Infection rate with bacteriological pattern in clean surgery in Baquba Teaching Hospital

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Background: Surgical Site Infections (SSIs) are still the third most frequently reported nosocomial infections and represent a troublesome disorder of wound healing as these infections increased morbidity, mortality, extended hospital stay and economic burden to the hospital resources. Data regarding a hospital's rate of SSIs are becoming increasingly used as outcome measures for assessing the quality of their surgical procedures.

Patients and Method: A prospective study conducted in the Department of General Surgery at Baquba Teaching Hospital – Diyala – Iraq, from January 2019 to June 2019. 432 patients with clean surgery (237 male and 195 female) were included in this study and followed up to thirtieth postoperative day on an outpatient dating basis. When infection was clinically confirmed, samples of pus were screened for bacterial pathogens by standard microbiological methods at the hospital. Results and outcomes of all patients included in this study were collected and analyzed.

Result: 432 patients with clean surgery were included in this study, 237 male (54.86 %) and 195 female (45.14%), the age of patients ranged between 2 months to seventy years. SSIs were noticed and documented in 144/432 patients (33.33% of patient with clean surgery). Various types of bacteria were identified. E.coli was the most common pathogens in 31.25 % of infected cases, followed by Psudomonus spp. in 25% of patients, Enterobacter spp. in 25% while Proteus spp. was the least common pathogen in 18.75% of patients.

Conclusion: The incidence of SSIs serves as an indicator of the quality of services provided by healthcare institution. The incidence of SSIs after clean surgery in our hospital was 33.33% which is high as compared to other studies; this can be explained by the defect in infection control system in the hospital, ineffective ventilation system, admission of patients in the same room postoperatively irrespective to the type of the operation and irrational use of antibiotics.

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INTRODUCTION:
Post-operative wound infections have been reported as a troublesome disorder of wound healing since the beginning of surgery as a treatment modality (1) as these infections increased morbidity, mortality, extended hospital stay and economic burden to the hospital resources (2, 3). Because of the confusion between the infection of a surgical incision and the infection of a traumatic wound, the US Centers for Disease Control (CDC) created the term 'Surgical Site Infection (SSI)' (1, 2) and defined it as microbial contamination of the surgical wound within 30 days of an operation or within 1 year after surgery when implants placed in patients (1, 2, 4). The criteria for diagnosis of SSIs are as follows: 1) A purulent exudates draining from a surgical site 2) A positive culture obtained from a surgical site that was closed initially 3) Diagnosis of infection by the surgeon 4) Signs or symptoms like tenderness, swelling, redness or heat at the surgical site (5).

Although the true incidence of SSI is thought to be underestimated, because many are diagnosed in an outpatient setting or after discharge (6), SSIs are still the third most frequently reported nosocomial infections (7, 8), as 1.9% to 2.7% of all surgical patients are diagnosed with a SSI (9) and in some literatures the incidence were as high as 41.9% (10, 11) because of different systems employed for the epidemiological control of hospital infections from one country to another (12). Studies suggest that 40-60% of SSIs infections are preventable (3, 9, 13, 14, 15) but the absolute prevention seems to be an impossible goal (8, 16).

Data regarding a hospital's rate of SSIs are becoming increasingly used as outcome measures for assessing the quality of their surgical procedures (6), in spite of the fact that 66% of developing countries have no published data on the burden of such infections, according to the World Health Organization (WHO) (17, 18).

CDC classified wounds that are prone to develop SSIs into clean, clean-contaminated, contaminated, and dirty wounds according to the level of wound contamination (1, 9, 19, 20). The simplicity of this system of classification has resulted in it being widely used to predict the rate of infection after a surgery (1) as the incidence of SSI depends on wound class (6, 21).

The development of surgical infection depends on several factors like microbial pathogenicity, host defenses, local environmental factors and surgical techniques (22, 23). A wide variety of aerobic and anaerobic organisms may be present singly or in combination in these wounds (8, 13) and these pathogens can be part of the patient's normal flora or they may be acquired from the hospital environment (4, 22).

To reduce the incidence of postoperative surgical site infections, correction of medical problems, meticulous surgical technique (19, 22, 24) and appropriately selected prophylactic antibiotics administered one hour before skin incision, are the mainstay of prevention (13) but the wide spread use of antibiotics has frequently resulted in unrealistic use of antibiotics, over use of antibiotics and development of resistance to antibiotics. This has resulted in increase in the cost of postoperative treatment and violation of established surgical principles (4, 5, 19).

