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Original article

A Cross Sectional Study on the Incidence and Risk Factors for Abdominal Surgical Site Infections: At Halibet National Referral Hospital, Asmara, Eritrea

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ABSTRACT

Introduction: Abdominal Surgical Site Infections (ASSIs) are infections that occur commonly within 30 days after an operation and related to the operation in general surgery. **Methods and Materials:** A cross-sectional study was conducted to assess the incidence and risk factors of ASSI: at Halibet National Referral Hospital (HNRH), Asmara, Eritrea. The study included all patients (140) who underwent abdominal surgery from September 4 to December 23, 2017. **Results:** The study results revealed an overall incidence of 5 percent; 71.4 percent as superficial and 28.6 percent as deep. ASSI was observed in patients with prostatectomy (42.8%), appendectomy (28.6%), cholecystectomy (14.3%) and colonic surgery (14.3%); being more prevalent in males (61.4%). Preoperative hospital stay was also observed to be longer (6.86 days) in patients with ASSI. The study results indicated a significant association with preoperative hospital stay (p – value = 0.026), type of surgery (p-value = 0.039) and duration of operation (p-value = 0.01). Out of the seven samples with ASSI, five (71.4%) were found with culture growth of *S.aureus*, *E.coli* and *Klebsella spp*. that were mainly resistant to ampicillin, cephalexin, ceftazidime but sensitive to chloramphenicol and nitofurantoin. **Conclusion:** ASSI at HNRH was found to be low as compared to other hospitals. Therefore, the study recommends decreased preoperative hospital stay and the use of sensitive antibiotics, in order to reduce the rate of infection to a lower level than the existing prevalence.

KEYWORDS: Abdominal Surgical Site Infections, Incidence, Risk Factors

INTRODUCTION

In Eritrea there are five Zonal Referral Hospitals and two National Referral Hospitals. These two National Referral Hospitals are Orotta National Referral and Teaching Hospital and Halibet National Referral Hospital that are found at the central zone in the Capital City, Asmara [1]. Surgical Site Infection (SSIs) is an infection that generally occur within 30 days after an operation or 90 days if an implant is left in place and the infection appears to be related to the operation in general surgery [2].

Surgical site infections are classified in to three; i) superficial incision SSI that occur within 30 days after any National Health Care Safety Network (NHSN) operative procedure, involves only skin and subcutaneous tissue of the incision. ii) Deep incisional SSI that occur within 30 or 90 days after the NHSN operative procedure and involves deep soft tissues of the incision (e.g., facial and muscle layers) and iii) Organ or space SSI that occur within 30 or 90 days after the NHSN operative procedure and involves any part of the body deeper than the facial or muscle layers that is opened or manipulated during the operative procedure [2].

In comparison to other surgeries that are conducted at different sites of the body open abdominal surgery has higher risk of developing infections. If any complication happens due to any type of surgery, it usually increases the cost of care, leading to an increase in patient's hospital days of stay, frequency of surgery and re-admission, expenses on wound dressing materials in general health care services related to human and material resources, besides the harms

that be felt by the patient and his family that include morbidity, disability and mortality rate increase.

Surgical site infections are the second common diseases of healthcare-associated infection next to urinary tract infections (UTI). The incidence of SSI becomes high when surgical procedures are conducted in gastrointestinal tract area and infections occur as a result of the presence of intra-luminal bacteria. Therefore, Abdominal Surgical Site Infections (ASSI) is one of the most common post-operative complications. There are studies that documented an association of SSI development, and aging, increased Body Mass Index (BMI), chronic diseases (high blood pressure, kidney or liver failure, malignancy, febrile illness, cardiac disorder etc…), tobacco use, malnutrition and immunological disorder, elective surgery, different wound classification, showering, poor antibiotic use as prophylactic, preoperative shaving, site and duration of operation, type operational procedure, operative techniques and wound closure [3-7].

SSI was found to be 14.33 percent prevalent in elderly male patients and Staphylococcus aurous (37.83%) was reported as the most common microorganism, the rate of SSI incidence increases with an increased pre-operative hospital stay and it is more common in emergency operations than elective surgery [8]. The risk of SSI was observed to increase in patients who underwent shaving (2.3%) in pre-operative days as compared to those who are not shaved (1.7%) [3, 4]. Therefore the aim of our study was to determine the incidence and associated risk factors causing abdominal surgical site infections in General Surgical Department at Halibet National Referral Hospital, Asmara Eritrea.

MATERIALS AND METHODS

Study design and setting

A cross-sectional study was conducted at Halibet National Referral Hospital, department of general surgery, Asmara Eritrea.

Study participants and study period

The study included all patients (140) who underwent abdominal surgery from September 4 to December 23, 2017, and the target population was patients who underwent for an abdominal operation as an elective and emergency surgery within the specified time period at Halibet National Referral Hospitals, Asmara, Eritrea.

