Original Research Article

Comparative study on the sensitivity pattern between the Cephalosporins and Fluoroquinolones on wound infection isolates

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ABSTRACT

Human skin acts as an excellent barrier to infections provided it is not breached. A wound is a type of injury in which the skin is torn, cut or punctured (open wound) or where blunt force trauma causes a contusion (closed wound). It is further classified as accidental, pathological or post-operative according to its nature. The cephalosporins and Fluoroquinolones have been the most commonly prescribed antibiotics for the treatment of resulting wound infections based on sensitivity result. Hence this study is to comparatively evaluate the sensitivity pattern of the cephalosporins and Fluoroquinolones on wound infection isolates. A total of 50 samples were collected from various wound sites and inoculated on blood agar, McConkey agar and chocolate agar using streaking method of inoculation. Out of a total of 50 samples collected 45(90%) showed positive growth while 5(10%) showed no significant growth. 5 different bacteria species were isolated, characterized and identified following some standard microbiological technique. The most frequent isolate was Staphylococcus aureus (52.2%) followed by E. coli (26.1%), Pseudomonas aeruginosa (10.6%), Proteus spp (10.5%), and Klebsiella spp (5.3%). In the antibiotic sensitivity testing the Fluoroquinolones showed more sensitivity in comparison to the cephalosporins (85.5%) with the ciprofloxacin (65.2%) and levofloxacin (42.3%) been the most effective antibiotic. The Fluoroquinolones have a better and broader spectrum of activity than the cephalosporins which explains why they are more effective in the treatment of wound infection.

Keywords
Cephalosporins, Fluoroquinolones, sensitivity pattern, and wound infection

Introduction

A wound is a breach in the skin and the exposure of subcutaneous tissue following loss of the skin integrity which provides a moist, warm and nutritive environment that is conductive to microbial colonization and proliferation (Shittu, et. al., 2002. Nittin, et. al., 2013). If the integrity and protective function of the skin is breached, large
quantities of different cell types will enter
the wound and initiate an inflammatory
response. The current spread of multi-drug
resistant bacteria pathogens has added a new
dimension to the problem of wound
infections (Sule and Olusanya, 2000). This
is particularly worse in resource poor
countries where sale of antibiotics is under
poor control (Onile, 1997). A regular
bacteriological review of infected wounds is
therefore a necessity if affected patients
must receive qualitative health care, particulary when blind treatment is a
necessity, as in underdeveloped and
developing nations (Fadeyi et al., 2008).
The cephalosporins and Fluoroquinolones
have been the most commonly prescribed
antibiotics for the treatment of resulting
wound infections based on culture and
sensitivity results (Sule and Olusanya,
2000).

Wounds are populated by microorganisms
from two sources: exogenous (post-injury)
and endogenous (normal flora of skin and
mucous membranes) (Bhatt and Lakhey,
2007).

Most wounds have polymicrobial population
of aerobic and anaerobic bacteria, many
with predictable primary pathogen e.g. of
primary pathogens includes *Staphylococcus
aureus, Staphylococcus pyogenes* and
*Pseudomonas aeruginosa* while primary
anaerobic pathogens includes anaerobic
cocci, bacteriodes, protovella,
porphyromonas, clostridium and
environmental pathogens; here the source of
wound will define the microbial population
e.g. chronic wounds can be colonized by
hospital flora e.g. MRSA (Methicillin
resistant *Staphylococcus aureus*) e.t.c. (Cheesebrough, 2006)

It is now generally accepted that systemic
antibiotics are essential for the management
of clinically infected wounds, the choice of
antibiotics to be used is not always apparent
only after a comprehensive assessment
process including considerations of patients
characteristics, the results of microbiological
investigations and the identification of both
the nature and location of wound, can the
most appropriate antibiotic be identified.

There are various types of antibiotics but in
correlation to this work more emphasis will
be layed on the sensitivity pattern between
the Cephalosporin and Fluoroquinolones as
a result of their extensive use in the
treatment of wound infection.

Hence these work is to comparatively
evaluate the sensitivity pattern between the
cephalosporins and Fluoroquinolones on
wound infection isolates.

