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Risk Factors of Surgical Site Infection at Muhimbili National Hospital, Dar es Salaam, Tanzania.

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Background: ***Surgical site infection (SSI) is a common source of morbidity among operated patients. At Muhimbili National Hospital (MNH), studies indicate that the rate of SSI has been increasing over the past thirty years. The aim of this study was to determine the prevalence and factors associated with SSI among patients undergoing surgery at MNH.***
Methods: ***This was a hospital-based cross-sectional study. One hundred and eighteen patients who underwent surgical procedures in the surgical wards were recruited. Demographic information was obtained using standardised questionnaire, surgical sites were examined to determine infections, and case notes were reviewed for clinical information including surgical notes. Blood sample was collected for HIV serology.***
Results: ***SSI occurred in 42 patients (35.6%). Wound class, abdominal surgeries, emergency procedures and HIV infection increased the risk of SSI. Superficial SSI was the most commonly observed type, 54.8%. Overall HIV prevalence in this study was 16.9% with a 5 times risk of developing SSI.***
Conclusions: ***Surgical site infection has remained a major Nosocomial infection in developing countries. Factors shown to be associated with increased risk are wound class, site and nature of surgery, and HIV infection. This study found higher prevalence of HIV infection among surgical patients.***

Introduction

Surgical Site Infection (SSI) is very common, being the second most common cause of adverse events in hospitalized patients worldwide[1]. Surgical Site Infection can be classified into incisional (superficial and deep) or organ/space occupying infections. Superficial SSI is frequently diagnosed at the Out Patient Department, OPD, and does not require re-hospitalization, however invasive SSI's are serious requiring re-hospitalization. SSIs result in increased mortality, readmission rate, length of hospital stay and cost for patients and families, and hospitals in terms of bed occupancy.
Studies have shown that wound infection was significantly increasing with level of wound class, emergency interventions, NINSS risk score, pre-operative hospital stay, and use of drains[2,3,4]. In spite of all efforts put in place to prevent the occurrence of SSI, certain levels have been considered as acceptable by the level of primary wound contamination. In Tanzania, several recent studies done had shown an upward trend in the occurrence of SSI; at Ifakara, Kehr and colleagues[5] in 2006 found a SSI prevalence of 21.6% of which 43% were superficial, 45% were deep and only 12% were organ or space infections: 1% of these patients died as a result of their infections. All these patients had received a peri-operative anti-biotic course. Another study done at KCMC by Eriksen and colleagues[6] found SSI rate of 19.4%. Of these, 36.4% were diagnosed post-discharge. The risk factors for SSI development in this study were wound class, duration of operation and length of pre-operative hospital stay. The efficacy and sensitivity of anti-biotics used was the greatest concern in these two studies. The HIV status in these patients was not documented.

At Muhimbili National Hospital in Tanzania, wound infection rate has been on the increase over time. Shija[7] in his 1973 dissertation found a prevalence of 6%. This had doubled recently, whereby Wayi[8] in 2000 while working on clean wounds found a prevalence of 12.3%. A year later Ussiri et al[9] working on clean-contaminated and contaminated wounds found a SSI prevalence rate of 15.6%. The last two studies were carried out at a time when HIV was already highly endemic in this society. The actual cause of this rise in SSI has not been studied here, and there is no surveillance scheme in place to control these infections.

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Human Immunodeficiency Virus (HIV) infection in surgical patients has been shown to be higher than in the general population[10,11,12, 13] While some studies have shown a significant association between HIV infection and the occurrence of SSI [14,15], others have failed to show such and association[16, 17]. We postulate that this increase in SSI rate may in part be due to HIV infection given the high prevalence of the disease in our locality and being almost the only factor that might have changed over the same time period.

Patients and Methods

This was a cross-sectional hospital based study carried out from March to October 2010 in which 118 participants who underwent both elective and emergency surgical procedures at Muhimbili National Hospital were recruited. All participants gave written consent to the study protocol which was approved by MUHAS Ethical Committee. Subjects were recruited 24 hours after undergoing a surgical procedure. A standardized questionnaire was used to obtain demographic information while clinical information including details of surgical procedures was obtained from participants' case notes. Participants with wounds left open, diabetes mellitus, and advanced malignancy were excluded.