Data collection procedure

A semi-structured questionnaire was used for making an observational checklist to be filled by surgeons and attending physicians. Patients who underwent abdominal surgery were observed and followed for 30 days post operatively, and for those patients with an infection samples were collected from the infected abdominal wound and send to the laboratory for culture and sensitivity test pattern.

Data processing and analysis

The data was checked for its completeness and entered in to excel, and then it was exported to SPSS version 20 for data analysis by using chi-square test at significance level of $p < 0.05$.

Ethical consideration

The study was obtained permission from ethical and research committee of MOH, and Medical director of Halibet National Referral Hospital. During the study period assurance of confidentiality and informed consent of the study participants was also carried.

RESULTS

A total of 140 patients who underwent abdominal surgery at Halibet National Referral Hospital (HNRH) from September 4 to December 23, 2017, majority were males (61.4%) and 71.1 percent of the patients were above 40 years of age (Table 1). The mean age of the patients was 53.66 years. Sixty-six percent of the patients were within the normal range of Body Mass Index (BMI) and there were only 8 (5.7%) who were actively smoking. The wound types were classified as clean (30%), clean-contaminated (59.3%) and contaminated (10.7%) (table 1).

Pre-operative shaving was not commonly practiced by most of the patients and only 18.6 percent were shaved before operation, the remaining 81.4 percent underwent different types of abdominal surgical procedures without being shaved. Sixty five percent of patients took shower before doing an operation. The types of surgical procedures done were elective and emergency having a percentage of 87.9 and 12.1, respectively. Majority (59.3%) of the patients took an antibiotic as prophylactics and drainage was used in 27.9 percent of the patients who underwent surgery (Table 1).

Table 1: Socio-Demographic characteristics and risk factors of ASSI and types of operations

Variable	Frequency (N)	Percent (%)
Sex		
Male	86	61.4
Female	54	38.6
Age		
< 20	4	2.9
20-39	28	20.0
40-59	49	35.0
≥ 60	59	42.1
Body Mass Index (BMI)		
≤ 18.5	25	17.9
18.5-24.99	93	66.4
25-29.99	21	15.0
≥ 30	1	0.7
Current Smokers		

Yes	8	5.7
No	132	94.3
Type of Wound		
Clean	42	30.0
Clean Contaminated	83	59.3
Contaminated Wound	15	10.7
Pre-operative Shaving		
Yes	26	18.6
No	114	81.4
Preoperative Showering		
Yes	49	35.0
No	91	65.0
Type of Surgery		
Elective	123	87.9
Emergency	17	12.1
Preoperative Antibiotic		
Yes	83	59.3
No	57	40.7
Time of Antibiotic Given		
≤ 60 Minutes	75	90.4
60 Minutes to 120 Minutes	6	7.2
≥ 120 Minutes	2	2.4
Drainage Use		
Yes	39	27.9
No	101	72.1

The common surgical operations that were done during the study period included herniorraphy (27.1%), cholecystectomy (26.4%), prostatectomy (14.3%), appendectomy (9.3%), testicular surgery (8.6%), colonic surgery (7.1%) and others (7.1%). Signs and symptoms of infection that were observed at the surgical site were fever (1.4%), purulent discharge (5%), pain (5.7%), swelling and redness at the surgical site (4.3%) (table 2).

Table 2: Types of operations procedures and post-operative sign and symptom of infection

Variable	Frequency (N)	Percent (%)
Type of Surgical Procedures		
Herniorraphy	38	27.1
Cholecystectomy	37	26.4
Prostatectomy	20	14.3
Appendectomy	13	9.3
Testicular surgery	12	8.6
Colonic surgery	10	7.1
*Others	10	7.1
Fever		
Yes	2	1.4
No	138	98.6
Purulent Discharge At Surgical Site		
Yes	7	5.0
No	133	95.0
Pain At Surgical Site		
Yes	8	5.7
No	132	94.3
Swelling Surgical Site		
Yes	6	4.3
No	134	95.7
Redness At Surgical Site		
Yes	7	5.0
No	133	95.0

* Others include Gastric and duodenal surgery (n=4), cystolithotomy (n=4), Extended Cholecystectomy with Hepatico-Jejunostomy (n=2)

Table 3: Association between ASSI and different risk factor

Variable	Frequency (N)	Percent (%)	p - value
Sex			
Male	6	85.7	0.249
Female	1	14.3	
Age			
< 20	1	14.3	
20-39	1	14.3	*0.056*
40-59	0	0.0	
≥ 60	5	71.4	
Body Mass Index (BMI)			
≤ 18.5	1	14.3	0.654
18.5-24.99	6	85.7	
Type of Surgery			
Elective	4	57.2	***0.039***
Emergency	3	42.8	
Type of Wound			
Clean Contaminated	5	71.4	0.101
Contaminated Wound	2	28.6	
Drainage Use			
Yes	4	57.2	0.094
No	3	42.8	
Operation Duration			
<1.5 hours	3	42.8	***0.010***
1.5 - 3 hours	4	57.2	

The study results showed a significant association between type of surgery and ASSI development at a p-value = 0.039. The length of operational procedures of different types of surgeries and the occurrence of ASSI was found to have a significant association (p-value 0.010); whereas a positive correlation between age and ASSI was observed, even though a weak association existed (p-value= 0.056). The study results revealed no association between ASSI and Sex, BMI, the type of wound and drainage use (table 3).

