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Surgical site infection and associated factors among adult patients admitted in west and east Gojjam zone hospitals, Amhara region, Ethiopia

Abstract

Introduction: Surgical site infection is a superficial or deep infection that occurs in part of the body including skin and subcutaneous tissue within 30 days after operation. It represents the most common nosocomial infection among surgical patients. It causes increased morbidity, mortality, hospital stay, and readmission and treatment costs.

Objective: Surgical site infection and associated factors among adult patients in East and West Gojjam hospitals.

Methods: A cross sectional study was conducted among 165 patients. Study participants were selected by systematic sampling method. Data were collected by using interviewer administered questionnaire and observation checklists. Logistic regression model were computed to identify the association between outcome and predictor variables.

Result: Nearly one- fourth, 42 (25.5%) of the participants were developed surgical site infections. Among these, 38 (90.5%) were in-hospital infections and 4(9.5%) were readmissions. Smoking cigarettes [AOR=6.3(19.3-21)], diabetic comorbidity [AOR=16.7(4.3-65)], extremity surgery [AOR =1.2(3.1-7.4)], and absence of wound care [AOR=21[3-26.1) were factors associated with surgical site infection.

Conclusion and recommendations: Prevalence of surgical site infection was relatively high. The most important factors associated with surgical site infection were smoking, diabetic co-morbidity, location of surgery and wound care. Therefore, health care providers should give proper wound care, screen and manage comorbidities like diabetic and educate the impact of cigarette smoking to patients.

Keywords: surgical site infection, adult patients, associated factor

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Introduction

Surgical site infections (SSI) are infections of the tissues, organs or spaces exposed by surgeons during performance of an invasive procedure. Surgical site infections can be superficial (infection involves only skin and subcutaneous tissue of the incision), deep (infection involves deep soft tissues such as facial and muscle layers of the incision) or organ/space in which infection involves any part of the anatomy like organs or spaces other than the incision. Surgical site infections are mainly occurred within 30 days after operation. A patient who had surgical site infections has at least one of the following clinical features: pain or tenderness; localized swelling; purulent drainage from deep incision; erythematic or heat.[1,2]

Surgical site infections are persistent and preventable health care-associated infections. According to the CDC report, there were 157,500 surgical site infections following inpatient surgeries in United States alone in 2011.[3,4] Surgical site infections represent the most common nosocomial infections. Surgical site infections are associated with considerable morbidity and occasional lethality, as well as substantial health care costs, patient inconvenience, dissatisfaction and rarely additional surgery.[5,6]

Among surgical patients, SSIs were the most common nosocomial infection, accounting for 38% of all such infections. Among these SSIs, two thirds were confined to the incision, and one third involved organs or spaces accessed during the operation.[7] Surgical site infections increase length of hospitalizations, hospital readmissions, and costs.[8]

The factors associated with surgical site infection include patient-related factors (comorbidity like diabetic, aging, obesity, smoking, and ischemia), surgery related factors (prolonged procedures, poor hand scrub and poor skin preparation), physiologic alteration (trauma, shock, hypothermia, hypoxia, and hyperglycemia) and degree of microbial contamination of the wound during surgery.[9,10]

The prevalence of surgical site infection in Ethiopia ranges from 19.1% in Hawassa University Referral Hospital, Southern Ethiopia to 75% in Ayder teaching and referral hospital at Mekele, northern Ethiopia.[11,12] Therefore, the main objective of this study was to assess the prevalence and associated factors of SSI in East and west Gojjam zone hospitals.

Methods and materials

An institutional based cross sectional study was conducted from March to May, 2017, to assess surgical site infection and associated factors among adult admitted patients in West and East Gojjam zone hospitals. All selected post operated adult patients in surgical and obstetrics and gynecology wards who had superficial incision (involves only skin and subcutaneous tissue), deep incision (involve up to facial and muscle layers) and organ/space (involve any part of the anatomy (organs or spaces) in West and East Gojjam zone

hospitals that were willing to participate and available during study period were included in the study. However, patients who were unable to responded and severely ill during data collection period within these hospitals were excluded from the study.

The sample size were determined by using single population proportion formula with 5% marginal error and 95% confidence interval by considering 10.9% proportion prevalence of post-operative SSI among patients from Bahirdar, northwestern Ethiopia.[13] Moreover, by considering 10% non-response rate a total of 165 adult patients were included in the study.

A total of 330 surgeries for different indications were conducted at East and West Gojjam zone hospitals during the study period. From them using systematic random sampling technique at every two interval 165 patients were selected.

