ORIGINAL ARTICLES

Successful control of schistosomiasis in large sugar irrigation estates of Zimbabwe .................... MJ Chimbari, B Ndlela ........................................ 169

Antibiogram of Klebsiella pneumoniae isolates from Buea, Cameroon ............................................ RN Ndip, VPK Titanji, TN Akenji, AM Mutanga, WF Mbacham, LM Ndip ........... 173

Model for assessment of endothelial cell function and viability using the MTT dye test and [3H] ..... DN Mbanya, PJ Kesteven, PW Saunders ........... 177

EDITORIAL

Editorial .................................................................................................... LF Levy ............................................................ 181

CASE REPORTS

Longstanding retained foreign bodies in the cranium: a short case report ........................................ H Boodhoo, SS Nadvi, N Nathoo ..................... 182

Endometriosis presenting as an obstructed femoral hernia: a case report ........................................ R Makunike, C Murunda, SD Saburi ..................... 184

LETTERS TO THE EDITOR

Earliest presenting sign and morbidity profile of sickle cell disease patients attending the adult SCD clinic at the UCH Ibadan, Nigeria .................................................. WA Shokunbi, TR Kotila, OA Dare ..................... 186

NOTES AND NEWS

Instructions to Authors .................................................. Central African Journal of Medicine .................. 188
Antibiogram of Klebsiella pneumoniae isolates from Buea, Cameroon

RN NDIP, VPK TITANJI, TN AKENJI, AM MUTANGA, WF MBACHAM, LM NDIP

Abstract

Objective: To determine the antibiotic susceptibility of K. pneumoniae isolates from Buea, Cameroon.

Design: A prospective study of K. pneumoniae isolates from clinical samples of nosocomial origin.

Setting: A laboratory based investigative study at the Biotechnology Centres of the Universities of Buea and Yaounde 1, Cameroon, and three Buea based hospitals. K. pneumoniae isolates were obtained from sputum, wound swabs and urine and screened for their antibiogram using standard procedures.

Results: Results on the antibiogram showed seven distinct antibiotypes distinguished by different susceptibilities to aminoglycosides (Spectinomycin and Gentamicin), Chloramphenicol and Augmentin. All the isolates shared multi-resistance to Amoxicillin and Trimethoprim. However, the isolates showed marked susceptibilities to Norfloxacin (90.01%), Cefuroxime (95.45%) and Ciprofloxacin (86.36%).

Conclusion: The study has revealed that K. pneumoniae isolates in the environment of Buea, Cameroon are multi-drug resistant. This finding is of clinical and epidemiological significance.

Introduction

Klebsiella pneumoniae is an important human pathogen that has been associated in recent decades with nosocomial outbreaks. They are important opportunistic pathogens, commonly isolated from urinary tract infections, surgical wounds, nosocomial pneumonia and bloodstream infections. These organisms are also an important source of transferrable antibiotic resistance, and several outbreaks caused by multiple resistant K. pneumoniae, especially the extended-spectrum β-lactamase-producing (ESBL) strains of the types TEM and SHV have been reported. Owing to their clinical significance, many methods exist for the epidemiological investigation of infections caused by this organism. In different parts of the world, biotyping, serotyping, antibiogram, plasmid profiles and more recent techniques like pulse field gel electrophoresis (PFGE) and random amplified polymorphic deoxyribonucleic acid (RAPD) analyses have been used in typing Klebsiellae.

In the present study, we decided to use antibiogram as an epidemiological marker for K. pneumoniae isolates because there is a high frequency of drug abuse in the environment of Buea, Cameroon. The penicillins, Chloramphenicol, and to a lesser extent the aminoglycosides are relatively cheap, and therefore commonly available to the population; who tend to abuse them, heralding the emergence of resistance. K. pneumoniae are known to be resistant to a number of antibiotics, including extended-spectrum cephalosporins and aminoglycosides, because of the acquisition of plasmids which code for the production of ESBL and aminoglycoside-modifying enzymes. However, it has been widely acclaimed that the susceptibility of pathogens to antibiotics varies with time and geographical location. Since they account for a significant proportion of nosocomial infections and the tendency of nosocomial pathogens to develop or acquire new antibiotic resistance traits poses a great problem in their treatment and control, it becomes necessary, therefore, to study the susceptibility patterns of K. pneumoniae isolates to some commonly used and relatively reserved antibiotics in Cameroon in order to update our knowledge on the use of these antimicrobial agents in the management of K. pneumoniae infections.