The object of this study was to determine the incidence of SSIs in clean operations performed in our institute and to identify various types of pathogens involved in such infections.

PATIENTS AND METHODS
A prospective study conducted in the Department of General Surgery at Baquba Teaching Hospital – Diyala – Iraq, from January 2019 to June 2019. A total of 810 patients of different age groups and both genders underwent various surgical procedures in the hospital theaters that fulfill the criteria of infection control system applied in the hospital, the operations were classified into (clean, clean-contaminated, contaminated and dirty) according to Centre for Disease Control (CDC) guidelines. Only 432 patients with clean surgery (237 male and 195 female) were included in this study. Patients with pre-existing medical problems as anemia and diabetes mellitus that affect wound healing and infection were controlled preoperatively.

Wounds were inspected on 3rd postoperative day for any signs of inflammation and infection depending on CDC definition of SSIs as mentioned above. In cases where soakage of dressing and abnormal smells suggestive of infection, dressings were inspected earlier than 3 days. All patients were given antibiotic
treatment for eight days (injectable antibiotics for 3 days and 5 days on oral antibiotics), and then were followed up to thirtieth postoperative day on an outpatient dating basis. When infection was clinically confirmed, samples of pus were carefully collected after cleaning the surrounding areas and these samples were screened for bacterial pathogens by standard microbiological methods at the hospital.

**Statistical Analysis:** Results and outcomes of all patients included in this study were collected on a specific questionnaire and an Excel Microsoft 2010 program used for data analysis.

**RESULTS**

During the period of this study 810 operations were performed, these operations were classified according to CDC guidelines into clean, clean-contaminated, contaminated and dirty operations according to the level of wound contamination. Only 432 patients with clean surgery (53.33 % of total operations performed) were included in this study. The patients included were 237 male (54.86 %) and 195 female (45.14%) as in figure 1

![Fig. 1: Distribution of patients according to the sex](image)

The age of patients ranged between 2 months to seventy years. Table 1 shows the age distribution of the patients included in the study.

<table>
<thead>
<tr>
<th>Age</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>66</td>
</tr>
<tr>
<td>11-20</td>
<td>71</td>
</tr>
<tr>
<td>21-30</td>
<td>108</td>
</tr>
<tr>
<td>31-40</td>
<td>73</td>
</tr>
<tr>
<td>41-50</td>
<td>46</td>
</tr>
<tr>
<td>51-60</td>
<td>37</td>
</tr>
<tr>
<td>61-70</td>
<td>31</td>
</tr>
</tbody>
</table>

The types of clean operations performed are shown in table 2.

<table>
<thead>
<tr>
<th>Operations performed</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroid and thyroglossal cyst</td>
<td>72</td>
</tr>
<tr>
<td>Inguinal Hernia</td>
<td>78</td>
</tr>
<tr>
<td>Lipoma</td>
<td>54</td>
</tr>
<tr>
<td>Varicocele</td>
<td>27</td>
</tr>
<tr>
<td>Paraumbilical Hernia</td>
<td>150</td>
</tr>
<tr>
<td>Breast surgery</td>
<td>30</td>
</tr>
<tr>
<td>Abdominoplasty</td>
<td>21</td>
</tr>
</tbody>
</table>

In the postoperative period the patients were given injectable antibiotics for 3 days as shown in table 3.

**Table 3: The type of injectable antibiotics used in the first three postoperative days**

<table>
<thead>
<tr>
<th>Type of Injectable Antibiotic</th>
<th>No. of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd generation cephalosporin</td>
<td>360</td>
<td>83.33 %</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>72</td>
<td>16.67 %</td>
</tr>
</tbody>
</table>
Then, the injectable antibiotics were replaced by oral antibiotics for 5 days (table 4 shows the type of oral antibiotics used).

