Antibiotic Resistance of Gram-Negative Bacteria to Ampicillin, Gentamicin and Imipenem in Samples of the Patients Admitted to Shahidbeheshti Hospital in Kashan

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Abstract: Gram-negative bacteria (GNB) are among the commonest causes of infections. Lack of control on antibiotics use made GNB resistant to different antibiotics so susceptibility of 205 GNB samples to ampicillin, gentamicin and imipenem were evaluated. In our study there were 78% resistance rate of GNB to ampicillin, 26.3% resistance rate of GNB to gentamicin and 6.3% to imipenem. New strategies in controlling antibiotic resistance seem to be necessary.

Key words: Antimicrobial - Bacteria - Resistance - Ampicillin - Gentamicin - Imipenem

INTRODUCTION

Gram-negative bacteria (GNB) are common causes of intra-abdominal infections, urinary tract infections, nosocomial pneumonia and bacteremia [1]. *Escherichia coli*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* are important pathogens in the hospital setting, accounting for 27% of all pathogens and 70% of all Gram-negative pathogens causing healthcare-associated infections [1].

Gram-negative bacteria are highly adaptive pathogens that can develop resistance through several mechanisms [2]. Resistant Gram-negative bacteria are a serious global public health concern, especially in developing countries such as Iran that there are reports of high antibiotic resistance [3-6]. In the United States it has been estimated that as many as 2 million patients each year become infected with a bacterial infection that is resistant to antibiotics, with an estimated 23,000 deaths associated with these infections [7]. The prevalence of resistant Gram-negative bacteria can vary at local, regional, national and international levels [8]. Antibiotic-resistant infections pose considerable challenges to the health care system in relation to diagnosis, treatment and infection control, as well as considerable costs. In most cases, antibiotic-resistant infections require extended hospital stays, additional doctor visits and healthcare use. The estimates of the healthcare costs to the United States economy for antibiotic-resistant infections have ranged as high as $20 billion [7].

High bacterial resistance in our hospital settings [2, 5, 9, 10], as well as the presence of limited studies regarding antibiotic resistance of GNB in Iran made us to evaluate pattern of infection and bacterial susceptibility of GNB of the patients with positive culture of GNB in Shahidbeheshti Hospital in 2010-2011 for antibiotic resistance.

MATERIALS AND METHODS

In this retrospective study, that has been approved by Kashan University of Medical Sciences Ethical Committee, by referring to the Shahidbeheshti Hospital laboratory, cultures of Gram-negative bacteria isolated from different samples of patients admitted to the hospital from 1st Jun 2010 to 1st December 2011, were identified [11]. Susceptibility of every case to ampicillin, gentamicin and imipenem has been added to checklists and all data were analyzed with SPSS software version 11.5. Names of
Table 1: Susceptibility of different GNB to the three tested antibiotics

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Ampicillin</th>
<th>Gentamicin</th>
<th>Imipenem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S</td>
<td>I</td>
<td>R</td>
</tr>
<tr>
<td>E. coli</td>
<td>2</td>
<td>23</td>
<td>107</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>1</td>
<td>4</td>
<td>26</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>3</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Enterobacter</td>
<td>0</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Citrobacter</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Proteus</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Acinetobacter</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Brucella</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>34</td>
<td>160</td>
</tr>
</tbody>
</table>

the patients remained unrevealed. Antimicrobial susceptibility was evaluated by the Kirby-Bauer disk diffusion method in guidelines of Clinical and Laboratory Standards Institute [11].

RESULTS

From 205 samples that had been entered to checklists 97 (47.3%) were from male patients and 108 (52.7%) were from female ones. Different bacterial types can be seen in figure 1 and the pattern of susceptibility among samples of patients with GNB are shown in figure 2.

Different bacterial resistance pattern can be seen in table 1 and figure 3.

DISCUSSION

Antibiotics are critical in the fight against infectious disease caused by bacteria. Antimicrobial chemotherapy has been a leading cause for the dramatic rise of average life expectancy in the Twentieth Century. However, disease-causing microbes that have become resistant to drug therapy are an increasing public health problem [10]. There are reports of increasing in GNB resistance to different antibiotics [8, 10].

In our study there was 78% resistance rate of GNB to ampicillin. Resistance rate of E. coli, Klebsiella, Pseudomonas, Enterobacter, Citrobacter, Proteus, Acinetobacter and Brucella to ampicillin was 81, 84, 70, 80, 57, 50, 0 and 0% respectively. There was 26.3% resistance rate of GNB to gentamicin. Resistance rate of E. coli, Klebsiella, Pseudomonas, Enterobacter, Citrobacter, Proteus, Acinetobacter and Brucella to gentamicin was 24, 22.5, 55, 20, 14.2, 0, 50 and 0% respectively; and there were 6.3% resistance rate of GNB to imipenem. Resistance rate of E. coli, Klebsiella, Pseudomonas, Enterobacter, Citrobacter, Proteus, Acinetobacter and Brucella to imipenem was 3, 6.4, 25, 10, 0, 0, 50 and 0% respectively.

Resistance of E. coli to ampicillin in Tadesse et al [12] study was 24.1% that is way lesser than our 81% result. In a study by Iqbal et al. [13] the resistance rate of E. coli to ampicillin, gentamicin and imipenem was 76%, 37% and 0.3% respectively. Our results regarding ampicillin and imipenem resistances are in accordance with this study and regarding gentamicin, our 24% results are less than 37% results of Iqbal et al. [13] study and may show different profiles in the two study environments of these three antibiotic use.
Our results of ampicillin resistance is quite shocking because this antibiotic with the high resistance, we obtained, is practically useless in medicine. Karlowsky et al. [14] announced *E. coli* ampicillin resistance from 1998 to 2001 range from 36% to 37.4 whereas our results are twice as much as those.

Gail et al. [15] investigated 7225 sample of *E. coli* that showed the resistance rate of 30, 4 and 1% in 1990-1993 for ampicillin, gentamicin and imipenem. In this study, ampicillin, gentamicin and imipenem resistance rates were 38, 8 and 2% regarding *Klebsiella; 76, 7 and 3% regarding Enterobacter and 98, 35 and 13% regarding *Pseudomonas* respectively.

Our high results of ampicillin resistance shows that it is not useful in treating most of GNB infections any more. If we do not control the increasing trend of other antibiotics such as gentamicin and imipenem, we will soon lose their efficacy in treating such infections.

REFERENCES