In Buea, Cameroon, there appears to be no report on the antibiogram and epidemiology of K. pneumoniae infections. In fact, we are not aware of any. It is against this background that the antibiogram of K. pneumoniae isolates was determined in an attempt to provide baseline data for clinical management and epidemiological surveys.
Results

Antimicrobial Susceptibility Patterns.

Table I shows the antimicrobial susceptibility results exhibited by K. pneumoniae isolates. Of the 22 isolates tested, over 85% were sensitive to the fluoroquinolones (Norfloxacin, Ciprofloxacin, Ofloxacin) and the Cephalosporin, Cefuroxime. Most strains showed varied susceptibilities to the Aminoglycosides (Gentamicin and Spectinomycin), Augmentin and Chloramphenicol. However, all isolates showed total resistance (100%) to Amoxicillin and Trimethoprim. K. pneumoniae isolates were identified as belonging to seven different antibiotypes (Table II) distinguished by different susceptibilities to Aminoglycosides, Chloramphenicol and Augmentin. Most of the isolates (77.3%) were resistant to three or more antibiotics. The predominant antibiotype \((\text{Amx}^R, \text{Tmp}^R)\) constituted nine (40.91%) of the isolates while the least patterns \((\text{Amx}^R, \text{Tmp}^R, \text{Aug}^S)\) and \((\text{Amx}^R, \text{Tmp}^R, \text{Chl}^R, \text{Aug}^S, \text{Gen}^R, \text{Spc}^R)\) were exhibited by one (4.54%) isolate respectively.

Table I: Antibiotic sensitivity results of K. pneumoniae strains isolated from various clinical specimens.

<table>
<thead>
<tr>
<th>Antibiotics</th>
<th>Susceptible (%)</th>
<th>Resistant (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimethoprim (5μg)</td>
<td>0 (0%)</td>
<td>22 (100%)</td>
</tr>
<tr>
<td>Norfloxacin (10μg)</td>
<td>20 (90.01%)</td>
<td>2 (9.99%)</td>
</tr>
<tr>
<td>Ciprofloxacin (5μg)</td>
<td>19 (86.36%)</td>
<td>3 (13.64%)</td>
</tr>
<tr>
<td>Gentamicin (10μg)</td>
<td>17 (77.27%)</td>
<td>5 (22.73%)</td>
</tr>
<tr>
<td>Cefuroxime (30μg)</td>
<td>21 (95.45%)</td>
<td>1 (4.54%)</td>
</tr>
<tr>
<td>Augmentin (30μg)</td>
<td>14 (63.64%)</td>
<td>8 (36.36%)</td>
</tr>
<tr>
<td>Amoxicillin (10μg)</td>
<td>0</td>
<td>22 (100%)</td>
</tr>
<tr>
<td>Ofloxacin (5μg)</td>
<td>21 (95.45%)</td>
<td>1 (4.54%)</td>
</tr>
<tr>
<td>Chloramphenicol (10μg)</td>
<td>13 (59.09%)</td>
<td>9 (40.91%)</td>
</tr>
<tr>
<td>Spectinomycin (30μg)</td>
<td>18 (81.82%)</td>
<td>4 (18.18%)</td>
</tr>
</tbody>
</table>

Table II: Antibiotypes of K. pneumoniae isolates.

<table>
<thead>
<tr>
<th>Antibiotypen</th>
<th>Number of strains with antibiotype</th>
<th>% with antibiotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{Amx}^R, \text{Tmp}^R)</td>
<td>9</td>
<td>40.91%</td>
</tr>
<tr>
<td>(\text{Amx}^R, \text{Tmp}^R, \text{Spc}^R)</td>
<td>3</td>
<td>13.64%</td>
</tr>
<tr>
<td>(\text{Amx}^R, \text{Tmp}^R, \text{Chl}^R)</td>
<td>2</td>
<td>9.09%</td>
</tr>
<tr>
<td>(\text{Amx}^R, \text{Tmp}^R, \text{Chl}^R, \text{Aug}^S)</td>
<td>2</td>
<td>9.09%</td>
</tr>
<tr>
<td>(\text{Amx}^R, \text{Tmp}^R, \text{Gen}^R, \text{Chl}^R, \text{Aug}^S)</td>
<td>4</td>
<td>18.18%</td>
</tr>
<tr>
<td>(\text{Amx}^R, \text{Tmp}^R, \text{Chl}^R, \text{Aug}^S, \text{Gen}^R, \text{Spc}^R)</td>
<td>1</td>
<td>4.54%</td>
</tr>
<tr>
<td>(\text{Amx}^R, \text{Tmp}^R, \text{Aug}^S)</td>
<td>1</td>
<td>4.54%</td>
</tr>
</tbody>
</table>

\(\text{Abreviations: Amx}—\text{Amoxicillin}; \text{Tmp}—\text{Trimethoprim}; \text{spc}—\text{Spectinomycin}; \text{Chl}—\text{Chloramphenicol}; \text{Aug}—\text{Augmentin}; \text{Gen}—\text{Gentamicin}.\)

nResistance.

