

**An Evaluation of effectiveness of Antibiotic Prophylaxis Protocols for Pediatric Surgical Procedures in an Egyptian Teaching Hospital**

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**Abstract**

**Background:** Postoperative wound infection is an infection in the tissues of the incision and operative area. It can occur from 1 day to many years after an operation but commonly occurs between the fifth and tenth days after surgery. Keeping in view the prevalence of wound infections in our set up, this study was designed to evaluate the frequency, the antimicrobial prophylactic regimen, the hospital guidelines for surgical site infection prophylaxis and its adherence, to the internationally published guidelines.

**Patients and settings:** An observational Prospective study is used to detect the prescription, dosage, administration, interactions, and errors of peri-operative antibiotics. The study proceeded at Ain Shams University hospitals, pediatric surgery department which consists of three units the ward, the ICU, and the operation unit. There is no pharmacy inside the unit. Drugs are dispensed weekly from the floor pharmacy to the nurse and stored in the stock cabinet. Hundred surgical pediatric patients (major and minor surgeries) were enrolled.

Clinical information in physician's orders, laboratory test results, physician's progress notes, anesthesia reports were reviewed. Verbally communicated information from the parents about the medical history of patients was included. Medical records were screened for evidence of medication error and interactions occurrence taking into consideration that all the medication orders were handwritten. The data was obtained either directly from the patient, or by observations or from the patient's file. The following data were recorded: gender, age, dates of admission, surgery and discharge.

**Results:** The study results showed that 26 patients had acquired surgical site infections (26%). The infected cases are divided according to wound class as 4(8.9%) of the clean wound class, 13(39.4%) of the clean contaminated, 8(47.1%) of the contaminated wound class and 1(20%) of the dirty wound class have got surgical site infection. The adherence to the hospital protocol was 71% but 0% to the international protocols.

**Conclusion:** Adherence to the international guidelines is recommended to minimize the high rate of surgical site infections. Hospital should follow the recommended doses, regimen, and drug choice. Physicians, pharmacists, and nurses must be revised their roles in minimizing the infection rate.

**Introduction**

The definition of wound infection is revised by the centers for Disease Control (CDC) in 1992, by creating the definition of "surgical site infection" [SSI] which prevents the confusion between surgical incision infection and traumatic wound infection. SSIs contribute to the morbidity and mortality which are associated with surgeries, although most of SSIs are superficial [1].

Surgical site infection (SSI) previously termed postoperative wound infection is defined as that infection presenting up to 30 days after a surgical procedure if no prosthetic is placed and up to 1 year if a prosthetic is implanted in the patient. Based on a survey data there were over 290,000 infections in hospitalized patients in the US in the year 2002 of these, SSI was estimated to be directly responsible for 8205 deaths in surgical patients that year. SSI results in patient discomfort, prolonged length of hospital stay and increased cost [2].

The risk of developing SSI is affected by many factors which includes the degree of microbial contamination of the operation site indicated by wound class as clean, clean contaminated, contaminated and dirty, and also by patient age, length of surgery, pre-operative shaving of the operative site, hypothermia and co morbidities e.g. diabetes and obesity [3].

Surgical site infections are about 20% of healthcare associated infections. Failure of wound healing result in developing SSIs which increases treatment cost as it increases hospital stay time, admission to intensive care unit and higher post operative mortality. For each infected patient hospital cost is estimated at US$3937, therefore surgeons and other healthcare professionals are interested in prevention of SSIs [4].

Surgical wound classification is an indicator for infectious risk assessment, perioperative protocol development and making of surgical decision. Wounds are classified into 4 classes clean, clean-contaminated, contaminated, and dirty wounds with postoperative rates of SSI as 1-5%, 3-11%, 10-17%, and over 27%, respectively [5].

According to the Center for disease control (CDC) there are four types of wound class illustrated as following [6]:

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After the operation patients were either sent again to the ward or...
Differences in the rate of infection may be attributed to difference of the hospital population, underlying diseases. Differences in clinical procedures and the extent of infection control measures, difference in the hospitals environment. It can also be attributed to the high rate which resulted in this study to that the study is done in a teaching university hospital to which complex surgical cases are referred [8].

Table 2 illustrates wound class data that result in 4(8.9%) of the clean wound class, 13(39.4%) of the clean contaminated wound class, 8(47.1%) of the contaminated wound class, and 1(20%) of the dirty wound class got surgical site infections. Using Chi square test shows that there is a relationship between wound class and getting surgical site infection. As the P value = 0.003.

