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Prevalence of Surgical Site Infection and Associated Factors Among Patients Operated in General Surgery Department at Yekatit 12 Hospital Medical College, Addis Ababa, Ethiopia

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Abstract

Background: From healthcare associated infections surgical site infection is the most commonly encountered in problem surgically admitted patients which results undesirable outcome and treatment cost burden.

Aim of the study: The aim of the study was to determine magnitude of surgical site infection and associated factors in patients to whom surgery was done at Yekatit 12 Hospital Medical College.

Methodology: A longitudinal study design was used to conduct the study and all patients admitted to the surgical wards for which surgery was done in July and August 2022 was included. Binary logistic regression model was used to identify risk factors associated with surgical site infections and statistically significant associations were declared for p value less than 0.05 using adjusted odds ratio with 95% confidence interval.

Result: In the current study, 24 of 419 5.7% (95% CI: 3.7, 8.4%) patients developed surgical site infections out of which 3 of 419 (0.7%) died from surgical site infection complication. Surgical site infections were significantly associated with hospital stay (AOR: 35.3, 95% CI: 11.2, 112.8) ** and gastrointestinal surgeries (AOR: .299, 95% CI: .090, .999) *.

Conclusion: The magnitude of surgical site infection in this study was slightly higher than the accepted infection rate but by far low than other studies with comparable set ups.

Keywords: Surgical site infection; wound class; surgical wards

Abbreviations and acronyms

ASA = American Society of Anesthesiologists.
CDC = Centre for Disease Control and Prevention.
HAI = Healthcare-Associated Infections.
Hbg A1c = Hemoglobin A1c.
HURH = Hawassa University Referral Hospital.
SSI = Surgical Site Infection.
SRC = Surgical Referral Clinic.
SPMMC = Saint Paulo's Millennium Medical College.

Y12HMC = Yekatit 12 Hospital Medical College.

Introduction

Most hospital-acquired infections(HAIs) are avoidable infections that affect millions of people yearly worldwide where surgical site infections are the most frequently mentioned in most low and middle-income countries affecting about 30% of operated patients [1, 2]. Surgical site infections are usually defined as postoperative infections that happen within 30 days of surgical procedure or a year of surgery having implants [3-6] In developed countries incidence of SSIs are low compared to developing countries, and generally, SSIs are developed in about 2-5% of operated patients. In developing countries like Africa, about 2.5-30 % of HAIs are caused by SSIs [10, 11].

There are no single risk factors for SSIs rather they are multi-factorials and complex which can be classified into patient-related, procedure-related, environmental-related, and indication of surgery [12-15]. Trauma, blood transfusion, abdominal surgery, wound contamination, hypovolemia, longer duration of surgery, longer preoperative hospital stay, use of drain, previous surgery, on-table hair removal, advanced age, and multiple diagnoses at time discharge are the most frequently mentioned risk factors for SSIs [1, 16, 17].

SSIs are diagnosed when there is serious/ non-purulent discharge from the wound with signs of inflammation and/or wound deliberately opened the surgeon due to localized collection [18, 19]. Effectively reducing risks for SSIs enables optimal patient care by establishing basic principles like surgical hand preparations, skin antisepsis, adequate antibiotics prophylaxis, less invasive and shorter surgery duration, improved homeostasis, and avoidance of hypothermia. Despite improvements in operating room practices, instrument sterilization methods, better surgical techniques, and the best efforts of infection prevention strategies in developing countries surgical site infections remain a major cause of hospital-acquired infections [20-25].

Despite SSIs being the most common cause of HAI magnitude factors associated with them were not studied in Yekatit 12 Hospital Medical College and this study's results will used for a quality improvement plan.

Methods and Materials

Study area and period

The study conducted in Y12HMC in July and August 2022 which is located in Addis Ababa, Ethiopia administered under Addis Ababa health beauro under Addis Ababa City administration and currently providing patient care and training services for medical students, residents and other health post graduates in collaboration with higher education institutions in Ethiopia.

Study design

A health facility-based longitudinal study design was used to assess magnitude and associated factors of SSIs among patients operated in Y12HMC.

Source Population and study population

All patients whom surgical procedures done in July and August, 2022 at Y12HMC were included in the study.

Inclusion and exclusion criteria

Patients operated for emergency and elective procedure in the specified period were included in the study whereas patients operated with dirty wounds and patients who had undergone an operation with another institution come for a follow-up were excluded.

Study variables

Surgical site infection was the dependent variables whereas Socio-demographic characteristics of patients, Surgery related factors, Co-morbidities and wound related factors, Anesthesia and medication related factor were taken as independent variables.

Data collection technique and quality control

Data were gathered using data extraction checklist from the electronic medical records and these checklists were designed though literature review and pretest was done on 20 patients. Data collectors were trained junior surgery residents on the data collection tool and how to conduct data collection. The principal investigator had supervised the data collection process and checked completeness and consistency of data on weekly basis.

