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Prevalence of Pseudomonas aeruginosa and Acinetobacter baumannii at Baghdad hospital

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Abstract

Background: Both gram-positive and gram-negative bacteria are relevant to nosocomial infections according to many scientific inquiries. A. baumannii and P. aeruginosa are particularly significant contributors to nosocomial infections .the most common types of hospital-associated infections are surgical site infections, bloodstream infections. Objectives: to determine the frequency of A. baumannii and P. aeruginosa bacteria among Baghdad medical centers and their antibiotic susceptibility .Methodology: The incidence, clinical characteristics, antimicrobial susceptibility, and outcomes of nosocomial P. aeruginosa and A. baumannii at Baghdad Hospital lobbies and patients from Medical City in Baghdad, during a one-year period. Results: A total of 630 isolates of different bacterial types including (114) P. aeruginosa (221) A. baumannii, and others and different clinical specimens were collected between February 2023 to September 2023 from Hospital lobbies and patients from Medical City in Baghdad, Introductory identification of isolates is done through cultural identification, microscopic examination, and biochemical tests. also identified at the species level with the VITEK® 2 system by using ID GNB cards, and the results showed the highest percentages belonging to A. baumannii were in Children section was 61(33%), and P. aeruginosa were In patient samples was 31(20%). Conclusions: The incidence of nosocomial the percentages show that A. baumannii isolates more than P. aeruginosa in patients and in hospital lobbies, especially in Burn rooms units. The most active antimicrobial agents for P. aeruginosa were Meropenem (65%), and A. baumannii isolates were to Ceftriaxone (83%).

Key words: Pseudomonas aeruginosa, Acinetobacter baumannii, multidrug resistant, nosocomial infections, antibiotic resistance.

Introduction

Both gram-positive and gram-negative bacteria are relevant to nosocomial infections (NIs) according to many scientific inquiries [1–4]. Acinetobacter.baumannii and Pseudomonas. aeruginosa are essential gram-negative bacteria related to NIs [1].

Hospital associated infections (HAIs) most frequent types are surgical site infections (SSIs), bloodstream infections (BSIs), and urinary tract infections (UTIs) [5, 6]. UTIs are the ubiquitous (31%) HAI [7]. UTIs evolved by A. baumannii and P. aeruginosa are associated with catheterization or surgery of urinary tract [8, 9]. Surgical site infections (SSIs), which affect the skin, subcutaneous and deep soft tissues account 17% of HAIs [7, 9]. A prevalent form of HAI, blood stream infections, can be mediated by the insertion of catheters in blood stream, contaminated diagnostic procedures, or by foreign bodies' introduction [9].

Pseudomonas.aeruginosa and Acinetobacter. baumannii bacteria that are mostly related to hospital infections are laborious to treat. This challenging arises from production of (AmpC beta-lactamases) and efflux pumps with low-permeability outer membrane mechanisms, which mediate their drug resistance. Mechanisms like Horizontal gene transfer can gain by these bacteria which make it more resist to amino glycosides, beta-lactams and fluoroquinolones, making them more laborious to treat [10, 11]. This research intended to determine the frequency of Acinetobacter. baumannii and Pseudomonas. aeruginosa bacteria among Baghdad medical centers and their antibiotic susceptibility.

Materials and Methods:

A total 630 samples of different hospital sections and different clinical specimens were collected between February 2023 to September 2023 from numerous Baghdad city hospitals. These samples were gathered from Operating theaters, intensive care units, pediatric and adult department and the burns units, in addition to the medical staff, Hospital visitors, hospital floors and walls, and various medical equipment. The isolates were cultured on suitable culture media for primary isolation and identification.

Morphological examinations:

In order to examine the physiologies of bacterial isolate growth, various culture mediums were employed. To differentiate various bacterial strains, the characteristics of the colony, such as color, forms, and texture, were used.

In addition, the Microscopic Examination by prepare Gram staining, a single isolated colony was put on a glass microscope slide using a sterile loop. The form, organization, and color of the cell were then observed. Gram-negative rods, indicative of isolation (31).

Identification of bacteria by Vitek II compact system:

The colorimetric reagent cards used in the VITEK II compact system are incubated, and the data is automatically assessed. The VITEK II technology made use of pure colonies that developed on blood media. The following is the procedure for recognizing species: A suspension of Gram-negative bacteria was prepared for the identification card (ID). Approximately 3 milliliters of saline were transferred to a test tube. An isolate colony was chosen and dissolved. Then, the suspension's density was checked using dens check; a pure colony must have an inoculums density between (0.5 and 0.6) McFarland (MCF). Finally, the ID card was placed in the test tube after the test tube was transferred to the cassette.