<table>
<thead>
<tr>
<th>Item</th>
<th>Total no.</th>
<th>Infected no.</th>
<th>Rate (sig&lt;0.05)</th>
<th>95% CI lower</th>
<th>upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean</td>
<td>45</td>
<td>4</td>
<td>8.9</td>
<td>0.003</td>
<td>NA</td>
</tr>
<tr>
<td>Clean-contaminated</td>
<td>33</td>
<td>13</td>
<td>39.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contaminated</td>
<td>17</td>
<td>8</td>
<td>47.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dirty</td>
<td>5</td>
<td>1</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From the results presented it was apparent that by applying the wound class analysis 4(8.9%) were of the clean wound class, 13(39.4%) were of the clean contaminated, 8(47.1%) were of the contaminated wound class and 1(20%) were of the dirty wound class have acquired surgical site infection. The previously mentioned results were in agreement with Ahmed M. et al. [7] where clean surgical cases were 7.2% and amongst clean-contaminated cases were 19.4% and with Wassef M., et al [12] where 8.2% clean wounds, 13.8% clean contaminated and 10.1% contaminated wound cases.

On the contrary, the results obtained by Khan M. et al [11] showed that 4.88% were clean cases, 8.39% were clean contaminated cases, and 20.45% were contaminated or dirty cases.

Postoperative infections after clean procedures are most probably caused by bacteria that are part of the skin flora; exogenous sources may also be a factor, such as infected or colonized healthcare workers, the operating room environment or instruments [13]. On evaluation of the hospital adherence to the international guidelines it was found that 100 cases their prophylaxis antibiotic regimens had not adhere to the hospital guidelines.

After studying the hospital guidelines for the prophylaxis of surgical site infections the following appeared:

1. The guidelines ignore the definition of prophylactic antibiotic as it should be given only pre operative before the incision by half an hour and if the duration of surgery exceeds the half life of the given drug the anesthesiologist should give another shot during the operation time.
2. The prophylactic antibiotic should be discontinued within 24 hours postoperatively.
3. The guidelines also ignores the determination of cephalosporins generation as the used generations in the hospital are third and fourth generation which definitely increases the resistance.

About the adherence of international guidelines shown in (tables 3, 4) we found that there was completely ignorance to those guidelines, which may be the cause the high incidence that was reported of surgical site infections in this study.
Vascular procedures: Clostridia can also be present in lower extremity amputation for ischemia [14-18].

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### Table 4: International published guidelines.

<table>
<thead>
<tr>
<th>Recommended intravenous antibiotics for surgical procedures</th>
<th>Common pathogens</th>
<th>Recommended antibiotic prophylaxis</th>
<th>Post operative duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac Heart surgery+, PDA (patent ductus arteriosus), ASD/VSD (atrial/ ventricular septal defect), Glenn Shunt, valve replant/replacement, prosthetic graft erosion Aortic reconstruction</td>
<td>S. epidermidis, S. aureus</td>
<td>Cefazolin OR Vancomycin for known MRSA or high risk for MRSA, or major reaction to beta-lactams++</td>
<td>Discontinue within 48/72 hrs of surgical end time</td>
</tr>
<tr>
<td>Gastrointestinal esophageal, gastrooduodenal PEG placement/ revision/ conversion to other feeding tubes OR high-risk conditions</td>
<td>Enteric gram-negative bacilli, gram positive cocci</td>
<td>For high risk+++: Cefazolin If major reaction to beta-lactams+++: Clindamycin plus Gentamicin. For high risk*: Cefazolin If major reaction to beta-lactam+++; clindamycin plus Gentamicin Cefoxitin OR Ampicillin/sublactam OR Cefazolin plus Metronidazole If major reaction to beta-lactams+++: Clindamycin plus Gentamicin</td>
<td>Discontinue within 24 hrs of surgical end time</td>
</tr>
<tr>
<td>Biliary, including lap cholecystectomy</td>
<td>Enteric gram-negative bacilli, gram positive cocci, clostridia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colorectal** Appendectomy or ruptured viscus</td>
<td>Enteric gram negative bacilli, anaerobes, enterococci</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head and Neck Surgery Incision through oral or pharyngeal mucosa, lower jaw fraction, removal of esophagus pouch</td>
<td>Anaerobes, enteric gram-negative bacilli, S.aureus</td>
<td>Cefazolin OR If major reaction to beta-lactams+++; Clindamycin plus Gentamicin</td>
<td>Discontinue within 24 hrs of surgical end time</td>
</tr>
<tr>
<td>Neurosurgery## Craniotomy, shunt placement/revision, insertion of pump/reservoir, spinal procedure (lamincetomy, fusion or cord decompression)</td>
<td>S. aureus, S. epidermidis</td>
<td>Cefazolin OR Vancomycin for known MRSA or high risk for MRSA, or major reaction to beta-lactams++</td>
<td>Discontinue within 24 hrs of surgical end time</td>
</tr>
<tr>
<td>Orthopedic Spinal procedures or implantation of hardware if tourniquet is used, give antibiotic before tourniquet inflation</td>
<td>S. epidermidis, S. aureus</td>
<td>Cefazolin or Cefepime and Vancomycin for known MRSA or high risk for MRSA, or major reaction to beta-lactams+++</td>
<td>Discontinue within 24 hrs of surgical end time</td>
</tr>
<tr>
<td>Thoracic Lung resection, VATS</td>
<td>S. aureus, S. epidermidis, streptococci, enteric gram-negative bacilli##</td>
<td>Cefazolin OR Vancomycin or Clindamycin for known MRSA or high risk for MRSA, or major reaction to beta-lactams++</td>
<td>Discontinue within 24 hrs of surgical end time</td>
</tr>
<tr>
<td>Vascular (see Cardiac) Extremity amputation for ischemia, vascular access for hemodialysis</td>
<td>S. aureus, S. epidermidis, enteric gram-negative bacilli</td>
<td>Cefazolin OR Vancomycin OR Clindamycin for known MRSA or high risk for MRSA, or major reaction to beta-lactams++</td>
<td>Discontinue within 24 hrs of surgical end time</td>
</tr>
<tr>
<td>Gynecologic</td>
<td>Enteric gram negative bacilli, anaerobes, Gp B strep; enterococci</td>
<td>Cefoxitin OR Ampicillin plus Metronidazole plus Gentamicin If major reaction to beta-lactam+++; Clindamycin plus Gentamicin</td>
<td>Discontinue within 24 hrs of surgical end time</td>
</tr>
<tr>
<td>Genitourinary Bladder augmentation, pyeloplasty</td>
<td>Enteric grammegative bacilli, anaerobes, enterococci</td>
<td>For high risk only**: Cefazolin OR Cefoxitin OR Ampicillin plus Metronidazole plus Gentamicin If major reaction to beta-lactam+++; Clindamycin plus Gentamicin</td>
<td>Discontinue within 24 hrs of surgical end time</td>
</tr>
</tbody>
</table>

