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Drug sensitivity Profile of Pseudomonas spp. isolated from a tertiary care hospital against commonly used antibiotics

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Abstract

Background: Antimicrobials agents are being abundantly used to control bacterial growth, like Pseudomonas, leading to resistance.

Objective: To find out the drug sensitivity patterns of the Pseudomonas spp. against various antibiotics in the tertiary care hospital (Ghurki Trust & Teaching Hospital).

Methodology: This cross-sectional study was designed on the retrospective collection of the records of 1000 sample reports, of the patients admitted in Ghurki Trust Teaching Hospital from the period of January 2018 to December 2019, who presented with multiple infections or developed pseudomonas infections during their stay in the hospital. Tests were carried out in the clinical microbiology Laboratory of Lahore Medical & Dental College for bacterial culture. Specimen included were breast tissues, pus, urine and stool culture, blood culture, wound discharge, ear discharge, abscess from the wound, various infected implants, and dead necrotic tissues from bone. Data were analyzed using SPSS version 26.

Results: Out of the 1000 samples, a total of 150 (15%) were positive for bacterial growth. Among these 150, 70 were positive for gram-negative. The bacterial profiles of these 150 samples have shown that frequently (42) isolated gram-negative bacteria was Pseudomonas. On further tests, these bacteria were more sensitive to Imipenem and Cilastatin (69%) followed by levofloxacin (31%). No sensitivity was found against vancomycin and amoxicillin.

Conclusion: In this study, the Pseudomonas were isolated and showed sensitivity to Imipenem and Cilastatin followed by levofloxacin. These studies should be conducted frequently to keep a track of the sensitivity patterns of bacteria.

Keywords: Pseudomonas, Sensitivity, Specimen

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Introduction

The Pseudomonas is an encapsulated, rod-shaped anaerobe that is a motile and gram-negative bacteria. This organism has a single flagellum that helps it to increase mobility and surface interactions.[1] It is commonly found in soil, water, and plants and can survive in a number of environments. In the human body, it can be found in the skin of healthy individuals, moist areas of the body like the throat, armpits, genitals, and stools.[2,3]

There are multiple strains of Pseudomonas, however, the most common type of pseudomonas which is causing infection in the general population is Pseudomonas Aeruginosa.[4] It can cause a number of infections which include pneumonia, urinary tract infections, and skin and soft-tissue infections. It can also be isolated from the severe skin burn areas and in infections among immune-compromised individuals.[1,4,5] It has become a real concern in hospitalized patients for longer than 1 week, and it is a frequent cause of nosocomial infections. There is a particular sensitivity pattern of organisms, which were resulting from frequently and directly from the widespread use of antibiotics. The use of antimicrobials agents is abundantly used to control bacterial growth. Empirical antibiotic therapy for suspected cases of Pseudomonas Aeruginosa includes monotherapy and combination therapy, which reduces the severity of the disease and mortality.

However, it is difficult to treat these infections due to the development of drug resistance. As a result, their high prescription volume leads to resistance among old and new strains of bacteria.[6,7]

The multidrug-resistant pattern of Pseudomonas is especially associated with increased mortality and morbidity because no certain therapeutic options exist.[8,9,10] Hence, there is a need to conduct variable monitoring studies of the Pseudomonas spp. for its growth pattern. This study was conducted to find out

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the drug susceptibility and sensitivity patterns in the Pseudomonas spp. isolated from various clinical specimens of patients in a tertiary care hospital.

Methodology

Design and settings: This cross-sectional study was based on the retrospective collection of data, and was conducted at a microbiology laboratory of Lahore Medical and Dental College. Clinical samples were received in the laboratory from the Ghurki Trust and Teaching Hospital (GTTH) which is a tertiary care hospital associated with Lahore Medical and Dental College. This study was based on the culture and sensitivity reports of the 1000 hospitalized patients at the Ghurki Trust and Teaching Hospital for a period of two years from January 2018 to December 2019. Patient records were properly reviewed and studied, and only those records were included that fulfilled inclusion criteria. Those admitted with multiple infections or developed pseudomonas infections were noted. Specimen included in the study were pus samples from breast tissue, pus, urine and stool culture, blood culture, wound discharge, ear discharge, abscess from the wound, several infected implants, and dead necrotic tissues from bone.

