Abstract:

**Background:** Surgical site infections are one of the most common causes of nosocomial globally resulting in high morbidity and mortality. **Aim:** To determine the prevalence and determinants of surgical site infections in the Tamale Teaching Hospital in Northern Ghana. **Materials and Methods:** A retrospective cross-sectional study where a month each was randomly selected to represent each quarter of the year 2012. Medical records in inpatient folders and nurses note books of patients admitted to the surgical ward diagnosed with surgical site infection by an attending physician were reviewed. **Results:** The overall prevalence of surgical site wound infection was 39%. Determinants of surgical site infections were; long stays in the ward (p<0.001), diabetes (p=0.03), emergency/elective surgeries (p<0.001 each), second quarter of the year (p=0.008), young and middle aged groups (p=0.02 and 0.01 respectively) and certain surgical procedures such as abdominal, orthopedic and mastectomy all with p values of <0.001 each. **Conclusion:** The overall prevalence of surgical site wound infection is 39%. Significant determinants of surgical site infection were; long stays in the ward, diabetes, emergency/elective surgeries, second quarter of the year, young and middle aged groups and certain surgical procedures such as abdominal, orthopedic and mastectomy.

**Key words:** Northern Ghana, Surgical Site Infection, Surgical Ward, Tamale Teaching Hospital
Introduction

World Health Organization (WHO) describes hospital acquired infections to be one of the major infectious diseases having a huge economic impact worldwide [1]. These infections affect about 2 million people annually resulting in 5% to 15% of them requiring hospitalization [2,3].

Surgical site infections (SSIs) are known to be one of the most common causes of nosocomial infections worldwide and account for nearly 20% to 25% of all nosocomial infections [4,5]. Surgical site infection rates are reported to range from 2.5% to 41.9% globally resulting in high morbidity and mortality [6,7]. Approximately 2% to 5% of the 16 million people undergoing surgical procedures each year develop surgical site infection [5,7-9] with more recent data putting it at two-thirds of patients who undergo operations [10]. The situation is more severe in developing countries where resources are scarce and staffs are always in short supply [5,11].

A wide range of factors have been proven to influence wound infection. Some of these factors include pre-existing illness, wound class, wound contamination, extremes of ages, malignancy, metabolic diseases, malnutrition, immunosuppression, cigarette smoking, remote site infection, length of surgical operation, emergency procedures and long duration of pre and postoperative hospitalization amongst others [12-18].

The Ministry of Health (MOH) in collaboration with Ghana Health Service (GHS) in Ghana developed a policy leading to the subsequent launching of a National Manual for Infection Prevention and Control where every health worker is supposed to be trained in infection prevention and control practices. Despite this policy, surgical site infections continue to rise in the surgical unit of the Tamale Teaching Hospital which serves as the main referral center for the three Northern Regions in Ghana.

We therefore conducted this study to determine the prevalence and some determinants of surgical site infections in the Tamale Teaching Hospital which is the only tertiary referral hospital in Northern Ghana.

Materials and Methods

Study design and setting

This was a retrospective cross-sectional study carried out for the year 2012 in the surgical ward of the Tamale Teaching Hospital in the Northern region of Ghana. The Tamale Teaching Hospital is the only tertiary referral hospital in northern Ghana and serves all the three regions of northern Ghana including the northern parts of Brong Ahafo region and sometimes northern Cote D'Ivoire and Togo and southern Burkina Faso. The surgical ward of the hospital has a bed capacity of around one hundred. The ward is divided into two sections of septic and aseptic wards. The septic ward is responsible for the care of all infected wounds brought in from the community and/or referred from lower level health facilities. The aseptic ward takes care of all other surgical cases including both pre and post operative patients.

Data collection

Four months of February, April, September and December where randomly selected to represent the first, second, third and fourth quarters of the year 2012 respectively. Medical records in inpatient folders and nurses note books of patients admitted to the surgical ward diagnosed with surgical site infection by an attending physician within the year of study were subsequently reviewed and the data entered in Epi Info software version 3.5.1.

Wound infection was defined as the presence of purulent discharge according to the criteria reported by Cutting and Harding [19]. Any diagnosis of wound infection that did not meet this criterion was excluded.

