Full Length Research Paper

Antibiotic susceptibility patterns of *Pseudomonas aeruginosa* strains isolated from various clinical specimens

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Infections with *Pseudomonas aeruginosa* have high morbidity and mortality rates. Quick and efficient antibiotherapy can reduce these infections effectively. The aim of this study is to detect the antibiotic susceptibility pattern of *P. aeruginosa* isolated from various clinical specimens in Sulaimani Teaching Hospital, Iraq. This study was conducted during June 2012 to June 2013. During this period total of 420 samples were tested. Out of this 420 samples, 75 clinical isolates of *P. aeruginosa* were isolated. In this study, isolates from various clinical samples are sensitive to gentamycin (54.7 %) followed by amikacin (62.7%), imipenem (96%), meropenem (98.7%), ceftazidime (82.7%), piperacillin (70.7%), tobramycin (69.3 %), ciprofloxacin (73.3 %), ceftriaxon (8%), and cefotaxime (0%). The results indicate that *P. aeruginosa* isolates in our hospitals have high susceptibility to meropenem, imipenem, and ceftazidime than other antibiotics. This should be taken into consideration when empirical therapy is planned by the clinicians in our hospitals.

**Key words:** Antibiotic susceptibility, *Pseudomonas aeruginosa*.

INTRODUCTION

*Pseudomonas aeruginosa* is a Gram negative, non sporeforming, straight or slightly curved rod-shaped bacterium that occurs as a single bacterium in its pairs and occasionally in short chains. It is widely distributed in nature including soil, water and various types of vegetation throughout the world. Besides that it has also revealed its presence in disinfectants, respiratory equipment, sinks, taps, and mops within the hospital as a biofilm. This organism found its entry into the hospital environment either through visitors and patients or goods that enter in hospital. Contact transmission or vehicle transmission is common mode of transmission in hospital (Todar, 2011; Murray et al., 2002). *P. aeruginosa* is an opportunistic nosocomial pathogen. Its infections is common in hospitalized patients, particularly those who are debilitated or immunocompromised for example in intensive care units, HIV-infected patients, particularly those in advanced stages are at risk groups. *P. aeruginosa* infections can develop in many anatomic sites, including skin, subcutaneous tissue, bones, ears, eyes, urinary tract, and heart valves. The site may varies with the portal of entry and the patient's vulnerability. In hospitalized patients, the first sign may be overwhelming Gram negative sepsis (Hoge et al., 2010; Murray et al., 2002). Today *P. aeruginosa* is feared as a dangerous opportunistic bacterium responsible for frequently lethal nosocomial infections. It is resistant to many disinfecting agents and highly resistant against most antibiotics (Hancock, 1998).

The aim of this study was to detect the antibiotic susceptibility of *P. aeruginosa* isolated from various clinical specimens in Teaching Hospital, Sulaimani, Iraq.

MATERIALS AND METHODS

Design and sample collection

This study was conducted at the microbiological laboratory of the teaching hospital in Sulaimani city, Iraq.
This study was conducted during June 2012 to June 2013. The study includes 75 clinical isolates of *P. aeruginosa* from 420 samples in which 235 samples were from burn, 110 samples were from wound surgery, 22 samples were from ear and 53 urine samples. In burn and wound exudates, a dry swab was moistened with a Brain-Heart Infusion broth and sample was taken from depth of lesion. In ear infection, swabs were taken after cleaning the external auditory canal while in UTIs, midstream urine was taken in sterile wide mouth containers. All specimens were transported to the lab without delay.

### Isolation and identification of bacteria

These samples were transferred to the microbiological laboratory of the Teaching Hospital laboratory, then inoculated on to blood, MacConkey (Oxoid,CM07,UK) and Nutrient agar (Oxoid,CM17,UK) and incubated at 37°C for 18 - 24 h; colonies that produce pyocyanin, pyoverdin and pyorubin pigments were transferred to nutrient agar and subcultured more than one time to obtain pure cultures (Forbes et al., 2007). The isolates were identified using conventional biochemical tests such as motility test, oxidase test, catalase test, citrate utilization test, triple sugar iron agar test, urease production test, indole test, nitrate reduction test, oxidative-fermentative test, gelatinase liquefaction, haemolysin production, alkaline protease production, lecithinase production (Atlas and Synder, 2006; Garcia and Isenberg 2007).

