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Prevalence and Determinants of Post - Operative Surgical Site Infections at Amana Regional Referral Hospital, Tanzania: A Prospective Observational Study

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Abstract: ***Background: Surgical site infection (SSI) remains a significant concern in hospital settings, contributing to prolonged hospitalization, increased morbidity rates, and heightened healthcare expenses. This prospective observational study, conducted at the surgical ward of Amana Regional Referral Hospital (ARRH) in Tanzania from March to July 2023, aimed to investigate factors associated with SSI during the initial week following surgery. Materials and Methods: A cohort of 258 patients undergoing surgery was enrolled, with a 7 - day follow - up period. Data, including socio - demographic and clinical information, were collected through questionnaires, and surgical sites were examined for signs of SSI. Univariate and multivariate analyses were performed using SPSS version 25, with a significance level of 5%. Results: Out of the initial cohort, 8 patients were lost to follow - up, 6 experienced fatalities, and 2 were referred from the study site. The remaining 242 participants included 167 males (67%) and 33% females, with the predominant age group of 30 - 44 years. Co - morbidities, such as diabetes mellitus (DM) and hypertension, were observed in 16.4% of patients. Statistical analysis revealed that wound class and duration of surgery were significantly associated with the development of SSI at ARRH, with p - values of 0.003 and 0.037, respectively. Conclusion: This study highlights the significant impact of wound class and duration of surgery on the development of surgical site infections at ARRH. The findings emphasize the importance of meticulous attention to these factors in preoperative planning and postoperative care to minimize the risk of SSI. Further research and interventions focused on addressing these specific factors may contribute to the reduction of SSI rates, ultimately improving patient outcomes and reducing healthcare costs. This research has implications for surgical practice and underscores the need for tailored strategies to mitigate the identified risk factors in the local context. In this study 22.8% of patients developed SSI. Among the several factors studied (smoking; operator skill level; prophylactic antibiotics taken before surgery; shaving in the operating room or ward; length of surgery; and wound type) the strongest predictors of SSI were the length of the procedure and wound classification. The use of prophylactic antibiotics before surgery was found to be an important factor in preventing SSI. Since many of these factors are modifiable then these results will help reduce SSI rates after general surgery.***

Keywords: Surgical Site Infections, Post - Operative Complications, Epidemiology, Risk Factors, Tanzania

1. Background

Surgical Site Infections (SSI) are infections that are related to a surgical procedure that occurs at or near the incisional site (superficial, deep/organ space) within 30 days of the surgery or within 90 days if implant material is implanted at the surgery [1] [2].

The criteria for identifying SSI include the presence of pus discharge from the incision site, the detection of culture - positive fluid from a closed incisional site, the reopening of a surgical site with at least one clinical sign of infection, and the diagnosis of SSI by the surgeon. [1]

The Center for Disease Control and Prevention (CDC) categorizes SSI as incisional or organ space (any part of the anatomy), and based on the type of wound, it can be clean, clean - contaminated, contaminated, or dirty [1] [3] [4].
If the surgery is an emergency, the risk of infection is even higher and also increases as the wound becomes more dirty [2] [3] [5].

Among operated patients, SSI account for 38% of all Hospital Acquired infections (HAI) worldwide. In United State 1 in 24 patients have a chance of developing SSI postoperatively [1]

On the other hand, surgical site infections SSI are a type of healthcare - associated infection (HAI) that can be prevented and are a major source of patient morbidity and financial burden for both patients and healthcare systems [6] [7] [8].

There are multiple factors that have been identified as contributing to the occurrence of SSI. These include conditions that may reduce patient wellness, such as co - morbidities, advanced age, and obesity. Additionally, surgical - related factors such as extended operation time, type of surgery, number of people in the operating room, skin preparation, prophylactic antibiotics, and operator skills can also increase the risk of SSI [2] [3] [9].

The purpose of this study is to identify and analyze the factors contributing to the incidence of surgical site infections within the first week post - operatively at Amana Regional Referral Hospital, Tanzania, providing insights that could help in reducing SSI rates in similar healthcare settings. This study significance lies in its focus on understanding the

determinants of SSIs in a Tanzanian regional referral hospital, contributing to the global effort to reduce post - operative infections and improve patient outcomes in surgical care.