Statistical analysis

The same version of Epi Info software was used to organize, clean and analyze the data. Logistic regressions were run to determine significant contributors to surgical site infections. Descriptive statistics included relative frequencies for categorical variables and means (and standard deviations) for continuous variables. Bivariate associations were tested by chi square (Mantel-Haenszel) test for two categorical variables. Multivariate analysis using unconditional multiple logistic regression analysis was conducted for the dichotomous outcome variable (surgical site infection) and p-values derived for the categorical independent variables at <0.05 significant level.

Results

A total of 352 patient records diagnosed with wound infections on admission in the surgical ward within the period of study were reviewed.

Demographic characteristics of SSIs

Out of the 136 complete data for age, 83 (61.0%) were males whiles 53 (39.0%) were females. The mean age of patients was 35.4 (SD=20.5). The
distribution of age groups with SSIs is as shown in table 1.

Table 1: Distribution of age groups of patients with SSIs

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤5</td>
<td>5</td>
<td>3.7</td>
</tr>
<tr>
<td>6-12</td>
<td>16</td>
<td>11.8</td>
</tr>
<tr>
<td>13-59</td>
<td>96</td>
<td>70.6</td>
</tr>
<tr>
<td>≥60</td>
<td>19</td>
<td>14.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>136</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

In this study, 47.4% (63) of cases with SSIs resided in urban areas whiles 52.6% (70) of them resided in rural areas.

**Prevalence of SSIs and other risk factors**

In the determination of the prevalence of SSIs, 349 complete records out of the 352 reviewed records were used for the analysis resulting in an overall prevalence of surgical site wound infection of 39% (136/349).

About 35% (43) of SSIs were recorded in those who underwent emergency surgery whiles 65% (80) of them were recorded in elective surgical cases.

The prevalence of surgical wound infection at different quarters of the year and amongst some surgical procedures is shown in table 2.

Table 2: Distribution of SSIs in surgical procedures and at different quarters of the year

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period of year</td>
<td></td>
</tr>
<tr>
<td>First quarter</td>
<td>19 (14.0)</td>
</tr>
<tr>
<td>Second quarter</td>
<td>69 (50.7)</td>
</tr>
<tr>
<td>Third quarter</td>
<td>23 (16.9)</td>
</tr>
<tr>
<td>Fourth quarter</td>
<td>25 (18.4)</td>
</tr>
<tr>
<td>Surgical procedure</td>
<td></td>
</tr>
<tr>
<td>Abdominal</td>
<td>72 (56.7)</td>
</tr>
<tr>
<td>Orthopedic</td>
<td>20 (15.7)</td>
</tr>
<tr>
<td>Hernia repair</td>
<td>11 (8.7)</td>
</tr>
<tr>
<td>Mastectomy</td>
<td>11 (8.7)</td>
</tr>
<tr>
<td>Others</td>
<td>13 (10.2)</td>
</tr>
</tbody>
</table>

The prevalence of SSIs was found to be higher amongst those who stayed in the wards for weeks and months as compared to those who spend less than seven days in the ward. This is shown in table 3.

Table 3: Distribution of SSIs according to duration of stay in ward

<table>
<thead>
<tr>
<th>Duration of stay</th>
<th>Frequency (percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days (&lt;7)</td>
<td>6 (4.5)</td>
</tr>
<tr>
<td>Weeks (&lt;4)</td>
<td>95 (70.9)</td>
</tr>
<tr>
<td>Months (≥4 weeks)</td>
<td>33 (24.6)</td>
</tr>
</tbody>
</table>

**Determinants of SSIs**

In the bivariate analysis using chi square test, there was no association between surgical site wound infection and gender ($X^2$=0.05, p=0.82). Similarly there was no association between surgical site wound infection and patient location ($X^2$=0.89, p=0.34).

After a multivariate analysis using an unconditional multiple regression model, hernia repair was the only surgical procedure that had no significant relationship with SSIs as shown in table 4.

Table 4: Significance level of SSIs in surgical procedures

<table>
<thead>
<tr>
<th>Surgical procedure</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Orthopedic</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hernia repair</td>
<td>0.96</td>
</tr>
<tr>
<td>Mastectomy</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Others</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Similarly following a multivariate analysis using an unconditional multiple regression model, diabetes, the second quarter of the year and certain age groups were found to be significant risk factors of surgical site wound infection as shown in table 5.
Staying longer (weeks and months) in the ward was found to be a significant risk factor (p<0.001) of surgical site wound infection after running the multiple regression module.