Data analysis and presentation

SPSS statistical software version 25 was used to enter and analyze data. Descriptive statistics such as frequency, percentage, mean, standard deviation (SD), or median were used for most of the variables and results were presented using tables, graphs and narrative descriptions. We included predictors to the multivariable binary logistic regression model from the literature regardless of their bivariate p-value to identify factors associated with surgical site infections. Statistically significant association was declared on the basis of adjusted odds ratio (AOR) with 95% confidence interval (CI) and p-values < 0.05. Model fitness was check using Hosmer and Lemeshow goodness-of-fit test4.11 Ethical consideration.

Results

Socio-demographic characteristics

During the study period, 427 patients underwent both emergency and elective surgeries. Of these patients 8 were excluded from the study due to incomplete data and failure to meet the inclusion criteria and only 419 patients were enrolled in the study. From a total of 419 patients, 228(54.4%) were male. The mean (±SD) age of the patients was 40.78(±14.63) years and 67 (59.4%) were older than 35 years. About 386(92.1%) were urban residents and 92(21.9%) of the patients were illiterate. One hundred and forty-nine (35%) of the patients were self-employed. One hundred and eighty-three (43.7%) had a history of hospitalization. Three hundred and forty-one (81.7%) of patients had less than 7 days' hospital stay and the mean (±SD) hospital stay was 5.04 (±3.89) (Table 1).

Variables	*Frequency*	*Percent*
Age		
19-35	170	40.6
>35	249	59.6
Sex		
Male	228	54.4
Female	191	45.6
Education status		
Uneducated	92	21.9
Elementary	114	27.2
High school	111	26.2
Postsecondary education	102	24.3
Occupation		
Unemployed	81	19.3
Farmer	55	13.1
Government employee	134	32
Self-employed	149	35.6
Residence		

Urban	386	92.1
Rural	33	7.9
History of hospitalization		
Yes	183	43.7
No	236	56.3
Hospital stays		
=<7 days	341	81.7
>7 days	78	18.7

Table 1: Socio-demographic characteristics of study participant (n = 419) at Y12HMC, Addis Ababa, Ethiopia, July and August 2022.

Surgery related factors

About 261(62.3%) of the participants underwent elective surgery and 125(29.8%) of enrolled patients had a history of previous surgery. Gastrointestinal surgery was conducted among 169(40.3%) of the patients. The mean (±SD) duration of surgery was 2.00(±1.23) hours. About 314 (75%) of patients had blood loss of less than 100ml during the surgery. Fifty-eight (13.8%) of the patients had an implant inserted at the site of operation for drainage purposes. One hundred and sixty-nine (40.3%) of the surgeries were done by senior physicians. The vast majority, 385 (91.9%) of the surgeries were operated with General anesthesia, and 372 (88.8%) of the patients taking prophylaxis (Table 2).

Variables		***Frequency***	***Percent***
Type of surgery	Elective	261	62.3
	Emergency	158	37.7
History of surgery	Yes	125	29.8
	No	294	70.2
Site of operation	Head and neck	64	15.3
	Non-gastrointestinal	235	56.1
	Gastrointestinal	184	43.9
Duration of surgery	<=1 hour	99	23.6
	>1 hour	185	76.4
Amount of blood loss	=<100 ml	314	75
	>100 ml	105	25
Implant	Yes	58	13.8
	No	361	86.2
Academic rank	Resident	419	59.7
	Senior	169	40.3
Type of anesthesia given	SA	34	8.1
	GA	385	91.9
Antibiotic prophylaxis given	Yes	372	88.8
	No	47	9.2

Table 2: Surgery related factors of the study participants (n = 419) at Y12HMC, Addis Ababa, Ethiopia, July and August 2022.

Comorbidities and wound-related factors

Among the enrolled patients, 72 (17.2%) had comorbidities, out of which, 35(8.4%) were hypertensive and 23(5.5%) were cardiac 7(1.7%). The majority, 396(94.5%) of the patients received wound care, out of which 179(42.7%) of the patients had class all wounds. The majority, 386 (91.9%) of study patients received general anesthesia and antibiotic prophylaxis was given for 372(88.8%) of the study patients. Moreover, 24 (5.7%) of the patients were smokers and 78 (18.6%) of the patients were malnourished. Thirty-five (8.4%) of the patients were immunocompromised (Table 3).