2. Materials and Methods

Study design, population, and settings.
This was a prospective Observational study that included 258 patients admitted to the surgical department at Amana Regional Referral Hospital between March 2023 and July, 2023. The present study was approved by HKMU ethics committee and prior to data collection, written informed consent was sought from participants. The target population for the present study was all patients undergoing surgery either as elective or emergency surgical procedures and developed wound infection within the stipulated duration of this study. Patients who were referred from another facility were excluded. All patients were evaluated and followed up from the time of admission until the time of discharge and 7 days postoperatively to determine the incidence of SSI.

In this study, all consecutive patients meeting the inclusion criteria were recruited. The structured and pretested questionnaires were used to collect data. Detailed history regarding each case was recorded, such as age, sex, co - morbid conditions, antibiotic therapy and preoperative hospital stay. The operations were classified as clean, clean contaminated, contaminated and dirty. Other data including associated factors (i. e. diabetes, obesity), use of prophylactic antimicrobial agents, the type and duration of surgery, operator qualification, skin preparation and number of people in theater.

3. Result

258 patients in total were enrolled during the study period; however, 2 patients were lost to follow - up as a result of referral away from study area and 6 patients passed away postoperatively.250 patients were therefore eligible for follow - up and were monitored for 7 days. The majority of the patients 95 (38%) were aged between 30 - 44 years and 16 (6.4%) less than 14 years were the least. (Fig.1 and Table 1). Males 167 (67%) contributed most of the participants while 41 (16.4%) patients had comorbidities (DM and hypertension). Almost 204 (82%) were nonsmokers. (Table 1)

Table 1: Shows socio - demographic characteristics of the study participants

Variables	Frequency	Percentage (%)
Age group (years)		
< 14	16	6.4
15 - 29	50	20.0
30 – 44	95	38.0
45 – 59	52	20.8
> 60	37	14.8
TOTAL	250	100
Sex		
Male	167	66.8
Female	83	33.2
TOTAL	250	100.0
Comorbidities		
DM	28	11.2
Hypertension	13	5.2
No comorbidities	209	83.6
TOTAL	250	100.0
Cigarette Smoking		
Yes	46	18.4
No	204	81.6
TOTAL	250	100.0

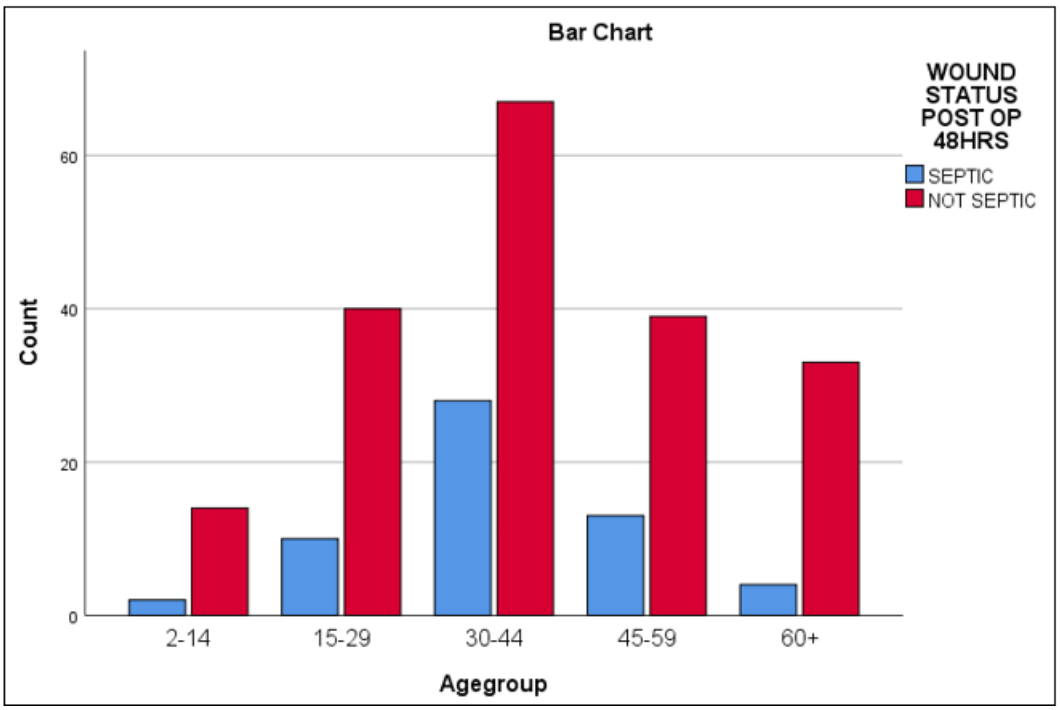

Figure 1: Distribution of patients with SSI with Age

Table 2: Factors associated with surgical site infections among patients who underwent surgery at ARRH.