The job ID and bar code for every card were printed on the cassette worksheet that was printed from the PC workstation. The cassette was then taken out of the loading station when the machine indicated that it was ready, and the start-filling button was pressed. When the user signed in to the window and then started the VITEK II software, they found the identification card (ID) from the work sheet with the organism’s name for separated (30).

Test for antibiotic susceptibility:

The antibiotic susceptibility of the isolates was ascertained using the VITEK II system. The subsequent antimicrobials have been employed: Meropenem, Ciprofloxacin, Amikacin, Amoxicillin, Azithromycin, Ceftriaxone, Tetracycline and, Trimethoprim .According to WHO recommendations and the CLSI system (33), these antibiotics used againstAcinetobacter baumannii and Pseudomonas aeruginosa.

The VITEK II system's identification and test for antibiotic susceptibility. The surface of MacConkey, Blood, Mannitol salt, and Nutrient agars show streaks from isolated bacteria that require identification. These agars are then incubated at 37 °C for duration of 24 to 48 hours. Additionally, the model number of the device is added to the database of the system. A suitable number of pure colonies are suspended in 3 milliliters of physiological saline solution in two transparent plastic test tubes. To diagnose the isolated bacteria suspension, the turbidity of the suspension must equal (0.50-0.63), or

about 1.5 X 10^8 CFU according to the Densichek Vetik2 turbidity device. Proceed to transfer 145 µL from the first tube to the second for the Antibiotic Susceptibility Test. It was filled with a two-test tube cassette holding a bacterial suspension in accordance with the company's (Biomerieux) specifications. After severing the transport tube, the apparatus placed the material inside the incubator card and heated it to 37°C. For every card in the reader, the result was read and a diagnostic report containing an antibiotic susceptibility test was written (32).

Statistical analysis:

Data were analyzed using Statistical Program For Social Science (SPSS) version 20.0 as well as Data Analysi1s via Microsoft Excel 2016. Quantitative data were expressed as mean ± standard deviation. Qualitative data were expressed as frequency and percentage

Results

Isolation and identification

A total of 630 isolates of different bacterial types including (114 P. aeruginosa, 221 A. baumannii, and others) and different clinical specimens were collected between February 2023 to September 2023 from Hospital lobbies and patients from Medical City in Baghdad, Introductory identification of isolates is done through cultural identification, microscopic examination, and biochemical tests. also identified at the species level with the VITEK® 2 system by using ID-GNB cards, the samples almost Swapped from Operations rooms, Children's section, Intensive care, Patient rooms, Burn rooms, and patient samples. and the results showed that isolates under study belonging to A. baumannii were 28(35%), 64(33%), 7(54%), 56(38%), 25(56%), and 45(30%) respectively and P. aeruginosa was 17(22%), 19(10%), 1(8%), 27(18%), 14(31%), and 31(20%) respectively as shown in Figure (1)