The outcome variable of the study was surgical site infection. The predictor variables of the study were sociodemographic factors (sex, age, religion, marital status, body mass index, income, residence), procedure related factors (wound type, site of surgery, duration of hospital stay, duration of procedure, category of procedure, wound care), patient related factors(medication intake, nutrition, anemia, diabetic mellitus, HIV/AIDS, alcohol) and working environment determinants (instrument processing, operation room ventilation).

Data were collected using semi structured interviewer-administered questionnaire and observational checklist. By using this checklist the patients were observed for the development of signs of surgical site infection such as purulent drainage, pain or tenderness; localized swelling; erythema; or heat and diagnosis of having surgical site infection by surgeon or attending physician. The questionnaire was prepared by reviewing literatures of similar studies and guidelines on surgical site infection with modification.[11,14] The questionnaire has 4 parts. The first part containing sociodemographic information while the second part of the questionnaire was assessing surgical site infection. The third part contains questions related to surgical procedure related factors while the final part of the questionnaire assesses patient related factors. The data were collected by 4 trained diploma nurses and were supervised by 2 BSc nurses having previous experience in data collection. Continuous follow-up and supervision were also made by principal investigator throughout the data collection period.

Data quality was assured by training of data collectors and supervisors, pretesting the questionnaire on similar setting (10% of total sample) that was not included in the study, close supervision and assistance of data collectors, and checking filled questionnaires on daily basis for completeness, clarity, and accuracy of data.

The data were coded and entered in Epi-data version 3.1software program and finally analyzed using SPSS version 21.0 window. Descriptive and inferential statistics were used to present the data. Descriptive statistics such as frequency and percentage were used to present the data. Bivariate and multivariable logistic regression was computed to assess statistical association between the outcome variable and predictor variables using odds ratio. Statistically significant variables in bivariate logistic regression analysis (P-value<0.25) were entered to multivariable logistic regression model for further analysis. Variables having *P* value less than 0.05 in multivariable logistic regression analysis was considered as statistically significant at 95% confidence interval.

The following terms were described in such a way in this study

Surgical site infection: when infection occurs within 30 days after operation and involves skin, subcutaneous tissue of the incision and patient has at least one of the following signs; purulent drainage, pain or tenderness; localized swelling; erythema; or heat and diagnosed of having surgical site infection by surgeon or attending physician. These include old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera.

Clean wound: These are uninfected operative wounds in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tracts are not entered. In addition, clean wounds are primarily closed, and if necessary, drained with closed drainage. Operative incisional wounds that follow non-penetrating (blunt) trauma should be included in this category if they meet the criteria.

Clean-Contaminated: These are operative wounds in which the respiratory, alimentary, genital, or urinary tract is entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered

Contaminated wounds: These include open, fresh, accidental wounds, operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract, and incisions in which acute, nonpurulent inflammation is encountered.

Ethical approval and consent to participate

The study was conducted after obtaining ethical clearance from Debre Markos University, College of Health Sciences, Research and Ethical Review Committee. After obtaining official letter from the college, a permission and support letter were provided to East and West Gojjam zone hospitals before data collection. The participants were informed about study to obtain their verbal assent, together with verbal consent from the parent or legal guardian before starting interview and assured that the data is not disclosed to anyone else. Besides this, the information was recorded anonymously and their right to decline interview was assured throughout the study.

Results

Socio demographic characteristics

A total of 165 patients were included in the study. All of these were voluntarily agreed to participate in the study. This resulted in a response rate of 100%. Out of 165 respondents, 87 (52.7%) were males. Moreover, the age of the participants included in this study ranged between 15 and 67 years with mean age of 27 (SD=±5.67) years. From the respondents majority (63%) were rural dwellers (Table 1).

Surgical site infection

Patients immediately after post operation were observed using observation checklists adapted from Centers for Diseases Control and Prevention surgical site infection criteria. According to this, a patient is said to had surgical site infection when superficial or deep skin infection occurs within 30 days after operation at or around incision site and patient has at least one of the following clinical features; purulent drainage, pain or tenderness; localized swelling; erythema; or heat and diagnosed of having surgical site infection by surgeon or attending physician. Based on the above criteria, 42(25.5%) of patients developed surgical site infection. Among these, 38 (90.5%) were in-

hospital infections and 4(9.5%) were readmissions. Besides this, 41(24.8%) of respondents had pus around the wound and 71(43.0%) of respondents had soaked linen covering the wound (Table 2).