Discussion

K. pneumoniae accounts for a substantial degree of nosocomial infections\(^{1,2}\) and the increasing tendency for nosocomial pathogens to acquire new antibiotic resistance traits poses a problem in chemotherapy\(^{10,17,23}\) revealing the need for an updated antibiotic susceptibility pattern for the effective management of infections caused by these organisms. This study reports on the antibiogram of K. pneumoniae. Results revealed that K. pneumoniae isolates showed marked susceptibilities to Ciprofloxacin, Norfloxacin, Ofloxacin, Cefuroxime and Gentamicin (Table I). The extreme susceptibility (95.45%) to the cefepime, Cefuroxime; the quinolones, Ofloxacin (95.45%), Norfloxacin (90.10%) and Ciprofloxacin...
(86.36%); the aminoglycosides, Spectinomycin (81.82%) and Gentamicin (77.27%) is at variance with those of other investigators.1,2,4,10,24,25

Though one isolate in this study showed4 low levels of susceptibilities to these drugs, the others documented extreme resistance to them, which they attributed to the production of ESBL. We speculate that the observed unusual difference could be related to the limited use of these drugs in Cameroon due to their high costs, therefore limiting the selection of resistant mutants. This could be further supported by the fact that previous studies have reported a wide distribution of these enzymes with the TEM-3 more prevalent in Europe, TEM-10, TEM-12 and TEM-26 in the USA, SHV-2 and SHV-5 world wide except sub-Saharan Africa.26

Until recently when it was reported in South Africa,22 these enzymes had been isolated from the Saharan African countries of Tunisia and Egypt.27 On the other hand, we are constrained to speculate that the non determination of ESBL production in our strains may be a contributing factor to this unusual susceptibility, especially to the cephalosporins, because production of β-lactamas is known to cause hidden resistance to the expanded-spectrum cephalosporins.28 Lower levels of susceptibility to Augmentin (63.64%) and Chloramphenicol (59.09%) were also observed corroborating a previous finding,4 even though a high degree of susceptibility (>80%) of the Klebsiellae to Chloramphenicol and Augmentin had been documented.29 This could be linked to the fact that Chloramphenicol, commonly used in our environment to treat typhoid fever, is highly abused13 thus putting a selective pressure on the drug, hence the emergence of resistance to it.

Results of this study revealed seven distinct resistance patterns (antibiotypes), of which the most prevalent exhibited resistance to Amoxicillin and Trimethoprim (Amx8, Tmp8) accounting for 40.91% of the isolates (Table II). This is also in agreement with the findings of Livrelli et al.4 The least patterns (Amx8, Tmp, Chl8, Aug8, Gen8, Spe8) and (Amx8, Tmp, Aug8) were exhibited by one (4.55%) isolate respectively. All the antibiotypes shared resistance to Amoxicillin and Trimethoprim. This suggests that these drugs may not be useful in the treatment of K. pneumoniae infections in this area.

An interesting feature of this study is that all K. pneumoniae isolates were resistant to two or more antibiotics. The multiple resistance to these drugs could be attributed to the fact that these antibiotics are highly abused due to constant and indiscriminate usage.13 Also, Klebsiellae are known to be an important source of transferable antibiotic resistance among Gram-negative bacilli.5,8,20 Consequently, the occurrence of multiply resistant Klebsiella strains might pose a potential problem in the treatment of infections in the study area.

With the use of an antibiogram, this study has provided baseline data for epidemiological research on K. pneumoniae infections in the environment of Buea, Cameroon. We, however, suggest the need to adopt discriminatory molecular typing methods such as RAPD and PFGE to complement the typing of K. pneumoniae isolates in our environment.

Acknowledgements

We are grateful to the University of Buea for providing equipment and some reagents used in this study. We also appreciate the cooperation received from the management of the Buea District Hospital, Mount Mary and the Military Hospitals, Buea where samples were collected.

References


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