Only 150 positive samples were separated for further assessment and immediately transported to the microbiology laboratory of the Lahore Medical and Dental College. They were evaluated for the identification of isolates via Gram staining and culture growth on a Nutrient agar, Blood agar, Maconkey agar, and CLED. Colonies from the nutrient agar were analyzed for biochemical tests and further sent for antibiotic sensitivity. In the isolation of Gram-positive organisms, cocci, catalase, and coagulase tests were conducted. Gram-negative bacilli were separated using various biochemical, oxidase, and triple sugar iron (TSI) agar tests. After the confirmation of the organism, growth patterns were tested for in vitro antibiotic sensitivity which was performed by the disc diffusion method. Data was collected and analyzed using SPSS version 26. Ethical approval was sought from an ethical committee of the hospital.

Results

This descriptive study was carried out to identify the sensitivity of drugs toward pseudomonas infections. The patients were admitted to a tertiary care hospital and their records were retrieved from the Microbiology wing of the Pathology Department. Out of the 1000 samples, a total of 150 samples (15%) were reported as positive for bacterial growth. (Figure-I) Out of these positive samples, Gram-negative samples (70) were separated. In Gram-negative samples (total samples 70), Pseudomonas spp. were the most common (42) infectious organisms among all. The antibiotic susceptibility in Gram-negative organisms was performed by the disc diffusion method. Gram-negative bacteria like Pseudomonas showed a different pattern of sensitivity. Pseudomonas is sensitive to Imipenem and Cilastatin (69%) followed by levofloxacin (31%), although no sensitivity was found in vancomycin and amoxicillin.

Figure-I: Bacterial Growth among study subjects (n=1000)

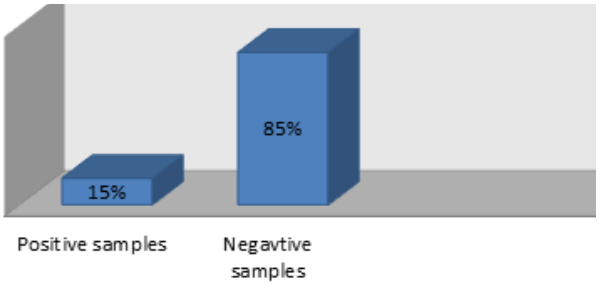


Figure-II: Gram positive and Gram negative samples showing growth

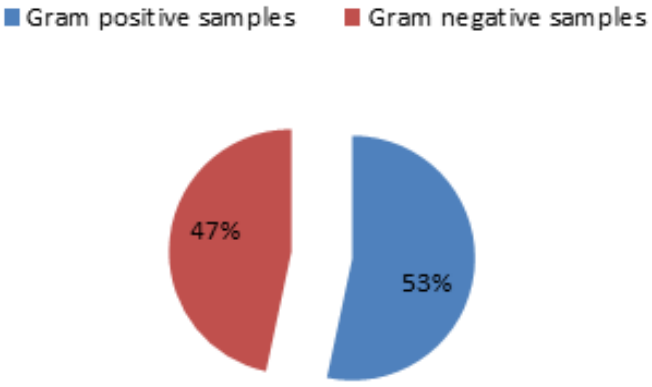
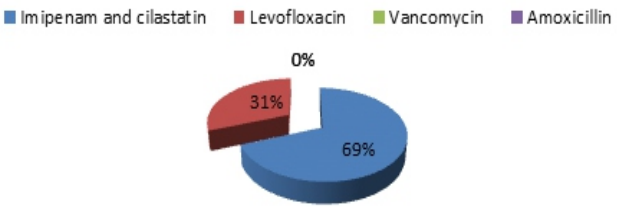


Figure-III: Antibiotic Susceptibility of Pseudomonas (gram negative bacteria)



Discussion

In this study, Pseudomonas sensitivity was observed against drugs like Imipenem, Cilastatin, levofloxacin, and vancomycin. These drugs were highly effective and recommended for the management of Pseudomonas in Gurki Trust and Teaching Hospital. The detailed drug susceptibility of Pseudomonas in the Ghurki Trust and Teaching Hospital is described in this study. Nowadays, Pseudomonas species have the ability to establish a colony in healthy individuals and function opportunistically.