**Table 4: The type of oral antibiotics used after the injectable antibiotics in the postoperative period**

<table>
<thead>
<tr>
<th>Type of oral antibiotic</th>
<th>No. of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co- amoxiclav</td>
<td>185</td>
<td>42.82 %</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>108</td>
<td>25 %</td>
</tr>
<tr>
<td>Cephalosporins</td>
<td>61</td>
<td>14.12 %</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>56</td>
<td>12.96 %</td>
</tr>
<tr>
<td>Others</td>
<td>22</td>
<td>5.1%</td>
</tr>
</tbody>
</table>

During the follow up period, which extended to thirty days postoperatively, SSIs were noticed and documented by standard microbiological methods in 144/432 patients (33.33% of patient with clean surgery). Various types of bacteria were identified by standard microbiological methods at the hospital. *E. coli* was the most common pathogens in 45/144 patients (31.25 % of infected cases), followed by *Psudomonas spp.* in 36/144 (25%), *Enterobacter spp.* in 36/144 patients (25%) while *Proteus* spp. was the least common pathogen in 27/144 patients (18.75%) as shown in table 5.

**Table 5: The types of bacteria isolated from the infected wounds.**

<table>
<thead>
<tr>
<th>Type of Bacteria</th>
<th>No. of patients</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli</td>
<td>45</td>
<td>31.25</td>
</tr>
<tr>
<td>Enterobacter</td>
<td>36</td>
<td>25%</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>36</td>
<td>25%</td>
</tr>
<tr>
<td>Proteus</td>
<td>27</td>
<td>18.75</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Despite the advances made in asepsis, antimicrobial drugs, sterilization and operative techniques, SSIs continue to be a major problem in all surgical branches (25), these infections are encountered when the surgical wound is colonized by potentially pathogenic microorganisms as a result of skin disruption by the incision and in spite of adequate preparation (4). These microorganisms vary from time to time and from place to place (22) and a number of exogenous and endogenous factors play an important role in the occurrence of such infections (23).

Despite of the variation in the incidence of SSIs among different healthcare institutions, such incidence serves as an indicator of the quality of services provided by that institution (14, 17). The difference in the incidence of SSIs may be attributed to the characteristics of hospital population, the underlying diseases, difference in clinical procedures, the extent of infection control measures and hospital environment (17, 19).

The incidence of SSIs in clean surgical procedures performed in our institute was 33.33%, which is high as compared to other studies as the incidence was 4% in the study of Asif Zafar Malik et al (17), 6.66% in the study of Prashanth D etal (13), 7.8 % in the study conducted by K Varik et al (21), 8% in Tariq A. Noman etal (19), 8.4 % in the study of Emmanuel O etal (22) and 25 % in the study of Laloto TL etal (14). Such high incidence could be partly explained by the defect in infection control system in the hospital, in addition to admission of patients in the same room irrespective to the type of operation and irrational use of antibiotics.

Regarding the type of bacterial pathogens isolated from the wounds of our patients, *E. coli* was the most common pathogen in 31.25% of patients, such results also found in other studies in which *E.coli* was isolated in 45% of cases in Sankaran SV et al (4), 30.4% of cases in Asif Zafar Malik et al (17), 38.47% of patients in Shrestha S et al (12) and 20% of cases in Prashanth D etal in (13). The next common pathogenic bacteria in our study was Pseudomonas spp. and Enterobacter.
spp., Pseudomonas spp. was isolated from 25% of cases in this study, this bacteria was responsible for 20% of cases of clean wound infection in the study of Prashanth D et al in (13), in 18.18% of cases in the study of Arvind Kurhade et al (23), also found as a common bacteria in the study of Masood Ahmad et al (16). Enterobacter also found in 25% of our patients while Asif Zafar Malik et al (17) found it in 5.4% of cases. Proteus spp. was responsible for infection in 18.75% of our patients and found in 13% in Prashanth D et al in (13) and 6.8% in Arvind Kurhade et al (23). No growth of staphylococci was seen in this study although it was isolated in the studies of Asif Zafar Malik et al (17), Emmanuel O etal (22) and Arvind Kurhade etal (23). Also no growth of anaerobic bacteria was observed in this study while it was isolated in the studies of Narasinga Rao Bandaru et al (1) and Arvind Kurhade et al (23).

CONCLUSION:
The incidence of SSIs after clean surgery in our hospital was 33.33% which is high as compared to other studies; such high incidence could be partly explained by the defect in infection control system in the hospital, ineffective ventilation system and irrational use of antibiotics. We recommend reconsideration of infection control system in our hospital together with following scientific guide lines in using of antibiotic.

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