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Carpabenem Resistant *Pseudomonas aeruginosa* Isolates from Minia University Hospital Patients

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Abstract

Increasing rates of serious multi-drug resistant (MDR) and carpabenem resistant Pseudomonas aeruginosa infections have been reported globally, including Egypt, This retrospective study investigates the epidemiological and microbiological characteristics of carpabenem resistant P. aeruginosa isolates in Minia University Hospitals, Minia, Egypt in period between August 2022 and January 2023, durig this period a total of 4490 clinical specimens were processed for isolation of carbapenem-resistant Pseudomonas aeroginosa (CRPA). 44 clinically significant, non-duplicate CRPA isolated.The minimum inhibitory concentrations (MIC) to imipenem and meropenem were determined and interpreted according to Clinical Laboratory Standards Institute guidelines.

Keywords: carbapenem-resistant, *Pseudomonas aeruginosa*, MDR

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1. Introduction

Pseudomonas aeruginosa is an important Gram-negative opportunistic pathogen found in many environmental settings and can be isolated from different living sources, such as plants, animals, and humans. This organism can persist in both community and hospital settings under conditions of limited nutrition [1]. Community-acquired infections (CAI) are less prevalent than nosocomial infections [2]. The prevalence rate of P. aeruginosa isolates in patients with community-acquired pneumonia (CAP) is 3.8% in Europe, 4.3% in North America, 5.2% in Asia, 4.9% in South America, and 5.5% in Africa [3]. *P. aeruginosa* is a common Gram-negative bacterium associated with nosocomial infection diseases such as pneumonia, wound infection, urinary tract infection, and invasive surgical infection [4] Multidrug resistant Pseudomonas aeruginosa is common cause of health care associated infections worldwide [5]. *P. aeruginosa* has developed resistance mechanisms after exposure to carbapenems, given the increasing use of carbapenems in clinical treatments. Such occurrence has exacerbated the morbidity and mortality associated with carbapenem-resistant *P. aeruginosa* (CRPA) [6,7].

In 2016, theWorld Health Organization (WHO) categorized CRPA to be of critical priority in the list of pathogens that pose the highest threat to human health [8]. The 2017 World Health Organization (WHO) global priority list of pathogens ranks carbapenem-resistant P. aeruginosa (CRPA) in the highest priority category [9]. The reported rates of carbapenem resistance seem to be considerably higher for non fermenter pathogens, especially for P. aeruginosa (frequently > 60%) than for fermenter ones (frequently < 10%) worldwide, in all types of infection [10] In this study, it was aimed to determine the antimicrobial resistance profile of P. aeruginosa isolates isolated from culture samples sent from various polyclinics and services in a university hospital.

2. Methods

2.1. Study design

It was a cross sectional study conducted in Minia University Hospitals from August 2022 to January 2023.Culture and other laboratory procedures performed at the clinical microbiology laboratory, clinical pathology department, Faculty of medicine, Minia University.

2.2. Samples

P. aeruginosa isolates were collected from a variety of sources, including blood (central and peripheral lines), the respiratory system (sputum, endotracheal, BAL, nasopharyngeal, throat swab, ear, and eye), urine (mid-stream urine and in-and-out catheters), miscellaneous sources (abscess, wound, tissue, and body fluid), and cerebrospinal fluid (CSF).

2.3. P. aeruginosa Identification and Antimicrobial Susceptibility Testing

The automated VITEK 2 system (Biomerieux, Marcy-l' Etoile, France) was used for the isolation, identification, and antibiotic susceptibility testing. In this context, amikacin (AK), gentamicin (GN), ciprofloxacin (CIP), ceftazidime (CAZ), piperacillin (PRL), ticarcillin, ticarcillin –clavulinic acid, (CES) aztreonam (ATM), meropenem (MEM), cefepime (FEP), imipenem (IPM), tobramycin and colistin (CT) sensitivity was evaluated. The CLSI (Clinical and Laboratory Standards Institute) breakpoints were applied.

