

Surgical site infection and associated factors among adult patients admitted in Bale Zone, Gindhir and Bale Robe General Hospitals, Oromia region, Southeast Ethiopia, 2020

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Abstract

Background: Surgical site infection is among the preventable healthcare-associated infections. The magnitude and associated factors of surgical site infection in was not well documented in the study area. So the aim of this study is to assess surgical site infection and associated factors among adult patients admitted in Bale zone general hospitals, Oromia Region, Southeast Ethiopia, 2020.

Methods: Hospital based cross-sectional study was conducted among all postoperative adult patients (260) who underwent surgery from March 1 to April 30/2020 in selected hospitals by simple random sampling. Pretested and structured questionnaires and observational checklists were used for data collection. Data were checked daily for completeness and entered to Epi data version 3.1 and analyzed by SPSS version 20. Frequency, percentage, mean and chart were used to present the result. Bi-variable and multivariable logistic regression analysis was implemented and those variables with a p-value of <0.25 in bi-variable were a candidate for multiple logistic regression. P-value < 0.05 was considered as significantly associated with outcome variables.

Results: A total of 260 patients participated in the study which gives a response rate of 90%. Of study participants, 139 (53.5%) were males and more than two-thirds of the respondents were from rural 174 (66.9%). The mean ages of the patients were 40.2, standard deviation ± 14.20 years. The prevalence of surgical site infection was 9.2% (95% CI [5.7-12.7]). Patients with comorbidity disease AOR, 15.75(95% CI [2.81-33.42]), antimicrobial prophylaxis before operation AOR= 0.19(95% CI [0.06-0.53]) and body mass index ≥ 25 AOR, 12.5(95% CI [3-65.4]) where associated factors of surgical site infections.

Conclusion: The magnitude of surgical site infections was comparatively high. Comorbidity disease, antimicrobial prophylaxis and body mass index ≥ 25 were associated factors. Efforts should be made to improve the appropriate and timely delivery of intravenous antimicrobial prophylaxis before surgery and health care providers should screen and manage co-morbidities.

Keywords: Surgical Site Infection, Adult Patient, Bale.

Introduction

Surgical site infection (SSI) is an infection that occurs within 30 days after the operation or up to 1 year of implant use. Involves the skin and subcutaneous tissue of the incision (superficial incision) and the deep soft tissue (fascia, muscle) of the incision [1]. Surgery is an essential component in health care, infections and complications after surgery and accounts for patient morbidity and mortality. Surgical site infections (SSIs) are those infections that are confined to the incisions and involve structures adjacent

to the wounds that were exposed during operation [2].

Surgical site infection has become a pay-for-performance metric and a target of quality improvement efforts. Surgical site infection also causes prolonged hospitalization from 1.5 to 16.6 days and the estimated average cost of each surgical site infection in the United States of America is \$2,739. The overall incidence of surgical site infection in Brazil was 3.4% [3-5].

Globally, surgical site infections among all surgeries were 23% annually with the worst complications causing prolonged hospital stays, increased resistance of microorganisms to antimicrobials, higher health system costs, emotional stress for patients and their families, and substantial economic burdens on hospitals (6-8). SSI rates range from 2.5% to 41.9% and are the third most frequently cause of nosocomial infection, and account for 14% to 16% of all nosocomial infections among hospitalized patients. The SSIs in developing countries are on the rise associated with a dramatic increase in patient's morbidity, and mortality and the most frequent type of health care-associated infection and approximately one in 10 people who have surgery acquire surgical site infection [1, 5].

Currently on behave of advances in clinical practices and easy preventive methods in Ethiopia, the magnitude of SSI, complications and burden in terms of patient morbidity, cost of treatment, and mortality rate still critical public health problems [7]. The magnitude of surgical site infection is still high, 11.1% Suhul teaching Hospital and 25.5% in west and east Gojjam zone hospitals [8-12].

However, studies are limited in Ethiopia regarding magnitude and associated factors of SSI at general hospitals particularly in study areas. Therefore, this study aims to determine the magnitude and associated factors of SSIs in selected Bale zone general hospitals Southeast Ethiopia. This study would be helpful in developing targeted intervention to reduce occurrence of SSIs. It will also serve as baseline data for those who are interested further research on the issue.