It is regarded as harmful in hospitals and poses significant threats.[11] Additionally, the species of this bacterium has the ability to adapt to various environmental challenges.[12] The P. aeruginosa is considered to be systemically adverse because it can easily settle in epithelial surfaces and make the host defenses immunocompromised. It can further instigate systemic toxicity and is also associated with a rise in morbidity and mortality rates.[13]

These infections can be prevented by following best practice guidelines that are generally accepted hospital-wide to control the spread of diseases. They include proper hand washing and the use of alcohol-based disinfectant before and after every patient exposure. Furthermore, the proper sterilized procedures while placing central venous catheters, discontinuation of central venous and urinary tract catheters when otherwise not required, and avoidance of the intubation and re-intubation in most possible cases.[14-16] Several classes of drugs are also available to cure infections by Pseudomonas.[17]

Pseudomonas infections require multiple strategies including monotherapy and a combination of drugs for a specific period. Generally, Carbapenem (eg, Imipenem, meropenem) along with antipseudomonal quinolones are broadly used in combination with aminoglycosides. Carbapenem antibiotics are the beta-lactam class of antibiotics, which inhibit bacterial cell wall synthesis. They have a very broad antibacterial spectrum against gram-positive and gram-negative aerobic and anaerobic bacteria. These treatment options are considered a final resort against increasingly difficult-to-manage drug-resistant pathogens, including P. Aeruginosa.[18,19] It is considered a well-tolerated, most effective, and potent antimicrobial therapy for the treatment of infections. This therapy is most valuable as empirical management for both aerobic and anaerobic infections, and bacteremia in several healthy and diseased patients.[17]

It is not only active against the most beta-lactamase producing organisms but also useful against some beta-lactamase enzymes. The dosages of Imipenem/cilastatin and concentrations of Imipenam are mostly effective against susceptible organisms present in abundant tissues and body fluids, which include sputum, lungs, tonsils, maxillary sinuses, mastoid mucous membrane, kidneys, bile, bile duct tissues, female genital organs, intra-peritoneal exudates, a wound drainage fluid and a cerebrospinal fluid. Carbapenem antibiotics including Imipenam are used with Cilastin which acts as a dehydrogenase inhibitor.[19] It is administered with Imipenam to enhance the urinary recovery of the drug and help in staying longer in the human body. It has no antibacterial activity or inhibitory effect on beta lactamases.[20] Levofloxacin, a fluoroquinolone is another drug which has potent activity against pseudomonas infections. This affects bacterial growth by inhibiting the growth and synthesis of bacterial DNA. Several studies have been conducted showing the sensitivity towards Pseudomonas.[21,22] In this study, pseudomonas showed partial sensitivity towards levofloxacin (31%). Vancomycin and Amoxicillin, both drugs work by killing bacteria, however; do not show any sensitivity towards pseudomonas. Multiple studies show resistance to these drugs.[23,24,25] A study carried out in India revealed that Impenam is the only drug that is unaffected by the action of the enzymes. This finding was also confirmed by a number of other authors. It is also supported by another study which suggested that maximum sensitivity (100%) was seen with Imipenam.[26]

Conclusion

Our study showed that gram-negative bacteria like Pseudomonas appeared to be more sensitive to specific drugs. *Pseudomonas spp.* is sensitive to

Imipenem and cilastatin followed by levofloxacin, although no sensitivity was found in vancomycin and amoxicillin. Hence, studies like these should be run frequently to keep track of the sensitivity pattern of bacteria.

Authors Contribution: AG: Design of work, Acquisition and analysis of data and Drafting. **HSB:** Conception of work Interpretation of data and revising. **MT:** Conception of work, Interpretation of data and drafting. **HM:** Acquisition, Analysis of data and revising. **AI:** Design of work and drafting. **HS:** Interptation of data and revising.
All authors critically revised and approve its final version.

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