Table 4: Association of SSI development and duration of hospital stay

Variable	Frequency (N)	Duration of Stay In Days	p - value
Preoperative Hospital Stay			
Patients with SSI	7	6.86 days	***0.026***
Patients without SSI	133	2.90 days	
Total Hospital Stay			
Patients with SSI	7	11.00 days	0.440
Patients without SSI	133	8.75 days	

Preoperative and total hospital stay were observed to be longer with mean 6.86 and 11 days in those patients who developed ASSI, respectively. However, those patients without ASSI were found to have a mean length of stay 2.9 and 8.75 days. A significant association was found between ASSI and preoperative hospital stay at p-value = 0.026, whereas no association was found with the total hospital stay (Table 4).

Out of the 140 patients who have done abdominal surgery, seven (5%) developed ASSI. Out of the identified 71 percent were superficial and the remaining 29 percent deep surgical site infections. Based on to the type of surgery ASSI incidence was found as prostatectomy (42.8%), appendectomy (28.6%), cholecystectomy (14.3%) and colonic surgery (14.3%) (table 5).

Out of the seven samples of the patients who developed ASSI, five (71.4%) were found to have a positive culture growth, whereas two (29.6%) of the patients didn't show any growth. In the samples with growth *S.Aures, E.Coli* and *Klebsella spp.* were found with each 33.3 percent (Table 5).

Those microorganisms that were identified in the culture and sensitivity test were found to be resistant to ampicillin, cephalexin and ceftazidime but sensitivity to chloramphenicol and nitrofurantoin.

Table 5: Types of ASSI, culture growth and type of isolate

Variable	Frequency (N)	Percent (%)
Types of ASSI		
Superficial	5	71.4
Deep	2	28.6
Types of ASSI by Operative Procedures		
Prostatectomy	3	42.8
Appendectomy	2	28.6
Cholecystectomy	1	14.3
Colonic surgery	1	14.3
Culture Growth		
Positive	5	71.4
Negative	2	28.6
Type of Isolate		
S. aureus	2	33.3
E.coli	2	33.3
Klebsiella spp.	2	33.3

DISCUSSION

This cross sectional study included 140 patients who underwent abdominal surgery at Halibet National Referral Hospital (HNRH) from September 4 to December 23, 2017. Majority of the study participants were males (61.4%) and 71.1 percent were above 40 years of age; with a mean age of 53.66 years.

The study findings indicated that, most (66%) of the patients had a normal range of Body Mass Index (BMI). Pre-operative shaving before an abdominal surgical procedure was uncommonly practiced by most of the patients, with only 18.6 percent shaved. There was a practice of showering prior to pre-operative day in about 65 percent of the patients. Elective surgery was observed to be higher (87.9%) than emergency surgery. Preoperative antibiotic use as a prophylactic medication was being practiced in 59.3 percent of the patients. This was recorded with an injection period of less than 60 minutes preoperatively (90.4%), between 60 to 120 minutes (7.2%) and in greater than 120 minutes (2.4%).

The types of wound were classified as clean (30%), clean contaminated (59.3%) and contaminated (10.7%). Different types of surgical operations were done in the study period. These types of operations include; herniorraphy (27.1%), cholecystectomy (26.4%), prostatectomy (14.3%), appendectomy (9.3%), testicular surgery (8.6%), colonic surgery (7.1%) and others (Gastric & duodenal surgery, cystolithotomy , extended cholecystectomy with hepatico-jejunostomy, gastro-duodenal surgery, cystolithotomy& extended cholecystectomy with hepatico-jejunostomy). Drainage was used in 27.9 percent of the overall surgical operations.

The study findings showed a positive correlation between age and Abdominal Surgical Site Infection (ASSI), even though a weak association was observed (p value= 0.056); But no any association observed between ASSI and sex, BMI, as well as the type of wound and drainage used. These results are supported by another study that was conducted in Iran (2005), that documented an incidence of SSI were not significantly correlated with BMI, Sex and preoperative shower [5].

The results of this study have similarity with a study that was conducted in Dehradun, India (2009), that reported an incidence of superficial incisional surgical site infections, with a proportional increase between infection rate and age [12].