Variables		***Frequency***	***Percent***
Presence of comorbidities	Yes	73	17.4
	No	346	82
Types of comorbidity	HTN	345	8.4
	RVI	8	1.9
	Cardiac	7	1.7
	Others	23	5.5
Wound care given as ordered	Yes	396	94.5
	No	23	5.5
Wound class	Class l	89	21.2
	Class ll	205	48.9
	Class lll	125	29.8
Smoking	Yes	24	5.7
	No	395	94.3
Malnutrition	Yes	78	18.6
	No	341	81.4
Immunocompromization	Yes	35	8.4
	No	384	91.6

Table 3: Comorbidities and wound related factors pf the study patients (n=419) at Y12HMC, Addis Ababa, Ethiopia, July and August 2022.

The magnitude of surgical site infections and outcomes

In our study conducted 24 of 419 patients had surgical site infections. The prevalence of surgical site infections in this study was found to be 5.7% (95% CI: 3.7, 8.4%). Of the patients who developed SSIs about 91.7% had superficial SSI, 37,5%, 37.5 % had ARF,29.2 had sepsis and 20.8 % had wound dehiscence. Of 24 patients who had surgical site infection, 6 had comorbidity and 5 of the patients with SSIs died (Table 4).

Variables	***Frequency***	***Percent***
Surgical site infections		
Yes	24	5.7
No	395	94.3
SSI with complications (n = 24)		
Superficial SSI	22	91.7
Wound dehiscence	5	20.8

Sepsis	7	29.2
Intra-abdominal abscess	5	20.8
ARF	9	37.5
Respiratory infection	6	25
Generalized peritonitis	6	25
Outcomes		
Improved	19	79.2
Died	5	20.8

Table 4: Magnitude of surgical site infection and outcome of the patients (n=419) at Y12HMC, Addis Ababa, Ethiopia, July and August 2022.

Variable		***SSI***		***COR with 95%CI***	***AOR with 95%CI***
		Yes	***No***		
Age	≤35	9	161	1	1
	>35	15	234	1.147(.490,2.684)	.706(.208,2.399)
Sex	M	14	214	1	1
	F	10	18119	.845(.366,1.947)	.926(.273,3.134)
Co morbid illness	Yes	4	69	1	1
	No	20	326	.947(.313,2.851)	1.098(.209,5.772)
History of hospitalization	Yes	11	172	1	1
	No	13	223	1.097(.480,2.509)	.566(.150,2.132)
Duration of hospital stay	<= 7 day	5	353	1	1
	>7 days	19	42	**31.938(11.337,89.978)**	**35.295(11.041,112.830)**
Preoperative stay	<= 7 day	19	341	1	1
	>7 days	5	54	.937(.835,1.052)	3.123(.386,25.275)
Smoking history	Yes	2	22	1	1
	No	22	373	1.541(.340,6.977)	.629(.047,8.380)
Malnutrition	Yes	5	75	1	1
	No	19	320	1,123(.406,3.104)	1.245(.280,5.541)
Immunocomprization	Yes	2	33	1	1
	No	22	362	1.003(.226,4.453)	4.174(.217,80.150)
Surgery type	Emergency	11	147	1	1
	Elective	13	248	.701(.306,1.604)	.463(.155,1.380)
Surgery site	GI	14	170	1	1
	Other	10	225	**.701(.306,1.694)**	**.299(.090,.999)**
Duration of procedure	=<1 hour	5	117	1	1
	>1 hour	19	278	1.599(.583,4.385)	1.555(.425,5.685)
Amount of blood lose	=<100	18	298	1	1
	>100	6	97	1.024(.395,2.653)	1.199(.360,3.996)
Implant inserted	Yes	5	54	1	1
	No	19	341	.602(.214,1.679)	.763(.116,5.035)

Academic rank	Resident	9	128	1	1
	Senior	15	267	.799(.341,1.875)	.941(.297,2.975)
Wound care Bid	Yes	22	374	1	1
	No	2	21	1.619(.357,7.349)	1.406(.144,13.733)
Wound type	Clean	9	232	1	1
	Non-clean	15	163	2.372(1.014,5.552)	3.196(.971,10.513)
Prophylaxis	Yes	22	350	1	1
	No	2	45	,707(.161,3.107)	.427(.042,4.348)

Table 5: Risk factors associated with SSIs among operated patients at Y12 HMC from July 1/2022-August/2022.G.C.

Factors associated with surgical site infections

All predictor variables age, sex, Comorbidity, history of hospitalization, duration of hospital stays, preoperative stay, smoking, malnutrition, immunocompromised, surgery type (elective or emergency), surgery site, duration of the procedure, blood loss amount, the implant inserted, academic rank (senior or resident), presence of wound care, type of wound and presence of prophylaxis were candidate for multivariate binary regression model regardless of univariate regressions outcomes. From the multivariate regression analysis, prolonged hospital stays for more than 7 days showed risk for SSIs by 35 times compared with short hospital stays with AOR=35.3(95% CI (11.04,112.83) ** and non-gastrointestinal surgeries had 70% lower risk to surgical site infection rate compared with gastrointestinal surgeries with AOR:0.03,95% CI:0.09,0.99) *.