Methods and Materials

Study area and period

This study was conducted in Gindhir General Hospital, Bale zone, Oromia region, Southeast Ethiopia. The Hospital 550km from Addis Ababa. Those hospitals give service to approximately 1.5 million patients annually and provide specialized services in four major

Departments

Pediatrics, surgery, gynecology, obstetrics and internal medicine. This study was conducted from March 1/2020 to April 30, 2020.

Study Design

Hospital based cross-sectional study design was conducted.

Source population and Study population

All post-operative patients in Bale zone general hospitals were the source population. All post-operative adult patients who had surgery in Bale Robe and Gindhir General Hospitals in the study period were the study population.

Inclusion And Exclusion Criteria

All post operated adult patients in surgical ward (18-65 years) of Gindhir and Bale Robe General Hospitals. Patient from outpatient department admitted for diagnosis of Surgical site infection

who operation done at other hospitals, patient who had implant at the site of operation, severely ill patients and leg amputation. Sample Size Determination and Sampling Technique

The sample size was determined by using single population proportion formula with the following assumptions: 5% marginal error and 95% confidence interval by considering p-value 25.5% proportion prevalence of postoperative surgical site infection from West and East Gojjam zone hospital (7) the sample size with 105 none response rate was 321. All adult patients who undergone major surgery in the surgical ward of both hospitals were involved in the study.

Study Variables

Surgical site infection is the dependent variable. However, Socio-demographic variables (Age, address, marital status, educational status and monthly income), Patient related factors (Cigarette use, alcohol use, body mass index, and co morbid disease: diabetic mellitus and hypertension), Surgical procedure related factors (Wound type, site of surgery, category of procedure, pre hospital stay, wound class ,type of operation, class ASA index, post hospital stay, preoperative and postoperative hemoglobin, duration of procedure, type of anesthesia, blood loss, prophylactic antibiotic) are independent variables.

Data collection instruments and procedure

Data were collected using structured interviewer administered questionnaire. By using standardized questionnaire checklist adapted from Centers for Diseases Control and Prevention surgical site infection criteria. The questionnaire were also adapted from similar study and modified to the context of study area after reviewing relevant literatures and guidelines on surgical site infection with modification. Questionnaire was used to capture from both the records (chart review) and the patients.

Eligible patients were observed through the postoperative period till discharge from the hospitals for the development of surgical site infection. The questionnaires has four parts: socio demographic information, patient related factors, surgical procedure related factors and surgical site infection related factors. Weight was measured by data collectors using weight scale with patients standing without shoes and wearing light clothing and height was also measured by data collectors by using height scale while the patients standing without shoes and finally body-mass index was calculated.

The patients were followed and reviewed the charts daily after operation until the patients discharge from the hospitals and after discharge until 30 days of operation (follow up at surgical referral clinic). The wounds were examined by using checklist on 3rd, 5th and day of discharge, then after discharge follow up at surgical referral clinic. The data were collected by 4 trained BSc nurses those not working at surgical ward and supervised by two Integrated Emergency Surgery officer. The patients were advised at the time of discharge to return for post-operative visits on 7, 14 and 25-30 days.

Data processing and analysis

The collected data were coded, cleaned and entered into Epi-data Entry version 3.1 and checked for the consistency of data entry then exported to SPSS version 20.0 for further analysis. Model fitness was checked by the Hosmer-Lemeshow test, which gives evidence of fitness with a predictor test level of $p > 0.11$. Frequencies and percentages of different variables were determined and odds ratios were calculated to determine the associations. Odds ratios with 95% confidence intervals were computed using binary logistic regression. All variables were entered to the model and variables whose p-value less than 0.25 were entered into multivariable analysis. The crude and adjusted odds ratios together with their corresponding 95% confidence intervals were computed.

Ethical approval

Ethical clearance was obtained from Madda Walabu University institutional review board, to insure full protection of the rights of study subjects. Furthermore, individuals who are involved in this study were given using verbal consent as a prerequisite before data collection.

Patient and Public Involvement

Participation of patients in this study was entirely voluntary and confidentiality was protected. The right of participants to continue or withdraw to participate was respected and names were not mentioned. Verbal informed consent was obtained from each participant after explaining the purpose of the study. The confidentiality of information obtained from the participants was assured and the study subjects were informed that, they had full right to participate to the study.