Surgeries that were performed either under emergency or elective situations were found to be significant (p<0.001 each) risk factors of SSIs.

**Microbiology and antibiotic sensitivity**

Approximately 3.7% (5 out of 136 completed records) had wound swabs taken for microbiology with 80% (4) of the isolates being *Staphylococcus aureus*, whiles the rest (20%) were *Klebsiella spp*.

60.0% (3) of the isolates were sensitive to cephalosporin’s group of antibiotics whiles 20.0% (1) each were sensitive to the quinolone’s and aminoglycoside groups of antibiotics.

**Discussion:**

In our retrospective cross sectional study of 352 patients diagnosed with SSIs, the 39% overall prevalence rate found was comparable to an India study where the overall prevalence rate was found to be 38.8% [20]. The prevalence rate in this study was however high as compared to a number of African countries where infection rates ranged from 9.1% - 26.0% [21-23]. The prevalence rate of SSIs was even higher in this study as compared to those reported from other continents; 2.5% in Europe [24], 5.5% in USA [25] and 1.8% in Latin America [26] and 8.4% in the Middle East [27].

The percentage of males (61%) was found to be higher than that of females (39%) in this study which was similar to that found in India where males were 62.68% and females were 37.32% [3]. Similarly, males were also found to have higher SSIs as compared to females in another study in India [13]. Our finding was also consistent with a Tanzanian study where the SSI prevalence rate was higher in males than in females [7]. Contrary to the findings in this study, other studies showed no significant difference in SSIs rate between males and females [21,28].

Our findings of gender not having a significant (p=0.82) relationship with SSIs was consistent with a number of other studies [21,22]. This was however not the case in an Indian study where the female gender was found to be statistically significant in relation to SSIs [30].

Similarly age was found not to be a significant predictor of SSIs which was consistent with other studies [21,22]. A study in Iran however found age to be significantly associated with risk of SSIs [27]. Just like in other studies [13,22], the prevalence of SSIs was also higher in older groups in this study. Whereas in this study, age groups of 6-12 years and 13-59 years were both significantly associated with SSIs, other studies found only older age groups (>40 years) to have a significant association with SSIs [21,28].

In this study we found staying in either a rural or an urban area not to be significantly associated with SSIs which was found to be consistent with an Indian study where staying in an urban area was also not a risk factor for SSIs [30].

One will have expected that due to inadequate pre operative preparations, some underlying conditions which predispose patients to an emergency surgery and the likelihood of more frequent contaminated or dirty wounds in emergency surgeries, the prevalence of SSIs will have been more in emergency surgeries as compared to elective surgeries as reported in most studies [13,21,28,29].

This was however not the case in this study a situation difficult to explain.

Diabetes was the only co-morbidity that was found to be a significant predictor of SSIs in this study a finding consistent with so many other studies across the world [7,13,22,30].

Although our study had a limitation in terms of distinguishing between pre and post operative stay durations in the ward, those patients who stayed in the ward for long, had a higher risk of developing...
SSIs. This finding was not different from that of other studies [29,30].

The very few records found for microbiology was probably due to the fact some patients were either discharged before the results were ready or there was poor communication between the ward and the laboratory. One other limitation of this study is that no tracing of laboratory request from the ward was done to verify the results of all wound swabs. Not with standing this limitation, our finding of *Staphylococcus aureus* being the most common organism isolated is consistent with other studies [3,5,13,28,30].

Some other limitations of this study are; as a retrospective study like in most retrospective studies, getting complete data or records of all the variables was a problem and also other possible host-related risk factors such as body mass index, malnutrition, cigarette, HIV and cancer were not considered.

**Conclusion**

The overall prevalence of surgical site wound infection in the surgical ward of the only tertiary referral hospital in northern Ghana is 39%. Significant determinants of surgical site infection were; long stays in the ward, diabetes, any type of surgery (emergency and elective), second quarter of the year, young and middle aged groups and certain surgical procedures such as abdominal, orthopedic and mastectomy.

**Recommendation**

We recommend that the hospital looks at other factors both institutional and nursing that were beyond the scope of this study to help address the seemingly high surgical site infection situation. A microbiological and antibiotic sensitivity profiling of wound infections in the ward will serve as a valuable tool in informing clinicians on the most effective antibiotics to use for SSIs in the ward.

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**Source of Funding:** Nil

**Acknowledgement**

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**References**