The study results showed an overall infection rate of 5 percent. Based on the classification of the wound the individual distribution of ASSI was, clean (0%), clean contaminated (71.4%) and contaminated wound (28.6%). The ASSI rate of this study (5%) was lower as compared to other studies that were conducted in Iran (2005), MEERUT (2013), India (2009) and (2013), and in Eritrea for Post Caesarian Site Wound Infection (PCSWI) (2016), that documented a higher prevalence of 17.4, 11.7, 12, 14.33 and 6.8 percent, respectively [5, 6, 8, 11 and 13].

A study on Incidence of Surgical Site Infections (SSIs) among Patients Undergoing Major Surgery at General Hospital Funtua, Katsina State, Nigeria documented a higher result (22.05 %) than our study 28 [14]. Out of the total patients who have done open surgery, three have developed ASSI for prostatectomy (42.8%), two for appendectomy (28.6%), and one each for cholecystectomy (14.3%) and colonic surgery (14.3%). In our study five patients (71.4%) with superficial infections and two patients (28.6%) with deep incisional infections were indentified and this has similarity to a study that was conducted in MEERUT in 2013 that documented high prevalence of SSI as superficial in sixty patients rather than deep in thirty-three patients [6].

Patient who develop ASSI had a longer pre-operative hospital stay, indicating that a mean length of 6.68 days, showing a significant association (p-value = 0.026). This result showed that there was an association between pre-operative hospital stay and ASSI. Therefore the study results revealed that longer pre-operative hospital stay as a risk factor to ASSI, mainly in elective surgery. Hence, the study results discovered a significant association between type of surgery and ASSI. The total hospital stay in patients with ASSI was 11 days which was higher by 2.25 days as compared to those without ASSI.

Therefore, it can be argued that unnecessary medical care cost and healthcare service expenses increase will be an economic burden to the family, society and health care delivery system. A study that was conducted in MEERUT,

by Maheshwari, Sanjay, Krishna and Abhinav (2013), reported a similar increase in an average hospital stay that resulted to an increase of expense for health care cost [6].This results can be supported by other study of Iran (2005), that documented a significant association between ASSI incidence and duration of pre-operative bed stay and electivity of surgery [5].

The study results confirmed an increase of ASSI incidence, with an increased duration of operation. Our study showed a significant association between the duration of operation and ASSI incidence (p value = 0.010); Similar study that was conducted in Bangladesh also revealed the same results with respect to the increase of duration of operation and increase in percentage of SSI having a significant association at p-value < 0.001[15]. A study that was conducted in Dehradun, India (2009), the incidence of superficial incisional surgical site infection was found to be higher. The incidence was 24.3 percent in surgeries that were lasting more than 2 hours [12].

Culture and sensitivity test was done for samples that were taken from patients who developed ASSI. The results of the seven samples were with a growth appearance of 71.4 percent (n=5) and no growth in 29.6 percent (n=2). The five samples with growth were identified to have a positive growth of *Staphylococcus aureus*, *E.Coli* and *Klebsella spp.* 33.3 percent, each. This study showed a resistance of *Staphylococcus aureus,* to penicillin, oxacillin, ampicillin, cephalexin, ceftazidime, ciprofloxacin, and erythromycin; which are similar to a study that was conducted in India (2009), that revealed a prevalence of 33 percent for *Staphylococcus aureus*being resistant to penicillin (91%), and oxacillin (42%) [13]. Another prospective study on SSI among postoperative patients at tertiary care centre, in Central India, also identified similar microorganisms, *Staphylococcus aureus*(37.83%), *Escherichia coli* (24.32%), *Klebsiella spp.* (10.81%), as causative agents for ASSI [8].

The study results of culture and sensitivity test showed a resistance to ampicillin, cephalexin, ceftazidime but sensitive to chloramphenicol and nitofurantoin. A retrospective study that was conducted in Eritrea (2016), documented a general antimicrobial resistance to, ampicillin, cephalexin, ceftazidime, nitrofurantoin, co-trimoxazole, nalidixic acid and tetracycline but sensitivity to chloramphenicol, amikacin, ciprofloxacin, ceftriaxone and gentamycin [16].

CONCLUSION

In conclusion, this four month cross- sectional study on Abdominal Surgical Site Infections at Halibet National Referral Hospital showed an overall incidence rate of 5 percent. The incidence rate was very low as compared to other studies that were done in other high income developed countries. There is a chance of reducing the ASSI rate to the lowest level if a better job is done on decreasing the preoperative hospital stay and use of sensitive antibiotic is promoted because of antibiotic resistance. The study result recommend, shortening of pre-operative hospital stay for the patients who are appointed for surgical procedure, use of sensitive antibiotics, regular and periodic culture and sensitivity test as microorganisms are getting resistant to antimicrobial antibiotics.

Authors' Conflict of Interest:

The authors declare that they have no competing interest.

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