2.4. Statistical Analysis

All data were analysed using SPSS software (IBM SPSS, Armonk, NY, USA). Graphs were generated using GraphPad Prism software (v9.4.1; GraphPad Software, San Diego CA, USA).

3. Results

Out of 4490 samples processed in the study period 110 (2.4%) P. aeruginosa isolated, 44(48.4%) were carbapenem resistant and 66(52.6%) were carbapenem sensitive, most CRPA isolated from urine specimen (n=18) (40.9%)followed by respiratory secretions (n=12) (27.2%),pus (n=8) (18.1%),blood (n=5) (11.3) respectively the lowest was vaginal swab (n=1) (2.2%).all CRPA isolated from specimens of hospitalized patients for more than 48 hours ie hospital acquired infections.all samples from ICU.

Table 1. Antibiotic susceptibility pattern of CRPA isolates

Sr. No	Antibiotics used	Sensitive N (%)	Resistant N (%)
1	meropenem	0	44(100%)
2	imepipenem	0	44(100%)
3	amikacin	8(18.8%)	36(81.2%)
4	gentamycin	4(9.09%)	40(90.9%)
5	ceftazideme	1(2.2%)	43(97.7%)
6	cefepeme	2(4.5%)	42(95.5%)
7	Tobramycin	4(9%)	40(90.9%)
8	ciprofloxacin	1(2.2%)	43(97.7%)

3.1. Antibiotic susceptibility pattern of CRPA

The highest sensitive was colistin (68.1%) followed by amikacin (18.8%) (Table 1). Carbapenems are β-lactam antibiotics with broad-spectrum activity and are used to treat infec- tions known or suspected to be caused by MDR bacteria [11]. The emergence and rapid spread of carbapenemases in Pseudomonas, is becoming a significant public health crisis worldwide [12]. Studies have shown an increasing trend of carbapenem resistance over the past decade [13]. The present study uncovered a significantly high level of resistance to routinely prescribed antibacterial agents in our hospital. All isolates were MDR and, among the antimicrobials tested, were fully resistant to piperacillin and piperacillin –clavulinic Moreover, more than 90% of the isolates were resistant to gentamicin, cefepime, ceftazideme, whereas colistin was the most active antimicrobial agent against our P. aeruginosa isolates. Overall, the frequency of MDR isolates in the present study was higher than studies carried out by Asadpour et al on P. aeruginosa isolates [14].

These results indicate that the available choices for appropriate treatment of infection caused by these resistant isolates are currently limited. However, the data on colistin used in our study was comparable to those in other studies [15-17] and, therefore, these are considered the antibiotics of choice against P. aeruginosa strains. The presence of higher rates of resistance against the antimicrobial agents tested in the current study reflects the irrational and extensive administration of these antibiotics in our medical settings, which eventually resulted in the emergence of this resistance among bacterial isolates.

Furthermore, our results highlight the necessity for launching local and nationwide surveillance guidelines on monitoring antibiotic administration to prevent antimicrobial resistance.

4. Conclusions

In conclusion, the results of this study revealed a noticeably high prevalence of MDR P. aeruginosa isolates in our hospital However, early recognition of it establishing comprehensive guidelines and infection control measures and employing an all-inclusive protocol for for antimicrobial therapy based on laboratory data are necessary to significantly decrease further dissemination of these resistant pathogens in our medical settings.

References

[1] W. Arber. (2014). Horizontal gene transfer among bacteria and its role in biological evolution. Life. 4: 217–224

[2] Sando E, Suzuki M, Ishida M, Yaegashi M, Aoshima M, Ariyoshi K, Morimoto K. Definitive and Indeterminate Pseudomonas aeruginosa Infection in Adults with Community-acquired Pneumonia: A Prospective Observational Study. Ann Am Thorac Soc. 2021 Sep;18(9):1475-1481.