Results

Socio-demographic characteristics of study population

A total of 260 patients were participated in the study which gives a response rate of 90%. Among this 139 (53.5%) were males and more than two-third of the patients were from rural area (66.9%). The mean age of the patients was 40.2 (SD±14.20) years and nearly one-fourth (25%) of the respondents was can't read and write. Most of the participants were farmer 120 (46.2%). Nine patients (3.5%) had co-morbidities: diabetic mellitus 4(1.5%), hypertension 3(1.2%) and HIV/AIDS 2(0.8%). Those histories of alcohol use were 8(3.1%) and that of smoking was 7(2.7%). The mean body mass index of the patients was 21.1 (standard deviations ±2.3).

Magnitude of surgical site infection

Among interviewed patients 24(9.2%) of them were develop surgical site infection. Of these, 13(5%) were develop surgical site infection before discharge from the hospitals. The mean postoperative day surgical site infection detected was 6.9(SD±2.8) days

and the mean number of additional postoperative day of hospital stay due to SSIs was 13.8 (SD±4.8) days. Nearly, more than two-third of SSI were superficial (87.5%) and only 3(12.5%) were develop deep SSI.

Surgical procedures related characteristics

Abdominal surgeries accounted for the majority of surgical procedure performed in study area 181(69.6%) followed by neck surgery (17.31%). One hundred sixty one (61.9%) of surgical procedures were clean-contaminated and most of the operations were emergency 147(56.5%). The mean duration of operation was 52.07 (SD±13.63) hour, mean duration of preoperative stay was 2.503 (SD±2.08) and that of postoperative stay was 4.11 (SD±2.89) days. Majority of patients 208 (80%) received antimicrobial prophylaxis before operation. More than two-third of patients were under ASA score one 224 (86.2%). Majority of the patients were undergone general anesthesia 243 (93.5%). Moreover, more than half of the patients (56.5%) were stays in the hospital ranges 2 to 7 days before operation and patients who stay in the hospital for more than 7 days before operation were 2.7%. Most of the patients (96.2%) were taken postoperative antibiotic for less than 7 days.

Factors associated with surgical site infections

The independent variables which had association with dependent variable in bivariable analysis at P-value of less than 0.25 were included in the multivariable logistic regression model. The outcome of the final backward multivariable logistic regression model showed that five independent variables were dropped from the final model. By adjusting potential confounders, body mass index $\geq 25\text{kg/m}^2$, co morbid disease and prophylactic antibiotic were statistically significant factor associated with surgical site infection at P-value of less than 0.05. Patients whose prophylactic antibiotic administered before operation were eighty 81% percent less likely to develop surgical site infection as compared with patients whose prophylactic antibiotic not administered before operation AOR=0.19(95% CI [0.06-0.53]). Moreover, patients who had co morbidity (diabetic mellitus and hypertension) were 15.8 times more likely to develop SSIs as compared with those who had no co morbidity AOR=15.8 (95% CI [2.81-33.42]). The risk of surgical site infection for that body mass index $\geq 25\text{kg/m}^2$ were 12.5 time more likely to develop surgical site infection as compared with those whose body mass index less than 25 kg/m².

Table 1: Bi-variable and multivariable analysis of factor associated with SSI in Gindhir and Bale robe general hospital from March 1, 2020 to April 30, 2020.

Variable	Category	SSI		COR(95%CI)	Adjusted OR(95%CI)
		Yes n (%)	No n (%)		
Duration of procedure	< 60 minute	11(6.6)	156(93.4)	1	1
	60-90 minute	13(14)	80(86)	2.3(1.98-5.37)	2.14(1.74-6.19)
prophylactic antibiotic given	Yes	11(5.3)	13(25)	0.06(0.01-0.30)	0.19(0.06-0.53)**
	No	197(94.7)	39(75)	1	1
Smoking cigarette	Yes(0)	3(37.5)	21(8.3)	6.6(1.47-29.56)	7.06(3.79-73.2)
	No(1)	5(62.5)	231(91.7)	1	1
Body mass index	18.5-24.9 kg/m2	17(6.3)	230(88.5)	1	1
	25-30kg/m2	7(2.7)	6(2.3)	11.84(3.15-44.4)	12.5(3-65.4)*
Co morbid disease	Yes	5(55.6)	19(7.6)	15.2(3.8-61.6)	15.75(2.81-33.42)*
	No	4(44.4)	232(89.2)	1	1
Pre operative hemoglobin	≤ 11day	7(14.9)	40(85.1)	2.0(1.78-5.18)	2.1(0.78-5.6)
	≥11 day	17(8)	196(92)	1	1
Type of surgery	Emergency	10(6.8)	137(93.2)	1.51(1.22-1.81)	1.49(.27-8.11)
	Elective	14(12.4)	99(87.6%)	1	1

Discussion

This study showed that over all magnitude of surgical site infection was 9.2%. Surgical site infection is one of the most common types of nosocomial infections. This study was conducted to assess surgical site infection after operation procedure among adult patients. In present study an attempt was made to identify magnitude of SSI and associated factors. Preoperative prophylactic antibiotic, body mass index and co morbid disease were significant factors associated with surgical site infection.

