Volume VII, Issue II, April 2016   **Research Article**

Prevalence and Antibiotic Susceptibility Pattern of *Pseudomonas aeruginosa* Isolated from Hospital Environment in South Libya

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Abstract: *Pseudomonas aeruginosa* has been emerged as a significant pathogen and is the most common dreadful gram-negative bacilli found in various health care associated infections all over the world due to its virulence, well-known ability to resist killing by various antibiotics and disinfectants. The aim of this study was isolation and identification of *Pseudomonas aeruginosa* in the hospital environment and determining the antibiotic susceptibility of the isolates to four antibiotics (Ciprofloxacin, Amikacin, Imipenem, and Piperacillin).

A total of 200 sterile cotton swab samples were collected from hospital environment including ground, walls, beds, bed sheets, blankets, doors, doors handle, nurse tables, trays, chairs, electronic equipment's, medicine cabinet, windows and (operation theater) (Sabha medical center and Brack general hospital were enrolled in this cross-sectional study). Bacterial isolates were identified by standard microbiological procedures. Antibiotic susceptibility testing was carried out by disc diffusion method.

Results revealed that out of the 200 collected samples, 12 *Pseudomonas* spp. (6%) were isolated. Other different bacterial species isolated were 148 (74%) and 40 samples (20%) were negative for growth. Most isolates were obtained from sinks 6 (50%) and then ground 2 (16.7%), Air conditions 2 (16.7%), walls 1 (8.3%), Chairs 1 (8.3%). we found that all *Pseudomonas* spp. isolates were sensitive to Ciprofloxacin, Amikacin, Piperacillin, and Imipenem.

Keywords: *Pseudomonas aeruginosa,* hospital contamination, antibiotic susceptibility pattern.

1. Introduction

Nosocomial infection or hospital-acquired infections (HAIs) are one of the most important problems in the worldwide. These infections are more dangerous than other infections because they are caused by bacteria have a high resistance to antibiotics. These infections are an important cause of increased morbidity, mortality and healthcare costs worldwide (Maheswaran *et al*., 2007). According to a study cited by the WHO (World Health Organization), over 1.4 million people worldwide suffer from HAI at any given time (Ducel *et al*., 2002). The risk of nosocomial infection depends on a number of factors. These include the ability of pathogens to remain viable on a surface,

the rate at which contaminated surfaces are touched by patients and healthcare workers, the context in which the patient is exposed, and the levels of contamination that result in transmission to patients (Boyce, 2007). For many healthcare-associated pathogens, the degree of hospital surface contamination is closely correlated with the risk of transmission (Nseir *et al*., 2011).

Pseudomonas spp. are commonly found in nature (soils, water, plants, and animals) and water treatment systems, thus demonstrating their adaptation to environments with low nutrient concentration, and over a large temperature range, between 4 and 42°C (Penna *et al*., 2002). Pseudomonads are diverse group of established and emerging pathogen and are major agents of nosocomial and community acquired

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infections, widely distributed in the hospital environment where they are particularly difficult to eradicate (Ravichandra *et al*., 2012). Most members of the genus (especially *Pseudomonas aeruginosa*) are opportunistic pathogens often associated with infections of the urinary tract, respiratory system, soft tissue, bone and joint, gastrointestinal infections, dermatitis, bacteremia, and a variety of systemic infections, particularly in patients with severe burns, cancer and AIDS (Pirnay *et al*., 2005).

Antibiotic-resistant bacteria are implicated in an increasing amount of hospitalized patient infections worldwide. Among patients diagnosed with an infection, antibiotic resistance is associated with an increased length of hospital stay, health care costs, and patient morbidity, and mortality (Boyce and Pittet, 2002). *Pseudomonas aeruginosa* is one of the most important microorganisms which causes problems clinically as a result of its high resistance to antimicrobial agents. The widespread occurrence of antibiotic resistant strains of *Pseudomonas aeruginosa* in hospitals is a matter of growing concern. Unfortunately, there are no specific measures to prevent nosocomial pseudomonal infections (Lutfu *et al*., 2005). The overall prevalence of antibiotic resistant *P. aeruginosa* is increasing, with up to 10% of global isolates found to be multi-drug resistance. It is recognized as the second leading cause of gram-negative nosocomial infection and a major treatment challenge for *Pseudomonas aeruginosa* (Nasreen *et al*., 2015). Infections in hospitals are dynamic: patients, staff, and visitors can import any kind of infection into hospital, and they can also acquire infections within hospital and carry infectious agents to other hospitals or into the community. The term 'nosocomial infection' is usually restricted to the infections that patients acquire in hospital, but has importance in occupational medicine as well. The development of infections follows certain well-defined rules, the understanding of which is important for prevention. Microbiological diagnosis is essential to understand the importance of the diagnosis of infections (Zsolt Filetoth, 2003). Rapid and accurate detection of *Pseudomonas aeruginosa* is necessary to implement adequate infection control measures to prevent nosocomial spread. The aim of this study was isolation and identification of *Pseudomonas aeruginosa* and evaluation of the bacterial contamination rate of items in the hospital setting that are in frequent contact with patients and/or physicians and determining the antibiotic susceptibility of the isolates to four antibiotics (Ciprofloxacin, Amikacin, Imipenem, and Piperacillin).