Variable	Surgical Site Infection (SSI)		
	Yes= n (%)	No= n (%)	P (value)
Age group (years)			
< 14	2 (12.5%)	14 (87.5%)	0.149
15 - 29	10 (20.0%)	40 (80.0%)	
30 – 44	28 (29.5%)	67 (70.5%)	
45 – 59	13 (25.0%)	39 (75.0%)	
> 60	4 (10.8%)	33 (89.2%)	
Sex			
Male	37 (22.2%)	130 (77.8%)	0.423
Female	20 (24.1%)	63 (75.1%)	
Comorbidities			
DM	9 (31.0%)	20 (69.0%)	0.334
Hypertension	1 (7.7%)	12 (92.3%)	
Cigarette Smoking			
Yes	13 (28.3%)	33 (71.7%)	0.214
No	44 (21.6%)	160 (78.4%)	
Days post op			
1-4	47 (21.8%)	169 (78.2%)	0.323
>5	10 (29.4%)	24 (70.6%)	
Shaving			
Within 30 minutes	17 (20.0%)	68 (80.0%)	0.453
More than 30 minutes	7 (26.9%)	19 (73.1%)	
Prophylactic antibiotics			
Yes	49 (23.7%)	158 (76.3%)	0.471
No	8 (18.6%)	35 (81.4%)	
Number of people in theater			
<8			0.694
>8			
Wound class			
Clean	7 (7.4%)	87 (92.6%)	0.000
Clean contaminated	29 (31.2%)	64 (68.8%)	
Contaminated	18 (32.7%)	37 (67.3%)	
Dirty	3 (37.5%)	5 (62.5%)	
Duration of surgery			
<90minutes	25 (17.9%)	128 (82.1%)	0.003
>90minutes	32 (33.0%)	65 (67.0%)	
Operator skills			
Intern	0 (0.0%)	2 (100%)	0.598
Registrar	28 (21.7%)	101 (78.3%)	
Specialist	29 (24.4%)	90 (75.6%)	

Table 3: Multivariate logistic regression analysis of risk factors for development of SSI

Variable	P value
Type of wound class	0.003
Duration of surgery	0.037

Factors associated with surgical site infections

Multivariate analysis of associated factors that predict occurrence of SSI is described in the Tables 2 and 3. Several known risk factors for SSI are statistically significant in this study. But type of wound class shows that if the wound is clean had less risk of SSI compared to dirty wound. Surgical site infection rate for clean, clean contaminated, contaminated and dirty wounds were 7.4%, 31.2%, 32.7% and 37.5% respectively with (P=0.000). Contaminated wound was a strong factor for SSI. So class of wounds was statistically significant factor in the cause of SSI.

Also, the duration of surgery had an effect on causing SSI in which case the higher the duration of the procedure is directly associated with SSI. So, in patients whose operations lasted less than 90 minutes, the prevalence of SSI was 25 (17.9%) and in those whose operations lasted more than 90 minutes were 32 (33.0%). The length of the surgery and the SSI were statistically significantly correlated with SSI (p= 0.003).

4. Discussion

According to this study, the prevalence of SSI is 22.8% which is the same findings of previous studies conducted by Chilonga et al at KCMC (21.3%) and Sensa et al at MNH (22%) [3] [13]. But it's higher compared to the prevalence rates in China (14.2% in 2020), Peru (2.4%), and India (5%) [7] [18] [22]. Meanwhile, Mbarara district Hospital in Uganda had a prevalence rate of 16.4%, and Mukagendaneza et al found a prevalence rate of 10.9% in Rwanda [2] [20]. It is worth noting that SSI prevalence rates tend to be high in Africa and developing countries [3] [8] [18] [20].

As a result, the best explanation for the observed differences in infection prevalence remains high healthcare standards in developed countries [15] [20].