Table 1 Socio demographic characteristics of adult patients admitted in selected East and west Gojjam zone hospitals, Amhara region, Ethiopia, 2017

Variables	Response	Frequency(n□165)	Percent (%)
Sex	Male	87	52.7
	Female	78	47.3
Age	15-34	78	47.3
	35-54	57	34.5
	>54	30	18.2
Marital status	Married	132	80.0
	Divorced	11	6.7
	Single	22	13.3
Religion	Orthodox	153	92.7
	Protestant	3	1.8
	Muslim	9	5.5
Residence	Rural	104	63.0
	Urban	61	37.0
Educational status	Informal education	96	58.2
	Formal education	69	41.8
Occupation	Farmer	82	49.7
	Merchant	31	18.8
	House wife	21	12.7
	Civil servant	19	11.5
	Student	12	7.3
Monthly income in ETB*	1000	87	52.7
	1001-2500	49	29.7
	2501-4000	29	17.6

*Ethiopian Birr

Surgical procedure related factors

The average post-operative hospital stay in these hospitals is 5 days. Abdominal surgery, 110(66.75%) were the major surgical procedure done in study areas and all patients got preoperative skin antisepsis (Table 3).

Patient related factors

Out of the study participants, almost all 164(99.4%) took medication according to physician order and all respondents took antibiotic prophylaxis before surgery. Moreover, among the respondents who had pre-morbid (co-morbid) factors, 15(9.1%), 40(24.2%) and 11(6.7%) had history of HIV/AIDS, anemia, and diabetes mellitus respectively (Table 4).

Table 2 Surgical site infection related characteristics that is obtained by using observational checklist at selected East and west Gojjam zone hospitals, Amhara region, Ethiopia, 2017

SSI related characteristics	Frequency (%)
Confirmed SSI after operation within 30 days?	
Yes	41(24.8)
No	124(75.2)
Is there any pain or tenderness at incision site?	
Yes	41(24.8)
No	124(75.2)
Is there discharge from wound site?	
Yes	56(33.9)
No	109(66.1)
Does patient has fever after operation?	
Yes	109(66.1)
No	56(33.9)
Does patient develops associated localized swelling at incision site?	
Yes	56(33.9)
No	109(66.1)
Does the incision site becomes erythematous?	
Yes	73(44.2)
No	92(55.8)
Does the linen change frequently when soaked?	
Yes	71(43)
No	94(57)
Does the wound has pus?	
Yes	41(24.8)
No	124(75.2)

Table 3 Surgical procedure related determinants among respondents in selected East and West Gojjam zone hospitals, Amhara region, Ethiopia 2017

Surgical procedure related factors	Response	Frequency (%)
Duration of Hospital stay	<7 days	138(83.6)
	≥7 days	27(16.4)
Type of surgery	Elective	61(37.0)
	Emergency	104(63.0)
Duration of procedure	≥2hour	77(46.7)
	<2hour	88(53.3)
Wound type	Clean	66(40)
	Clean contaminated	83(50.3)
	Contaminated	16(9.7)
Wound care	No	34(20.6)
	Yes	131(79.4)
Surgical procedure done	Abdominal surgery	110(66.75)
	Neck and head surgery	26(15.8)
	Extremity surgery	15(9.1)
	Other kind of surgery	14(8.5)
Preoperative skin antisepsis	Yes	165(100)
	No	-

Table 4 Patient related factors at selected East and West Gojjam zone hospitals, 2017

Patient related factors	Frequency (%)
Do you feed according to health care provider's order?	
Yes	161(97.6)
No	4(2.4)
Took antibiotics prophylaxis administration before skin incision?	
Yes	165(100)
No	-
Do you have associated HIV/AIDS?	
Yes	15(9.1)
No	150(90.9)
Do you have associated diabetics?	
Yes	11(6.7)
No	154(93.3)

Table Continued

Patient related factors	Frequency (%)
Do you have associated anemia?	
Yes	40(24.2)
No	125(75.8)
Do you smoke cigarettes?	
Yes	6(3.6)
No	159(96.4)
Do you drink alcohol?	
Yes	106(64.2)
No	71(35.8)
Body mass index in Kg/m^2	
<18.5	21(12.7)
18.5-25	125(75.8)
26-30	19(11.5)

Working environment related factors

The operation rooms had relatively good ventilation and the instruments were processed (decontaminate, clean, dry, pack and sterilize based on infection prevention standards.

Factors associated with surgical site infections

On bivariate logistic regression model, smoking, diabetes mellitus, anemia, wound care and location of surgical site were statistically associated with surgical site infections with p-value <0.25 at 95% confidence interval.

After bivariate analysis, only those variables which were significantly related (p-value <0.05) were entered for further multivariable analysis. By adjusting potential confounders, only smoking, diabetic mellitus, wound care and type of surgical procedure were significantly associated with surgical site infection. However, anemia were not significantly associated with surgical site infection in multivariable logistic regression analysis.

