando medical center 20% [5], in a university hospital in Germany 22% [10]. The possible reason for this difference might be time difference, care of the patients and even antibiotic prophylaxis given.

However, our study was higher than, the studies conducted in Ethiopia 9.9% [17], the study done in referral hospitals of Ethiopia [18], Suhul hospital Tigray of Ethiopia 11.1%[19], Southern hospitals of Ethiopia 11% [20] and the studies done in developing countries 6% [7], the study done in Italy 5.2% [21], in Mwanza Tanzania 10.9% [22], university Missouri Kansas city 0.6%[4] in Pakistan 11% [23]. The possible explanation for this might be the care of the patient and the time difference of the study.

A statistically significant association was obtained between the presence of comorbidity, prophylaxis given and surgical site infection. The presence of comorbidity and antibiotics prophylaxis given were the major predictors for the magnitude of surgical site infection.

Participants with comorbidity (AOR=**-2. 43**, 95% CI: **0 .01, 0.61**) were three times more likely to have surgical site infection as compared to participants with no comorbidity. The result is consistent with the study done in Woliyta Zone hospital Ethiopia [1], in Tanzania[5], in Pakistan [23], in Buenos Aires Hospital [7] and the university hospital of Germany[10].

The probable reason for this could be as there is comorbidity, the rehabilitation process may be hampered and microbial multiplication could increase to acquire infection.

Another statistically significant association was also obtained between antibiotics prophylaxis was given and surgical site infection. Respondents who have not used prophylaxis (AOR = **3.23**, 95% CI: **4 .83, 131.04]**) were three times more likely to have surgical site infection as compared to those patients who ever used antibiotic prophylaxis. The result is consistent with the study done in university hospitals of Ethiopia like Jimma [14], Woliyta Sodo [1], the systematic and meta-analysis study done in Ethiopia [6], in a tertiary hospital of Ethiopia [15], the prospective cohort study done in Ethiopia [16]. The probable reason for this could be that antibiotics could bring resistance and immunity compromising that could decrease the resistance for infection.

Finally, other factors like sex of respondents, age occupation, type of anesthesia given, duration of anesthesia, type of comorbidity, duration of surgery and type of surgery were found to have no association with surgical site infection.

Conclusion

The magnitude of surgical site infection in this study was high. Proper management of patients with co-morbidity especially those with diabetes mellitus, and cautious delivering antimicrobial prophylaxis before surgery would significantly reduce the incidence of surgical site infection.

List Of Abbreviations

AOR -Adjusted odds ratio

CI- Confidence interval

COR-Crude odds ratio

P- Proportion

P V value - Probability value

SPSS - Statistical package

SSI- Surgical site infection

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the Amhara Public Health Institute. The study participants were also informed about the objectives of the study, privacy, and data protection and gave informed consent before being enrolled in the study.

Consent for publication

Not applicable.

Competing Interests

The authors declare that we have no competing interests.

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Authors' contributions

Mequanint Bezie (MB) designed the study, participated in the data quality control, analyzed the data, and drafted the paper, Tadesse Wuletaw (TW) assisted with the design, approved the proposal, and revised

drafts of the paper and Abaynew Honelign (AH) assisted with the design, approved the proposal, and revised drafts of the paper. All authors read and approved the manuscript.

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Availability of data

The original data are available at hand and may be delivered upon request via the corresponding author.

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