**Materials and Methods**

**Sample collection**

Wound swabs/pus samples were collected
with sterile disposable cotton
swabs(Cheesebrough, 2006), from patients
with suspected wound infection ranging
from road traffic accidents, surgical incision
site, and post -operative wounds .Moreso,
relevant datas such as age, sex, aetiology of
wound were obtained from patients. A total
of 50 samples were collected out of which
27 were male and 23 were female patients
falling between the age ranges of 14 –
42years.

**Bacterial isolation**

The samples were inoculated on the agar
plates(blood, chocolate, and mcConkey
agar) with the aid of a sterile wire loop by
streak plate method and it was incubated at 37 °C for 24 hours.

The growth of microorganisms in the culture plates were examined for the various characteristics which includes shape, size, elevation, surface, edges, colony structure degree of growth and nature.

**Identification and characterization of bacteria isolates**

Bacteria isolates were characterized and identified using two step approach namely biochemical test and gram staining (Cheesebrough, 2006). The characteristic features of the colonies observed were noted. The biochemical test carried out includes the following; catalase test, coagulase test, oxidase test and indole test.

**Antibiotic sensitivity test**

This is simply the susceptibility of bacteria isolates to antibiotics. It is carried out to determine which antibiotic will be most successful in treating a bacterial infection in vivo. Antibiotic sensitivity testing is often done by modified Kirby Bauer’s disc diffusion method on MullerHinton agar. Small wafer containing antibiotics are impregnated onto the MullerHinton agar upon which the bacteria isolate was inoculated. If the bacteria are sensitive to the antibiotic, a clear ring or zone of inhibition is seen around the disc indicating poor growth (Cheesebrough, 2006). Presence of zone of inhibition is not automatically interpreted as susceptibility to the antibiotics; the zone width has to be measured and compared against a reference standard which contains measurement ranges and their equivalent categories of susceptible or resistant.

**Method of data analysis**

Data collected were subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS) Version 20 for frequencies and percentages to determine the abundance of bacteria species. Analysis of Variance (ANOVA) was used to test similarities and variations among the groups of antibiotics against the different bacteria isolates.

**Result and Discussion**

Out of 50 samples collected 45 samples representing 90% yielded significant growth while 5 samples representing 10% yielded no significant growth. The gender distribution amongst the 45 sample that showed significant growth are as follows male 25(50%) and female 20(40%) as represented in Table 1.

The percentage distribution of isolates from different wound sites showed that surgical wound site 20(44.5%) were the most commonly infected. This was followed by post-operative wound 15(33.3%) and the least infected site was wound sepsis (road traffic accident) 10(22.2%) and this is depicted in Table 2.

Distribution of bacteria pathogen from surgical wound site showed that E. coli is the most prevalent organism accounting for 35% of the isolates, followed by Staphylococcus aureus 30% and the least prevalent was Proteus spp 5%. Staphylococcus aureus constituted the most common organism accounting for 46.7% from post-operative wound followed by E.coli 33.3%, and the least prevalent were Pseudomonas aeruginosa 6.7%, Proteus spp 6.7% and klebsiella spp 6.7%. Staphylococcus aureus 80% is the most common isolate from wound sepsis site. Generally Staphylococcus aureus 52.2% was the most prevalent isolates from all
wound sites followed by *E. coli* 26.1% and the least prevalent was *Proteus* spp 5.9% all of these are represented in Table 3.

Figure 1, 2 and 3 shows the inhibition zone diameter of the antibiotics against the bacteria isolates. As observed from the histogram, among the Fluoroquinolones *E. coli* from surgical wound site (20.17mm), post-operative site (19.93mm) and wound sepsis site (19.93mm) were the most susceptible organism while *Proteus* spp from surgical wound site (15.57mm), post-operative site (16.67mm) and wound sepsis site (15.67mm) were the least susceptible. Among the cephalosporins *Proteus* spp from surgical wound site (11.57mm), post-operative wound site (12.37mm), and wound sepsis site (11.60mm) were the least susceptible. In general the Fluoroquinolones shows more activity against the isolates.

In this work a total of 50 samples from various wound sites were included out of which male patients were 25(50%) and female patients were 20(40%). The most common isolate was *Staphylococcus aureus* (52.2%), *E. coli* (26.1%), *Pseudomonas aeruginosa* (10.6%) and the least isolates was *Proteus* spp which was (5.9%). A similar study conducted in Tribhuvan university teaching hospital by Singh et al., (2006) reported that 82.50% showed bacterial growth and 17 different bacterial species were isolated including predominantly *Staphylococcus aureus* 57.70% followed by *E. coli*. No significant growth from some of the samples in these study may be due to delay in transportation of samples to laboratory from site of collection.