The surgical site infection rate in this study was comparable with previous study conducted in Pakistan which the rate of surgical site infection was 8.8% [9]. Similarly, comparable to study conducted in Ethiopia, with magnitudes of 9.9% in Amhara region public hospitals, 10.9% in Bahir Dar North West Ethiopia and 11.1% in Suhul Hospital, Northern Ethiopia (12-14). The possible reason for this similarity might be due to similar in methods and sample size. But, lower compared to previous study conducted in African country 30.9% in Nigerian hospital [10]. 22.6% in Tanta University Hospital of Egypt. the difference might be due to different in study period. Similarly, lower than studies conducted in Ethiopia: 13% at Wolaita Sodo University Teaching Hospital (14 and 25.5% in west and east Gojam zone hospitals. That difference could be due to difference in hospital level, time, study setting and sample size.

The finding was higher compared with study conducted in large Brazilian hospital the surgical site infection rate was 3.4%. This difference in surgical site infection rate in present study might be due to modern instruments, rooms and adequately trained man power and again 5% higher in Hawasa referral hospital. In this study co morbidity was significantly found to be predictor of surgical site infection. Patient with co morbidity were 15.8fold risk of developing surgical site infection as compared to those with no co morbidity. In agreement to previous study in west and east Gojam zone hospitals in which patient those had

co morbidity were 16.7 times risk to develop surgical site infection as compared with those had no co morbidity and again analogues with study conducted at Assela referral hospital showed that patient with co morbidity had statistically significant association with surgical site infection; that is risk of surgical site infection 5.4 fold risk of developing surgical site infection as compare to those with no co morbidity [13].

Present study shows that administration of antimicrobial prophylaxis before operation was revealed to be preventive factor for development of surgical site infection. This study indicates that administration of antimicrobial prophylaxis before operation was eighty 81% less likely to develop surgical site infection as compared with those prophylactic antibiotic not administered before operation. Again in agreement with previous studies conducted in Ethiopia which revealed that if antimicrobial prophylaxis not administered before operation, the risk of developing surgical site infection was 11.10 times compared with those antimicrobial prophylaxes delivered before operation [12]. The fact that, if antimicrobial prophylaxis administered earlier to operation, then the tissue as well as serum concentration of antimicrobials is adequate enough to prevent contamination of the wound during the operation until the wound is closed. This rationale was confirmed by one study that indicated the low tissue concentration of antimicrobial at the time of wound closure was independent predictor for development of SSIs.

In present study the risk of surgical site infection for those body mass index ≥ 25 kg/m2 were 12.5 times more likely to develop surgical site infection as compared with those body mass index < 25 kg/m2. This finding was congruent with study in USA patients with body mass index ≥ 25 kg/m2 were higher risk to develop surgical site infection than patients with body mass index of < 25 kg/m2.

The information originated from a real practical situation and this study also supported with observational checklist. However, the limitation of the study is variables related to antiseptics used for patient preparation, wound care and techniques used for materials sterilization were not included.

Conclusion

The magnitude of surgical site infection was relatively high as compared to national standard. The most important factors associated with surgical site infection were co-morbidity, body mass index $\geq 25\text{kg/m}^2$ and antimicrobial prophylaxis. Based on the findings of this study, we recommend administering antimicrobial prophylaxis before operation, routinely screen and manage co morbidities and extra measure should be taken in high risk patients (obese and patient with co morbid disease). The researchers to conduct prospective cohort studies considering surgical site infection after hospital discharge including other age groups.

List of abbreviations

ASA: American Society of Anesthesiologists; **SPSS:** Statistical Package for Social Science; **SSI:** Surgical Sites Infection.

Contributions: NA involved in the study design, data collection, analysis and write-up. AE performed analysis, interpretation of data. MH contributed to the design, draft and revision of the manuscript. All authors approved the final version.

Availability of the data

All the data supporting our findings of this study are available from the corresponding author upon request

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Data sharing statement: No additional data are available.

Transparency statement: All author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and no discrepancies from the study as originally planned.

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