Original article

Antibiotic susceptibility pattern of isolates of *Pseudomonas aeruginosa* in a Saudi Arabian Hospital

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Abstract

Pseudomonas aeruginosa is one of the most common gram-negative bacteria. identified in the clinical specimens of hospital admitted patients. A major problem in *P. aeruginosa* infection may be that this pathogen exhibits a high degree of resistance to a broad spectrum of antibiotics. The study aimed to isolate and determine the antimicrobial susceptibility patterns of the *P. aeruginosa*. This prospective study was done over a period of six months. Forty one clinical isolates of *Pseudomonas aeruginosa* (*P. aeruginosa*) were isolated from sputum specimens of the patients suspected of having respiratory tract infection. The antibiotic susceptibility profiles of all the isolates were determined using disk diffusion method as recommended by Clinical Laboratory Standards Institute. Ciprofloxacin was found to be the most effective antimicrobial agent with 85.4% susceptibility followed by imipenem (75.6%), aminoglycosides (amikacin, 95.1% and gentamicin, 90.3%), and the beta-lactams (cefepime 65.8%, ceftazidime, 51.2%). Piperacillin showed the maximum resistance (46.3%) followed by Aztreonam (36.6%). Regular antimicrobial susceptibility surveillance is essential for area-wise monitoring of the resistance patterns. An effective national and state level antibiotic policy and draft guidelines should be introduced to preserve the effectiveness of antibiotics and for better patient management.

Key Words: Antibiotic susceptibility patterns, *P. aeruginosa,* respiratory tract infection, multiple antibiotic resistance

Introduction

Widespread occurrences of Pseudomonas bacteria in nature were observed early in the history of microbiology. The bacterial strains of Pseudomonas genus are widely distributed in nature, but the most common human pathogen is *Pseudomonas aeruginosa*.[1] This bacterium is an important pathogen causing severe and life threatening infections in immunocompromised hosts, such as patients suffering from respiratory disease, cancer patients undergoing chemotherapy, and children and young adults with cystic fibrosis. Moreover, it is a leading cause of nosocomial infections and is associated with a high mortality rate. One of the remarkable reasons for this high mortality is its notable resistance to many currently available antibiotics. Yet, comparative analyses of the emergence of resistance associated with different classes of antipseudomonal drugs are lacking, even though knowledge about the relative risks of resistance with different antibiotics could be useful in helping to guide therapeutic choices.[2]

Ongoing surveillance of *P. aeruginosa* resistance against antimicrobial agents is fundamental to monitor trends in susceptibility patterns and to appropriately guide the clinician in choosing empirical or directed therapy, especially when new antimicrobial agents may not be readily available in the near future.[3] However, there is a few recent surveillance studies reporting antimicrobial resistance patterns of *P. aeruginosa* in some locations in Saudi Arabia.[4,5]

Over the past few years, a notable increase in antibiotic resistance among gram negative bacteria recovered from hospitalized patients has been reported, especially for critically ill patients.[6] Infections caused by multidrug resistant (MDR) gram negative bacteria, especially MDR *P. aeruginosa* are associated with significant morbidity and mortality.[7] Additionally, Hospital acquired Infections increase hospital lengths of stay and health care expenditures.[8] Multidrug-resistant strains of *P. aeruginosa* are often isolated among patients suffering from nosocomial infections particularly those receiving intensive care treatments.[9]

The aim of this study was to assess the current levels of antimicrobial susceptibility and to evaluate the resistance mechanisms to antipseudomonal antimicrobial agents among the clinical isolates of *P. aeruginosa* isolated from patients suffering from

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respiratory tract infection admitted to King Khalid Hospital, Al-Kharj, Kingdom of Saudi Arabia.

Materials and Methods

A total of 147 Sputum specimens of the patients suspected of having respiratory tract infection were collected. Of these 98 were males and 49 females, who were admitted to King Khalid Hospital, Al-Kharj, Kingdom of Saudi Arabia between July 2011 and December 2011. The mean age of the patients was 22.2 years, and the male-to-female ratio was 2:1. The specimens were collected in sterile bottles and brought to the Microbiology Laboratory and then processed within one to two hours. The specimens were cultured on blood Agar, chocolate Agar, MacConkey agar and Sabouraud agar plate. All plates were incubated at 37°C in an incubator. The plates were read after 24 hours and the Sabouraud plates were reincubated for a further 24 hours if there was no growth. A total of forty one isolates of *Pseudomonas* strains were identified as *P. aeruginosa* using conventional biochemical tests.[10]

Antibiotic susceptibility testing

The Kirby-Bauer disk diffusion method[11] was performed to determine the antibiotic susceptibility. The antibiotics tested were Gentamicin (10 μg), Impenem (10 μg), Amikacin (30 μg), Piperacillin (100 μg), Ciprofloxacin (5 μg), Ceftazidime (30 μg), Aztreonam (30 μg), Meropenem (10 μg), and Cefepime (30 μg). Results of disk diffusion method were interpreted in accordance to the Clinical and Laboratory Standards Institute (CLSI, 2000)[12].