Another reason is the collection of samples from patients taking antibiotics. Another similar study was also conducted by Kansakar et al., (2003) on bacteriology of wound infection and the antibiotic sensitivity pattern of the isolates reported that 60% of the samples collected were found to be positive growth and 17 different bacteria species was isolated. Most common isolate was *Staphylococcus aureus* (50%) followed by *E. coli* (11.9%), *Pseudomonas aeruginosa* (8.3%), *Klebsiella* species (8.3%) and *Proteus* species (5%) (Bhatt and Lakhey, 2007).

Antibiotic sensitivity testing of this study showed that the Fluoroquinolones were more sensitive in the treatment of wound infection in comparison to the Cephalosporins. *E. coli* from surgical wound site (20.17mm), post-operative site (19.93mm) and wound sepsis site (19.93mm) were the most susceptible organism when tested, *Proteus* spp from surgical wound site (15.57mm), post-operative site (16.67mm) and wound sepsis site (15.67mm) were the least susceptible. These results are reinforced by the study conducted in the United States where 70-80% isolates were susceptible to ciprofloxacin (Karlowst et al., 2003). Basically, the Fluoroquinolones have a better and broader spectrum of activity than the Cephalosporins (Desarro et al., 2001) which explains why they are more effective in the treatment of wound infection.

The most common isolate in wound infection was *Staphylococcus aureus* (52.2%), followed by *E. coli* (26.1%), *Pseudomonas aeruginosa* (10.6%) and the least prevalent isolate were *Proteus* spp and *Klebsiella* spp with the frequencies of (5.9%) and (5%) respectively.

The antibiotic sensitivity testing showed that the ciprofloxacin and levofloxacin (65.2%), (42.3%) respectively was the most effective antibiotic. Indiscriminate use of antibiotic has led to the development of antibiotic strains for commonly used drugs such as Fluoroquinolones and Cephalosporins, it is therefore suggested that a detailed study
with proper antibiotic usage, susceptibility testing irrespective of the organism isolated from wound swabs/pus samples is carried out to find out their resistance pattern so that modified antibiotics can be developed to completely tackle wound infection.

**Table.1** Gender distribution of significant growth

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number examined</th>
<th>Number with significant growth</th>
<th>Number without significant growth</th>
<th>Percentage (%) With significant growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>27</td>
<td>25</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>Female</td>
<td>23</td>
<td>20</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>45</td>
<td>5</td>
<td>90</td>
</tr>
</tbody>
</table>

**Table.2** Percentage distribution of isolates from different wound sites

<table>
<thead>
<tr>
<th>Wound sites</th>
<th>No. and percentage of samples with isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical</td>
<td>20 (44.5)</td>
</tr>
<tr>
<td>Post-operative</td>
<td>15 (33.3)</td>
</tr>
<tr>
<td>Wound sepsis</td>
<td>10 (22.2)</td>
</tr>
<tr>
<td>Total</td>
<td>45 (90)</td>
</tr>
</tbody>
</table>

**Table.3** Wound sites, number and percentage distribution of bacteria pathogen

<table>
<thead>
<tr>
<th>Wound site</th>
<th>Bacteria isolates No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Staphylococcus aureus</em></td>
</tr>
<tr>
<td>Surgical</td>
<td>6 (30)</td>
</tr>
<tr>
<td>Post-operative</td>
<td>7 (46.7)</td>
</tr>
<tr>
<td>Wound sepsis</td>
<td>8 (80)</td>
</tr>
</tbody>
</table>
Fig. 1 Inhibition zone diameter (mm) of antibiotics against the bacteria isolates on surgical wound sites

Fig. 2 Inhibition zone diameter (mm) of antibiotics against the bacteria isolates on post-operative wound sites
Fig.3 Inhibition zone diameter (mm) of antibiotics against the bacteria isolates on wound sepsis sites

![Inhibition zone diameter (mm) of antibiotics against the bacteria isolates on wound sepsis sites](image)

**References**


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