Several factors coincided with the risk factors for SSIs that are already known. Its known that the following variables, including the number of individuals in the operating room, the surgeon's expertise, shaving the surgical site, antibiotic prophylaxis, procedure time, and wound class, were linked to the rate of SSI occurrence, But the duration of the procedure, and wound class were the only statistically significant factors in causing SSI this study. The duration of the procedure was directly proportional to SSI and showed an increasing risk of SSI with increased operative time that was statistically significant with an operation time of 90minutes or more as compared to ≤ 90 minutes [9] [13].

To our knowledge, this is the first SSI surveillance investigation at ARRH, outlining the occurrence and related factors of SSI according to CDC definitions and 7 - day follow - up monitoring. The study is based on general surgery cases that underwent surgery. This study has identified the type of wound classification as a significant predictor of postoperative surgical site infections, which was also associated with SSI in a previous study [6] [7].

In our study, wounds that were dirty and contaminated had a statistically higher incidence of SSI than wounds that were clean and clean - contaminated [15] [17]. Our results supported studies showing a higher incidence of SSI in surgeries with an increased microbial load in the operating field [4] [8].

The other main risk factors identified in this study as being linked to a high prevalence of SSI were prolonged duration of surgery, which is related to prolonged exposure of tissue to the environment, prolonged hypothermia, and declining levels of antibiotics, which can give bacteria more time to colonize the body [10] [20].

In addition to being associated with reoperation, or intraoperative difficulties a prolonged surgical procedure wears surgeons out and causes them to use fewer aseptic

techniques. Additionally, greater blood loss from prolonged operations frequently results in tissue hypoxia [11] [13] [25].

The above findings will provide the direction for preventing SSI at ARRH as their modifiable associated factors which can be modified by improving class of wounds by good preparation of emergency cases before surgery and reducing the duration of surgery by coaching and job training of the Surgeons.

The study reveals a concerning prevalence of SSI at ARRH at 22.8%, aligning with previous research in the region [3] [13]. Notably, the prevalence is higher than rates reported in China, Peru, and India, indicating a distinctive trend of elevated SSI rates in Africa and developing countries [7] [18] [22]. The observed differences may be attributed to variations in healthcare standards, emphasizing the impact of high healthcare standards in developed countries [15] [20].

Several factors traditionally associated with SSI risk were considered, including the number of individuals in the operating room, surgeon expertise, shaving the surgical site, antibiotic prophylaxis, procedure time, and wound class. Intriguingly, this study identifies the duration of the procedure and wound class as the only statistically significant factors contributing to SSI at ARRH, with a direct correlation between prolonged operative time (>90 minutes) and increased SSI risk [9] [13].

This investigation, the first of its kind at ARRH, adheres to CDC definitions and utilizes a 7 - day follow - up, offering valuable insights into general surgery cases. Wound classification emerges as a significant predictor of SSI, with dirty and contaminated wounds exhibiting a statistically higher incidence than clean counterparts [6] [7] [15] [17]. The findings support the notion that surgeries with an increased microbial load in the operating field correlate with higher SSI rates [4] [8].

Prolonged duration of surgery emerges as a critical risk factor, linked to extended tissue exposure, hypothermia, declining antibiotic levels, reoperation, intraoperative difficulties, and diminished adherence to aseptic techniques. The study highlights the need for interventions to reduce surgical duration and improve surgeon preparedness, emphasizing the potential benefits of coaching and job training for surgeons [10] [20] [11] [13] [25].

5. Conclusion

In conclusion, the identified modifiable factors, including wound class and duration of surgery, present opportunities for targeted interventions to reduce SSI rates at ARRH. Strategies to enhance emergency case preparation, minimize surgical duration through training initiatives, and optimize aseptic techniques can contribute to mitigating the risk of SSI, ultimately improving patient outcomes. These insights highlight the need for targeted interventions to modify risk factors and reduce SSI rates post - operatively

Author contribution
All authors made a significant contribution to the work reported, whether that is in the conception, design, execution, acquisition of cases data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work

Availability of data and materials
The datasets analyzed during the current study are available on request from the corresponding author.

Ethics approval and consent to participate.
The study was approved by the HKMU Ethics committee. Written informed consent was obtained from the participants.

Competing interests: The authors declare that they have no competing interests.

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