Multivariable logistic regression analysis with P (<0.05) showed that patients who smoke cigarettes were 6.3 times more likely to develop surgical site infections [AOR=6.3(19.3-21)] compared with patients who didn't smoke cigarette. Moreover, patients who had diabetic comorbidity were 16.7 times more likely to develop surgical site infections [AOR=16.7(4.3-65)] as compared with patients who had not diabetes mellitus. Similarly, patients who had extremity surgery were 1.2 times more likely to develop surgical site infections [AOR 1.2(3.1-7.4)] as compared with patients who had surgery on breast and face.

Furthermore, patients who didn't have appropriate wound care were 21 times more likely develop surgical site infections [AOR= 21(3-26.1] compared with patients who got wound care (Table 5).

Table 5 Factors associated with surgical site infection in selected East and West Gojjam zone hospitals, 2017

		Surgical Site Infection				
Variables	**Response**	**Yes**	**No**	**COR(95%CI)***	**AOR(95%CI) ****	**P value**
Smoking	Yes	16(38.1%)	11(8.9%)	6.3[2.6-15]	6.3[19.3-21]	**0.001**
	No	26(61.9%)	112(91.1%)	1	1	
Diabetic mellitus	Yes	17(40.5%)	10(8.1%)	7.6[3.1-18.7]	16.7[4.3-65]	**0.001**
	No	25(59.5%)	113(91.9%)	1	1	
Anemia	Yes	15(35.7%)	25(20.3%)	2.1[1-4.6]	1.5[0.5-4.3]	0.400
	No	27(64.3%)	98(79.7%)	1	1	
Wound care	No	1(2.4%)	33(26.8%)	15[1.98-113]	21[3- 26.1]	**0.030**
	Yes	41(97.6%)	90(73.2%)	1	1	
Location of surgery	Abdominal	21(50%)	89(72.4%)	1.2[0.9-4.5]	0.2[0.05-0.87]	0.421
	Head & neck	3(7.1%)	23(18.7%)	0.9[0.02-0.48]	0.03[0.008-0.45]	0.678
	Extremity	10(23.8%)	5(4.1%)	1.5[0.33-6.78]	1.2[3.1-7.4]	**0.020**
	Other	8(19.0%)	6(4.5%)	1	1	1

*COR, crude odds ratio; **AOR, adjusted odds ratio; CI, confidence interval

Discussion

The study showed that 25.5% of the patients had developed surgical site infection. This finding is relatively higher than a study in Hawassa university referral hospital, where 19.1% of patients develop surgical site infection and[11] a teaching hospital in Ujjain, India, where only 5% of patients develop surgical site infection.[15] However, it is much lower than a study done in Ayder teaching and referral hospital, Mekele, Ethiopia, where prevalence of post-operative wound infection was 75%.[12]

In this study, patients who smoke cigarettes were 6.3 times more likely to develop surgical site infections [AOR=6.3(19.3-21)] as compared with patients who didn't smoke cigarettes. This is analogues with a study done in Hawassa university referral hospital and Harvard medical college, where patients who abstain smoking had a significant reduction of incisional wound infections.[5,9] This might be due to the fact that smoking interferes with wound healing by causing constriction of peripheral blood vessels which again causes tissue hypovolemia and hypoxia.

Another factor that affects surgical site infection was diabetic comorbidity. Patients who had diabetic comorbidity were 16.7 times more likely to develop surgical site infection [AOR = 16.7(4.3-65)] as compared with those who had no diabetic mellitus. This is similar to a study done in Denver Health medical center, United States , where diabetic patients were 2.3 times more at risk to develop surgical site infections[2.3(1.0-4.9)] than non-diabetic ones.[16] This might be due to the fact that high blood sugar level in diabetic patients can act as a good medium for bacterial growth and multiplication.

Furthermore, patients who didn't got recommended wound care were 21 times more likely develop surgical site infection [AOR=21(3-26.1)] as compared with patients who got recommended wound care. Different guidelines that aim to prevent surgical site infections also suggest proper wound care to prevent surgical site infections.[17,18] Similarly, patients who had surgery at extremities were 1.2 times more likely develop surgical site infections [AOR= 1.2 (3.1-7.4)] as compared with patients who had breast and face surgery. This is in line with a study done in University of Alabama, Birmingham, where extremity surgical procedures had a higher incidence of surgical site infections as compared to surgical procedures on breast or face.[19]

Limitation of the study

The study might be subjected to response set bias from the respondent. Since it was cross-sectional study by design, it was difficult to know which occurred first, the exposure or outcome. Organisms were not identified from an aseptically-obtained specimen from the superficial incision or subcutaneous tissue by a culture or non-culture based microbiologic testing method.

Conclusion and recommendation

Magnitude of surgical site infection was relatively high as compared with other studies. The most important factors associated with surgical site infection were smoking, diabetic co-morbidity, location of surgery and wound care. Therefore, health care providers should give proper wound care, screen and manage comorbidities like diabetic and educate the impact of cigarettes smoking to patients.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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