All participants were tested for HIV infection using rapid assay tests; SD Bioline test was done first and those who were SD bioline positive were tested with Determine test. HIV was considered positive when both SD Bioline and Determine tests were reactive. HIV testing was carried out in the Central Pathology Laboratory (CPL) of Muhimbili National Hospital. Surgical wounds were examined 48 hours after surgery, on the 5th, 8-10th day during suture removal and on the 30th day. Surgical site infection was determined on clinical evidence which included redness, localized swelling, pain or tenderness and purulent discharge. This is according to National Nosocomial Infection Surveillance Scheme (NINSS)[13].

Data collected were cleaned, coded and entered into Epi data package and were later transferred to Statistical Package for Social Sciences (SPSS) version 16 for analysis. Two way tables were used to summarize the data and association between categorical variables were determined using Chi square and Fischers' exact tests. Probability value of <0.05 was considered statistically significant. Logistic regression was used to determine relationships between risk factors and SSI.

Results

During the study period, a total of 118 patients consented to participate and had their HIV status checked. Of these, 59.3% were female giving a female to male sex ratio of 1.4: 1. The mean age of study participants was 39.5 ± 14.4 years, with 53.4% of the study subjects between 25 – 44 years (Table 1). In this study, 20 (16.9%) of the 118 patients were HIV-positive. HIV prevalence was highest (24.4%) among those aged over 45 years and was lowest in the age group 25 – 44 years (14.4%) (8/63). The prevalence of HIV infection in women was 21.4% compared to men at 10.4%. In fact 75% (15/20) of all HIV infections occurred in women. However the this finding was not statistically significant (p= 0.1) (Table 1).

Occurrence of surgical site infection by HIV status

Surgical site infection rate among the 118 study subjects was found in 35.6%, with 21.4% occurring among the HIV positive. Nine (45%) of the 20 HIV positive patients had SSI as compared to 33 (33.7%) the 98 HIV-negative cases. This differences was not statistically significant (p=0.3). However, HIV positive patients had a five times the odds of developing SSI [OR 5.21, 95% C.I 1.83 – 14.32] (Table 1).

Occurrence of surgical site infection by the class of the wound

Forty three (36.4%) of the patients had clean surgical wounds, closely followed by dirty wounds recorded in 40 (33.9%). There were 23 (19.5%) contaminated wounds and 12 (10.2%) clean – contaminated wounds. SSI rate was highest in dirty wounds (75%) followed respectively by contaminated wounds (30.4%), clean contaminated (25%) and clean wounds (4.7%). This difference in occurrence of SSI by wound class was

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statistically significance ($p < 0.0001$). As illustrated in Table 1, the odds of developing SSI increased dramatically from wound class I to class IV.

Occurrence of surgical site infection by site of operation

Abdominal surgeries accounted for 78.8% (93/118) of all cases, with breast, thyroid and extremity surgeries comprising 16.1% (19/118), 3.4% (4/118) and 1.7% (2/118) respectively. Patients who underwent abdominal surgeries had the highest proportion of SSI at 39.8% followed by breast surgery at 15.8%. This difference was statistically significant ($p< 0.05$). The odds of developing SSI was higher in extremity surgery by 5.33 (C.I 0.26 – 110.80), followed by abdominal surgery by 1.65 (95%C.I 0.44-6.20) (Table 1).

Table 1. Occurrence of Surgical Site Infection by Various Variables

Variables	Developed SSI, 42/118	P value	OR	C.I
Gender				
Female	18 (16.7%)			
Male	8 (25.7%)	0.268	0.58	0.23 – 1.46
Age				
< 25	2 (15.4%)			
25 - 44	19 (29.2%)		2.59	0.527 - 12.71
> 45	5 (12.5%)	0.146	0.83	0.14 -4.86
HIV status				
Positive	9 (45%)			
Negative	33 (33.7%)	0.3	5.12	1.83 – 14.32
Wound class				
Clean	2 (4.7%)			
Clean-contaminated	3 (4.7%)		1.52	0.20 -11.44
Contaminated	7 (30.4%)		14.02	2.87 -68.44
Dirty	30 (75%)	<0.0001	36.90	6.15 – 221.35
Site of operation				
Abdomen	37 (39.8%)		1.65	0.44 -6.20
Breast	3 (15.8%)		5.33	0.26 -110.80
Extremity	2 (100%)			
Thyroid	0	<0.05		
Nature of operation				
Emergency	37 (45.7%)		3.08	0.98 – 9.69
Elective	5 (13.5%)	< 0.05		

Occurrence of surgical site infection by nature of operation performed

The majority (68.6%) of the surgical procedures were performed on emergency basis. Only 37 (31.4%) of the 118 were elective procedures. The odds of developing SSI were three fold in emergency surgical procedures [OR 3.08, 95% CI 0.98 – 9.69]. Of the emergency surgical procedures, 45.7% (37/81) developed SSI as compared to 13.5% (5/37) of the elective procedures ($p< 0.05$) (Table 1).