### Antibiotic susceptibility testing

*In vitro* antimicrobial susceptibility testing of isolates were carried out using the disk diffusion method according to the Clinical and Laboratory Standards Institute on Mueller-Hinton agar (Merck, Germany) plates (CLSI, 2012). Bacterial isolates were tested against the following antimicrobial drugs: gentamicin, amikacin, imipenem, meropenem, piperacillin, ceftazidime, tobramycin, ciprofloxacin, cefotaxime, and ceftriaxone (Bioanalyse, Turkey). The antimicrobial susceptibilities were expressed as the percentage of isolates that were susceptible.

### RESULTS

A total of 420 samples were collected from burns, wounds, urine and ear, from the Teaching Hospital in Sulaimani city between June 2012 and June 2013. The 25.53% of strains were isolated from burn materials, 9.09% from wound materials, 5.66% from urine, and 9.09 % from ear samples. The distribution of *P. aeruginosa* isolates from different specimens are shown in Table 1.

<table>
<thead>
<tr>
<th>The specimens (n)</th>
<th><em>P. aeruginosa</em> n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burn injures (235)</td>
<td>60 (25.53)</td>
</tr>
<tr>
<td>Wound surgery (110)</td>
<td>10 (9.09)</td>
</tr>
<tr>
<td>Urine (53)</td>
<td>3 (5.66)</td>
</tr>
<tr>
<td>Ear swab(22)</td>
<td>2 (9.09)</td>
</tr>
<tr>
<td>Total (420)</td>
<td>75 (17.85)</td>
</tr>
</tbody>
</table>

In this study, with regards to gender, 43 (57%) subjects were male while 32 (43%) were female. The age of the subjects was ranged from 16 to 67 years (Figures 1 and 2).

The antibiotic susceptibility was determined according to CLSI standards. The resistance rates to ceftriaxone were found to be 82.7%, to gentamicin 40%, to amikacin 36 %, to tobramycin 25%, to piperacillin 24%, ciprofloxacin 24%, to ceftazidime 12%, to imipenem and meropenem 0%. The most effective antibiotics against *P. aeruginosa* were imipenem and meropenem. The results of antimicrobial susceptibility were shown in Table 2.

### Discussion

*P. aeruginosa* is primarily a nosocomial pathogen. It is the most common cause of infections of burn sepsis and of UTIs and the otitis externa. *P. aeruginosa* is usually prevalent among patients with cystic fibrosis, organ transplants and acute leukemia. Infections with the pathogen have high mortality rates (Bodey et al.1983; Diekema et al.1999). In the present, we aimed to determine the antibiotic susceptibility pattern of 75 *P. aeruginosa* strains isolated from different clinical sources. In the study, the isolation rate of *P. aeruginosa* and their antibiotic susceptibility pattern were comparable with other studies. These microorganism found along with other *Pseudomonas* species as part of the normal flora of human skin. It seldom causes infection in healthy individuals, while it can cause serious infections in immunocompromised hosts such as those with severe burns or wound surgery (Dale et al., 2004). In our study, the most frequent isolates of *P. aeruginosa* were isolated from burn injures (25.53%), followed by wound surgery (9.09%), ear swab (9.09%), and urine (5.66%).
**Figure 1.** P. aeruginosa isolates among different patient age groups.