[3] M.I. Restrepo, B.L. Babu, L.F. Reyes, J.D. Chalmers, N.J. Soni, O. Sibila, P. Faverio, C. Cilloniz, W. Rodriguez-Cintron, S. Aliberti. (2018): Burden and risk factors for Pseudomonas aeruginosa community-acquired pneumonia: A multinational point prevalence study of hospitalised patients. European Respiratory Journal. 52: 1701190.

[4] Z. Pang, R. Raudonis, B.R. Glick, T.J. Lin, Z. Cheng. (2019). Antibiotic resistance in Pseudomonas aeruginosa: mechanisms and alternative therapeutic strategies. Biotechnology Advances. 37 (1): 177–192.

[5] Z. Alinaqvi, S.A. Kharal, M.M. Qamaraziz. (2011) Burn patient. Professional Medical Journal. 18(2): 300-305

[6] J.A. Labarca, M.J. Salles, C. Seas, M. Guzm an-Blanco, (2016). Carbapenem resistance in Pseudomonas aeruginosa and Acinetobacter baumannii in the nosocomial setting in Latin America. Critical Reviews in Microbiology. 42 (2): 276–292.

[7] A.J. Brink. (2019). Epidemiology of carbapenem-resistant Gram-negative infections globally. Current Opinions in Infectious Diseases. 32 (6): 609–616.

[8] E. Tacconelli, E. Carrara, A. Savoldi, S. Harbarth, M. Mendelson, D.L. Monnet, et al., (2018). Discovery, research, and development of new antibiotics: the WHO priority list of antibiotic-resistant bacteria and tuberculosis. Lancet Infectios Diseases. 18 (3): 318–327.

[9] World Health Organization. (2017). Global Priority List of Antibiotic-Resistant Bacteria to Guide Research, Discovery, and Development of New Antibiotics.

[10] P. Nordmann, L. Poirel. (2019). Epidemiology and Diagnostics of Carbapenem Resistance in Gram-negative Bacteria. Clinical Infectious Diseases. S521–S528.

[11] G. Meletis. (2016). Carbapenem resistance: an overview of the problem and future perspectives. Therapeutic Advances in Infectious Diseases.3: 15-21.

[12] World Health Organization. (2017). Guidelines for the pre- vention and control of carbapenem-resistant Entero- bacteriaceae, Acinetobacter baumannii, and Pseudomonas aeruginosa in health care facilities. World Health Organization. https://apps.who.int/iris/ handle/10665/256462. Accessed 19 Aug 2019.

[13] P. Nordmann, T. Naas, L. Poirel. (2011). Global spread of carbapenemase-producing Enterobacteriaceae. Emerging Infectious Diseases. 17: 1791-1798.

[14] L. Asadpour. (2018). Antibacterial resistance, biofilm forming ability, and virulence potential of Pseudomonas aeruginosa isolated from burn patients in northern of Iran. Journal of Global Antimicrobial Resistance. S2213-7165(18): 30020-1.

[15] M. Radan, R. Moniri, A. Khorshidi, H. Gilasi, Z. Norouzi, F.D. Beigi, Y. Goli. (2016): Emerging carbapenem-resistant Pseudomonas aeruginosa isolates carrying blaIMP among burn patients in Isfahan Iran. Archives of Trauma Research. 5(3): e33664.

[16] D. Bangera, S.M. Shenoy, D.R. Saldanha. (2016) :Clinico-microbiological study of Pseudomonas aeruginosa in wound infections and the detection of metallo-β-lactamase production. International Wound Journal. 13(6):1299-1302.

[17] H.G. Safaei, S. Moghim, B.N. Isfahani, H. Fazeli, F. Poursina, S. Yadegari et al., (2017). Distribution of the strains of multidrug-resistant, extensively drug-resistant, and pan drug-resistant Pseudomonas aeruginosa isolates from burn patients. Advanced Biomedical Research. 6: 74.