2. Materials and Methods

2.1. Sample Collection:

A total of 200 sterile cotton swab samples were collected from hospital environment including ground, walls, beds, bed sheets, blankets, doors, doors handle, nurse tables, trays, chairs, electronic equipment's,

medicine cabinet, windows (Sabha medical center and Brack general hospital were enrolled in this cross-sectional study).

2.2. Isolation and identification of *Pseudomonas* spp.:

After collection, all samples were transferred to the laboratory, cultured on Nutrient broth then subcultured on Blood Agar (B.A.) and macConkey Agar (McA) plates and incubated at 37°C for 18-24 hrs. *Pseudomonas* spp. identification was performed by Gram stain, oxidase, and catalase test, sugar fermentation in Triple Sugar Iron agar (TSI) and Oxidation-Fermentation (OF) tubes and all *Pseudomonas* collected were tested by conventional biochemical tests using API20NE (Biomerieux, France).

2.3. Antibiotic susceptibility testing of isolated bacteria:

All *Pseudomonas* spp. isolates were tested for sensitivity against four commonly used antibiotics (Ciprofloxacin, Amikacin, Imipenem, and Piperacillin) by using disc diffusion method according to CLSI.

3. Results

Out of the 200 collected samples, 12 *Pseudomonas* spp. were isolated (6%), 7 from Brack hospital and 5 from the Sabha medical center. Other different bacterial species isolated were 148 (74%) (Tables 1 & 2).

Bacteria	Number	Percentage
Pseudomonas	12	6%
Other species	148	74%
-Ve Growth	40	20%
Total	200	100%

Table 1: Frequency of occurrence of *Pseudomonas* spp. Isolates & other bacteria.

Surface	No. of *Pseudomonas* isolates	Percentage
Sinks	6	50%
Grounds	2	16.7%
Walls	1	8.3%
Air conditions	2	16.7%
Chairs	1	8.3%
total	12	100%

Table 2: Frequency of occurrence of *Pseudomonas* spp. isolates in different surfaces.

Results of antibiotic sensitivity testing revealed that all *Pseudomonas* spp. isolates were sensitive to Ciprofloxacin, Amikacin, Piperacillin, Imipenem.

4. Discussion

Numerous studies have shown that hospital surfaces and frequently used medical equipment become contaminated by a variety of pathogenic and nonpathogenic organisms (Hayden *et al*., 2006; Carling

et al., 2008). The common nosocomial pathogens may well survive or persist on surfaces for months and can thereby be a continuous source of transmission if no regular prevention surface disinfection is performed (Kramer *et al*., 2006).

In this study, out of the 200 collected samples, 12 *Pseudomonas* spp. were isolated (6%). Other different bacterial species isolated were 148 (74%) and 40 samples were negative for growth (20%). Most isolates were obtained from sinks 6 (50%) and then ground 2 (16.7%), Air conditions 2 (16.7%), walls 1 (8.3%), Chairs 1 (8.3%). *P. aeruginosa* often has been isolated from sinks and other moist sites in hospitals. The possible transmission of *P. aeruginosa* from sinks to patients has been reported. Recent reports showed extensive bacteriological screening of the inanimate hospital environment has identified *Pseudomonas* spp. in the majority of moist sites of hospital. The important and an environmental sources of *Pseudomonas* spp. are humid places. The role of contamination of the environment with *Pseudomonas* in hospital has been the subject of several studies (Panagea *et al*., 2005; Pal *et al*., 2010). *P. aeruginosa* has been emerged as a significant pathogen and is the most common dreadful gram-negative bacilli found in various health care associated infections all over the world due to its virulence, well-known ability to resist killing by various antibiotics and disinfectants (Senthamarai *et al*., 2014).

Recent studies have focused on the decreased susceptibility of *P. aeruginosa* to currently used antpseudomonal agents, including β-lactams, aminoglycosides, and fluoroquinolones. The carbapenems, imipenem, and meropenem are usually active against multidrug-resistant (MDR) isolates of *P. aeruginosa*; however, resistance to these compounds has also become a growing therapeutic problem (Andrade *et al*., 2003).

In our study, we found that all *Pseudomonas* spp. isolates were sensitive to Ciprofloxacin, Amikacin, Piperacillin, and Imipenem. Masood and Zahra (2014) in their study reported low levels of resistance to the same antibiotics (23%) to Imipenem, (16%) to Amikacin, (5%) to Ciprofloxacin, (28%) to Piperacillin (Masood and Zahra, 2014).

Acknowledgements

The authors would like to thank the administration of Sabha medical center and Brack general hospital for their help and cooperation.

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