**Figure 2.** The sex wise distribution of the isolation score among the study population.

**Table 2.** Antimicrobial susceptibility of P. aeruginosa isolated from various clinical samples.

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Resistance n (%)</th>
<th>Intermediate n (%)</th>
<th>Sensitive n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gentamicin</td>
<td>30 (40)</td>
<td>4 (5.3)</td>
<td>41 (54.7)</td>
</tr>
<tr>
<td>Amikacin</td>
<td>27 (36)</td>
<td>1 (1.3)</td>
<td>47 (62.7)</td>
</tr>
<tr>
<td>Imipenem</td>
<td>0</td>
<td>3 (4.0)</td>
<td>72 (96.0)</td>
</tr>
<tr>
<td>Meropenem</td>
<td>0</td>
<td>1 (1.3)</td>
<td>74 (98.7)</td>
</tr>
<tr>
<td>Piperacillin</td>
<td>18 (24)</td>
<td>4 (5.3)</td>
<td>53 (70.7)</td>
</tr>
<tr>
<td>Ceftrazidime</td>
<td>9 (12)</td>
<td>4 (5.3)</td>
<td>62 (82.7)</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>19 (25)</td>
<td>4 (5.3)</td>
<td>52 (69.3)</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>18 (24)</td>
<td>2 (2.7)</td>
<td>55 (73.3)</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>60 (80)</td>
<td>9 (12)</td>
<td>06 (8.0)</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>62 (82.7)</td>
<td>13 (17.3)</td>
<td>0</td>
</tr>
</tbody>
</table>
results are in line with studies of Haleem et al. (2011) and Zhanet al. (2013). In this study, sex wise distribution of clinical isolates shows that cases caused by *P. aeruginosa* are more common in males (57%) compared to females (43%). In our study, most of the patients (45.33 %) were aged between 41 - 60 years. This is comparable with study of Rajat et al. (2012) and Mohan et al. (2013).

The bacteria can develop resistance to antibacterials both through the resistance genes on extrachromosomal genetic elements and through mutational processes (Lister et al., 2009). Increasing resistance to different antibiotics especially among nosocomial strains, has been reported world-wide (Orrett 2004; Chen et al., 1995; Jones et al., 2002) and this is an important therapeutic problem in the treatment of disease due to the pathogens. From previous literature high rate of resistance against cephalosporins, quinolones and carbapenems had been detected in *P. aeruginosa* (Shahcheraghi et al.,2009; Güney et al.2011; Fatima et al.2012). In our study, the sensitivity rate against imipenem and meropenem from carbapenems were determined as 100 %. In the present work, the isolates are sensitive to gentamicin (54.7%) followed by amikacin (62.7 %), tobramycin (69.3 %), ciprofloxacin (73.3 %), piperacillin (70.7 %), ceftazidime (82.7 %), ceftriaxon (8.0 %), and cefotaxime (0%). The obtained results are in line with studies of Shahcheraghi et al. (2009), Vaziri et al. (2011), McCracken et al. (2011), and Mohan et al. (2013). Our results indicate that *P. aeruginosa* strains in our hospital have higher resistance to cefotaxime and ceftriaxon than other antibiotics. This should be taken into consideration when antimicrobial therapy is planned by the clinicians in our hospital.

CONCLUSIONS

*P. aeruginosa* is one of the most frequently isolated nosocomial pathogens in our hospitals, therefore, burn exudates, surgical wounds exudates and urine samples were the commonest source of *P. aeruginosa* infections followed by ear discharges. Health workers must be made aware of the increasing resistance of nosocomial microorganisms and the proper administration of antibiotics in treating such infections. For practicing physicians, clinical microbiologists and public health officials, knowledge of local antimicrobial resistance patterns is essential to guide empirical therapy. More antibiotics currently administered in our hospitals should be included in the study to determine the level of resistance of microorganisms to them. Regarding treatment meropenem, imipenem, ceftazidime, ciprofloxacin, tobramycin and amikacin may be useful to control the difficult-to-treat *P. aeruginosa* infections in local area to combat the seriousness of pseudomonal infections. In addition, preventive strategies such as prudent antimicrobial use and infection control should be advocated to delay emergence of clinically significant drug resistant *P. aeruginosa*. The result of the present study has significant implications for practicing physicians in the region, with regard to empirical antipseudomonal selection. Also, it proved on the importance of legislation of the usage of antimicrobial agents in the area.

REFERENCES


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