Results

Of the 147 samples subjected to culture and sensitivity, 41 reported the presence of *Pseudomonas aeruginsosa*, thereby suggesting 27.9% as the occurrence level, of which 63.4% (i.e. 26 samples) and 36.6% (i.e.15 samples) were reported from males and females respectively. The antimicrobial susceptibility testing revealed that *P. aeruginosa* strains were highly sensitive to most of the antibiotics tested, which are shown in Table I and Figure I. The percentage of sensitivities were ciprofloxacin (85.4%), imipenem (75.6%), amikacin (95.1%), gentamicin (90.3%), cefepime (65.8%), ceftazidime (51.2%), meropenem (70.7%), piperacillin (46.3%), Aztreonam 36.6% and the percentage of resistance were ciprofloxacin (14.6%), imipenem (24.4%), amikacin (4.9%), gentamicin (9.7%), cefepime (43.2%), ceftazidime

(48.8%), meropenem (29.3%), piperacillin (53.7%), Aztreonam (63.4%).

Discussion

P. aeruginosa infection is a serious cause of nosocomial infections. With the widespread use of antibiotics and increase in the number of immunosuppressed hosts, *P. aeruginosa* has become a leading cause of gram-negative bacterial infections especially in immunosuppressed patients who need prolonged hospitalization.[13] The increasing rate of *P. aeruginosa* strains in a wide spectrum of clinical steerings determine them as emerging pathogens, especially in intensive care units (ICUs) and justifies the necessity for antimicrobial-resistance surveillance. Periodic antimicrobial resistance monitoring in *P. aeruginosa* infection is fundamental to updating the current activity level of commonly used antipseudomonal drugs.[3]

Ciprofloxacin was found to be the most effective agents (85.4% sensitivity) followed by imipenem and meropenem (75.6% and 70.7%, respectively). A study in Saudi Arabia also showed 85% of the *P. aeruginosa* isolates sensitive to ciprofloxacin.[3] In our study we found a high resistance to Piperacillin, Aztreonam Ceftazidime. Similar results have been reported in a study from Saudi Arabia.[14,15]

It was reported that the majority of meropenem-resistant *P. aeruginosa* showed resistance to imipenem, but almost half the imipenem resistant strains were susceptible to meropenem. Moreover, the strains resistant to meropenem were also resistant to ciprofloxacin and carbenicillin.[16] Imipenem has been reported to be very active against *P. aeruginosa* in a number of recent studies[17] while other has reported otherwise.[18] Resistance to 3 or more antibiotics (MDR) was about 20%.

In our study the rates of antimicrobial resistance of the isolates were 14.6 % to ciprofloxacin, 34.2 % to cefepime, 4.9% to amikacin, 24.4% to imipenem, 48.8% to ceftazidime, 9.7% to gentamicin and 53.7% to piperacillin. Among the aminoglycosides, amikacin has the highest sensitivity against *P. aeruginosa*, which is in corroboration with an earlier report published from Saudi Arabia.[14] Amikacin was designed as a poor substrate for the enzymes that bring about inactivation by phosphorylation, adenylation or acetylation, but some organisms have developed enzymes that inactivate this agent as well. Amikacin seems to be a promising therapy for Pseudomonal

infection. Hence, its use should be restricted to severe nosocomial infections, in order to avoid rapid emergence of resistant strains.[19] The problem of increasing resistance to *P. aeruginosa* has limited the use of other classes of antibiotics like the fluoroquinolones, tetracyclines, macrolides and chloramphenicol.[20] Drug resistance levels in different hospitals in Saudi Arabia and others countries too have been reported in the past and antibiotics in the respective hospitals are recognized to the differential usage. When we compared to previous Saudi Arabian studies,[14] our study showed higher resistance rates to all drugs tested except ciprofloxacin and imipenem.

Among the 41 clinical isolates of *P. aeruginosa* tested in our study, twenty percent (20%) of the isolates were found to be multidrug-resistant (MRD).