Discussion

From this study, we observed surgical site[6] have found higher rates with similar case mix. Kehr et al[5] working in Ifakara and Eriksen et al[6] at KCMC found SSI prevalence of 21.6% and 19.4% respectively. Our study has demonstrated that SSI is still a major Nosocomial infection in our environment. Even though the SSI reported in our study is higher than what was found in Thailand by Pranee et al[19], 7.7%, he did not include emergency cases, hence even those with poor wound class were well prepared for the operation and this could explain the lower rates of SSI observed than in our findings.

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The prevalence of HIV among surgical patients was found to be 16.9% (20/98), higher than what Mkony et al[13] found in 2003, 10.5%. But to the contrary, this is quite small compared to regional figures which stand at 23% to 39%[10-12, 20]. But still this is much higher than the national figure which currently is at 5.7% for population between 15 – 49 years of age. Only one patient in this series admitted to being HIV positive prior to enrolment but was not on ARV's due to high CD4 counts. This study calls for surgeons to be aware of the role they can play in the diagnosis of HIV by adopting Provider Initiated Testing and Counseling (PITC) strategy and channeling patients to appropriate clinics for treatment. Consequently, more HIV positive patients developed SSI than HIV negative group, 45% and 33.7% respectively: but these differences were not statistically significant (P =0.4). By performing further analysis to determine the odds of developing SSI by HIV status, it was determined that being HIV positive had a five times odds. The lack of significance may be due to the small sample size, and the case mix that was seen in this study. However, this is similar to findings by Emparam[21] studying only HIV positive patients who noted that more than half of his patients developed SSI but was also not statistically significant. The findings were similar to those in other studies that demonstrated statistically significant association between HIV infection and the development of SSI.[13, 15, 16] Studies by Emparam[21] and Cacala[16] considered level of CD4 count as a factor but were also not statistically significant. Other studies in South Africa by Cacala [16], and Martinson[17] also found no significant association between HIV infection and SSI development.

We also found that wound class is an important factor in the development of SSI. Dirty wounds had the highest odds of becoming infected, 37 times compared to clean wounds. This was followed by contaminated wounds, 14 times, and clean – contaminated 1.5 times increased risk. This study reminds surgeons in this hospital to reconsider their handling of contaminated and dirty wounds in terms of wound closure techniques. An appropriate wound closure was not within the scope of this study, but reference can be made to the available literature.

Surgeries that were carried out on emergency basis carried a three times risk of becoming infected as compared to elective ones. Most emergency cases would be having poor wound classes and this can explain the observation made. Practices that can be adopted to improve wound class in emergency situations can be areas of future studies. Likewise those procedures performed in the abdomen had a 1.7 times risk of becoming infected, so were extremity surgeries with a risk of factor five. These findings are similar to literature citations from other centres but their rates are a bit lower than ours[2 - 4]. A study done by Finn et al[4] categorically outlined that the most significant risk factor for the development of SSI is the bacterial burden, which formed the basis of classifying wounds into classes by Horan and colleagues, later adopted by CDC. Most observed type of SSI was superficial accounting for 54.8%, followed by Deep Incisional 38.1% and the rest being organ/space infections. The findings are similar to those from other studies; Kehr et al[5] working in Ifakara found 43%, 45% and 12% to be superficial, deep and space infections respectively. Superficial infections are less serious and were managed on outpatient basis. But deep and space infections led to prolonged hospitalizations and cost to the patient. A significant number of patients fell into this group and this should be a concern for any health system.
The increased SSI rate reported in this study needs an explanation, but the value of the present report lies in the potential usefulness of the presented results for future prevention of SSI. SSI surveillance is lacking in this hospital and the country as a whole, so results comparison are difficult to tell and time – serial SSI incidence cannot be predicted hence the difficulty in investigating the cause of such a trend. In our study we did not check on CD4 count which might be a factor in causation of SSI.

Conclusions

Surgical site infection has remained a major Nosocomial infection in developing countries. Factors shown to be associated with increased risk are wound class, site and nature of surgery, and HIV infection. This study found higher prevalence of HIV infection among surgical patients. We recommend active surveillance of SSI and adoption of PITC strategy for surgical patients.

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