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**For open-heart surgery only: use maximum cefazolin 2 gm; redose cefazolin when patient is removed from bypass; alternative to cefazolin monotherapy is cefazolin plus vancomycin for patients at high risk for MRSA. (Procedure involves insertion of prosthetic vascular graft).

++Major reactions include anaphylaxis, hives, shortness of breath, wheezing, edema. For minor reactions (nausea, vomiting, diarrhea, mild rash, itching), cephalosporins may still be used.

+++High risk gastrointestinal: morbid obesity, esophageal obstruction, decreased gastric acidity or decreased gastrointestinal motility

**High risk biliary: acute cholecystitis, non-functioning gall bladder, obstructive jaundice or common duct stones

**Colorectal procedures: Oral prophylaxis prior to surgery - After appropriate diet and catharsis, 1 gram of neomycin plus 1 gram of erythromycin at 1 pm, 2 pm, and 11 pm or 2 grams of neomycin plus 2 grams of metronidazole at 7 pm and 11 pm the day before an 8 am day operation

***High risk genitourinary: urine culture positive or unavailable, preoperative catheter, transrectal prosthetic biopsy, placement of prosthetic material

##Vascular procedures: Clostridia can also be present in lower extremity amputation for ischemia [14-18].
The obviously appeared SSI risk factor in this study was the more than 48 hours preoperative hospitalization. There are 24 patients had infection. Also from the 95% confidence interval we can conclude that the relationship between presence of risk factors and getting surgical site infection. 14(58.3%) of patients who have risk factor have got surgical site infection.

From the highly significant P value we can assure that, there is a relationship between presence of risk factors and getting surgical site infection. From also the 95% confidence interval we can conclude that staying more than 48 hours pre-operative in hospital is considered as a risk factor for developing surgical site infection, which is comparable to the result of Hafez S. et al. [9] (p value 0.007).

Conclusion

From the previously discussed study results we can conclude that; there is a high surgical site infection rate in the hospital when compared with the world wide rates or previously published researches outside Egypt.

High rates of infection may be referred to the low hygienic procedures applied during surgical operations. To minimize these rates the hospital is recommended to establish a clinical pharmacy department in the hospital with effective apparent roles and authorities, apply the international guideline in prophylactic antibiotic regimen in drug choice, drug dose and timing of injection. Infection Control team in the hospital must have an effective role in this mission. Physicians, Pharmacists, and nurses are recommended to assure the completely adherence to the roles published by the WHO.

References