Discussion

Surgical site infections (SSIs) are healthcare-associated infections that are a significant source of preventable morbidity and mortality reported as the third most frequently reported nosocomial infection. They may extend from the skin and superficial subcutaneous tissues of incision sites to deep subcutaneous tissues and organ spaces. They occur usually due to poor infection prevention practices among healthcare facilities in low and middle-income countries, and incidence is higher than in high-income countries [13, 26-28].

In this study, the overall prevalence of surgical site infections was found to be 5.7%(95% CI:3.7,8.4) and this study finding is consistent with studies conducted in China(5.2%) [29], Qatar (5%) [30], India (6%) [31] and Brazil (3.4%) [1], however it is lower than those studies conducted at Suhil(11.1%) [32], Asela hospital(9.4%) [33], Feleghiwot hospitals (9.4%) [34], Public hospital in Tanzania(12%) [14], Hawassa hospital(19.1%) [35] and India (21.66%) [36].

A patient's risk of acquiring an SSI is influenced by a broad range of factors so besides procedure-related risk factors, patient-related risk factors have been recognized. Sex is a patient-related risk factor and various analyses to determine risk factors showed being male has higher risk factors. Sex as a risk factor plays an important role when estimating the probability of disease and complication across all fields of medicine and many studies demonstrated that SSIs occur more in men than in women [37-40]. There are some sex hormone roles in the process of healing wounds and males were shown delayed wound healing compared to females and this is due to female estrogens having a beneficial effect on wound healing. Estrogen controls regeneration, inflammation, matrix manufacturing, protease inhibition, and epidermal function-related genes. So women have fewer incidences of SSI as compared to males [41]. However, when comparing SSI rates in men and women for certain types of heart surgeries it is found SSI occurs more frequently in female patients than male patients [42, 43]. In our study, it was found that a higher proportion of SSI among male patients.

SSIs account for 11% of all nosocomial infections in patients above 65 years. Unlike the general population, only a few studies have addressed risk factors for SSI in the elderly population. SSIs account for 11% of all nosocomial infections in patients above 65 years. Elderly patients with SSI have worse outcomes than young patients which could related to diminished host but the association between age and SSI is complex and appears that patients who are aged ≥65 years have a decreased risk for SSI. Although some unique risk

factors for SSI have been identified among patients additional research that addresses risk factors and modalities for SSI prevention is needed [44-48]. In our study it was also observed that SSI commonly occurred in much older age groups where 59.4% of patients are older than 35 years and it is in conformity with studies done by SPHMMC [49], Bahirdar public Hospitals [34] and Nigeria [50] with a median age of 34, 33and 32.4 years respectively. As mentioned in the literature review mentioned above the reason may be old age groups are immunocompromised which makes them more vulnerable to surgical site infection as compared to younger age groups.

In our study, more than 7 days of stay in the hospital increased surgical site infection by 35 times. This finding had similarities and was supported by other studies in Bahirdar [34], SPMMC [49], Nigeria [51], and India [52]. This could be due to the fact prolonged hospital stays result in patients being exposed to hospital-associated infections.

The risk of SS increases as the wound class moves from clean to contaminated/dirty wound. Contaminated wound increases the risk of bacterial invasion of the incision site from endogenous flora while clean wounds are mostly infected by the skin flora [53]. In the present study patients who had non-gastrointestinal surgeries had a 70% lower risk of surgical site infection rate compared with gastrointestinal surgeries and this finding is consistent with other studies from India, and Sudan [54, 55]. The reason could be that to majority of gastrointestinal surgeries are clean-contaminated and in emergency cases, contamination could occur due to a breach of normal gastrointestinal floras.

Conclusion and recommendation

The prevalence of surgical site infection in this study is 5.7% with 95% CI (3.7, 8.4) and found to be higher than the accepted rate (2-4%), and for this study, duration of hospital stay and wound site were found statistically associated with surgical site infection. The above study findings need further surveillance and need to have communication with the health care providers who have direct involvement in the care of those patients undergoing surgeries to have a common understanding of how to decrease the infection rate based on evidence-based care. It is also recommended the hospital infection prevention protocol be well implemented having regular wound surveillance program to reduce the surgical wound infection rate to an acceptable standard.

Ethical approval and patient consent

Ethical clearance was obtained from the Institutional Review Board of Addis Ababa Medical and Business College (Reference number: AAMBC/STU/11,497). Verbal consent was obtained from patients. The information gained from the patient cards and the patients or attendants upon data collection were kept confidential by using codes for each card throughout the study. The procedures followed were by the ethical standards of the Helsinki Declaration.

Informed Consent

We obtained documented and witnessed informed written and verbal consent for publication from the administration bodies otherwise informed consent from the subjects was not required.

Competing interest

No conflict of interest.

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