In summary, Ciprofloxacin was found to be the most active antimicrobial agent followed by imipenem. Aztreonam showed the maximum resistance followed by Piperacillin. Among aminoglycosides amikacin was found to be highly sensitive. Periodic susceptibility testing should be carried out over a period of two to three years, to detect the resistance trends. Also, a rational strategy on the limited and prudent use of anti-Pseudomonal agents is urgently required.

Table I Antibiotic Sensitivity Pattern of *Pseudomonas aeruginosa*

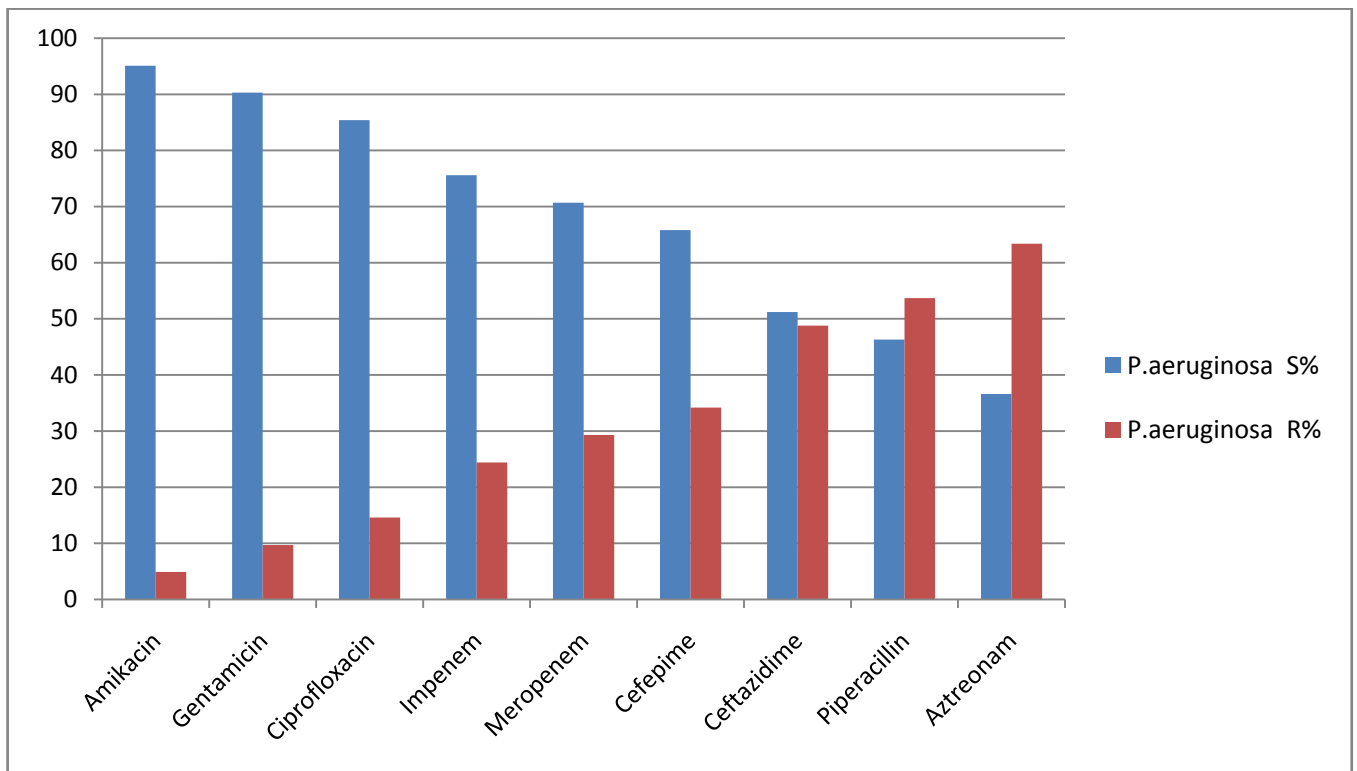| Percentage (%)	Amikacin	Gentamicin	Ciprofloxacin	Imipenem	Meropenem	Cefepime	Ceftazidime	Piperacillin	Aztreonam
Sensitive (S)	95.1	90.3	85.4	75.6	70.7	65.8	51.2	46.3	36.6
Resistant (R)	4.9	9.7	14.6	24.4	29.3	34.2	48.8	53.7	63.4

Figure I Antibiotic sensitivity profile of *P.aeruginosa*

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