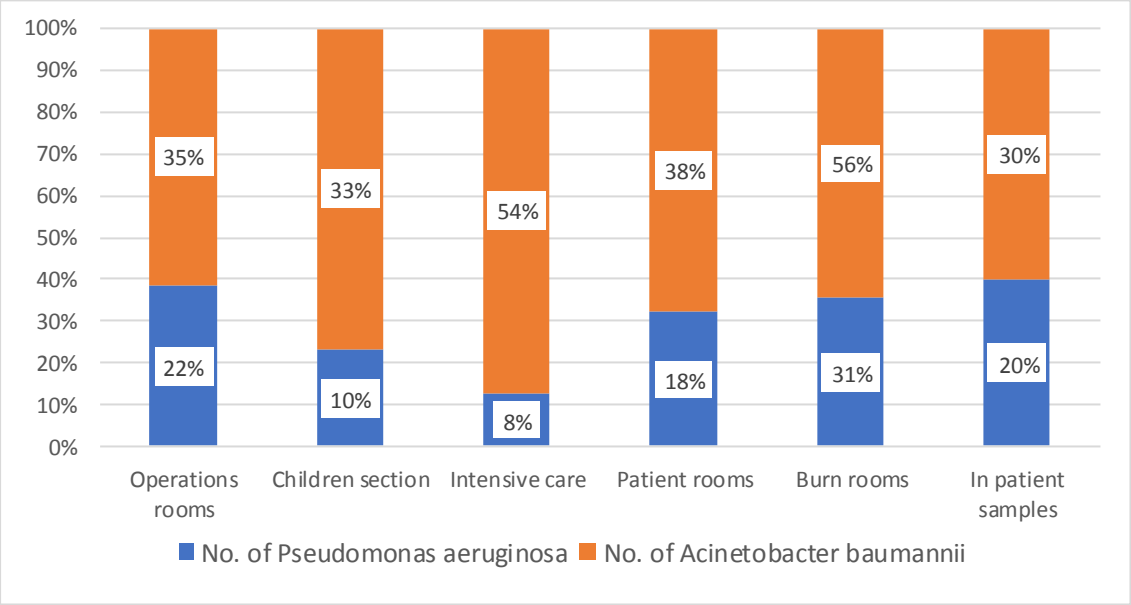

Figure (1): A. baumannii and P. aeruginosa percentages in Operations rooms, Children's section, Intensive care, Patient rooms, Burn rooms, and patient samples.

The percentages show that A. baumannii isolates more than P. aeruginosa in patients and in hospital lobbies, especially in Burn rooms units and P. aeruginosa scored a high percentage in the same section as shown in Table (1)

Table (1): Percentage of contamination in hospital quarters and patient samples.

Hospital section	Total No. of samples	No. of P. aeruginosa	%	No. of A. baumannii	%
Operations rooms	79	17	22	28	35
Children section	195	22	10	61	33
Intensive care	13	1	8	7	54
Patient rooms	146	29	18	56	38
Burn rooms	45	14	31	24	56
In patient samples	152	31	20	45	30
Total	630	114	18	221	35

Antimicrobial susceptibility

The antimicrobial susceptibility of Pseudomonas aeruginosa isolates is summarized in table 2 and figure 2. The most active antimicrobial agents were Meropenem (65%), Ceftriaxone (45%), Trimethoprim (18%) and Amikacin (17 %.).

The results of antibiotics susceptibility test demonstrated that A. baumannii isolates were resistant to Ceftriaxone (83%), Meropenem (82%), Amikacin (79%) and Ciprofloxacin (48%) as shown in table 3 and Figure 3.

Table 2: The antimicrobial susceptibility of Pseudomonas aeruginosa isolates

Antibiotics	Sensitive	%	Resistant	%
Amoxicillin	8	7	102	93
Tetracycline	9	8	101	92
Azithromycin	12	11	98	89
Ciprofloxacin	12	11	98	89
Amikacin	19	17	91	83
Trimethoprim	20	18	90	82
Ceftriaxone	50	45	60	55
Meropenem	71	65	39	35

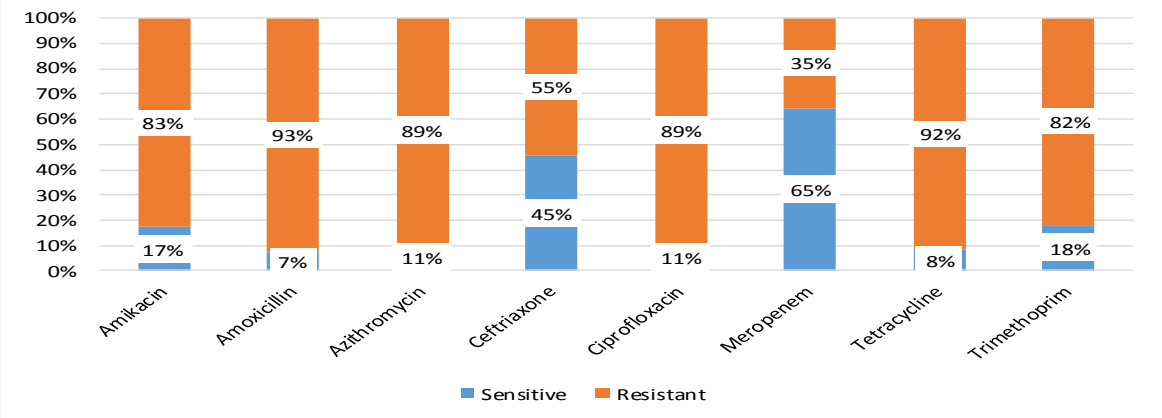

Figure 2: The antimicrobial susceptibility of Pseudomonas aeruginosa isolates

Table 3: The antimicrobial susceptibility of Acinetobacter baumannii isolates

Antibiotics	Sensitive	%	Resistant	%
Amoxicillin	18	8	201	92
Azithromycin	25	11	194	89
Tetracycline	30	14	189	86
Trimethoprim	53	24	166	76
Ciprofloxacin	105	48	114	52
Amikacin	173	79	46	21
Meropenem	180	82	39	18
Ceftriaxone	181	83	38	17

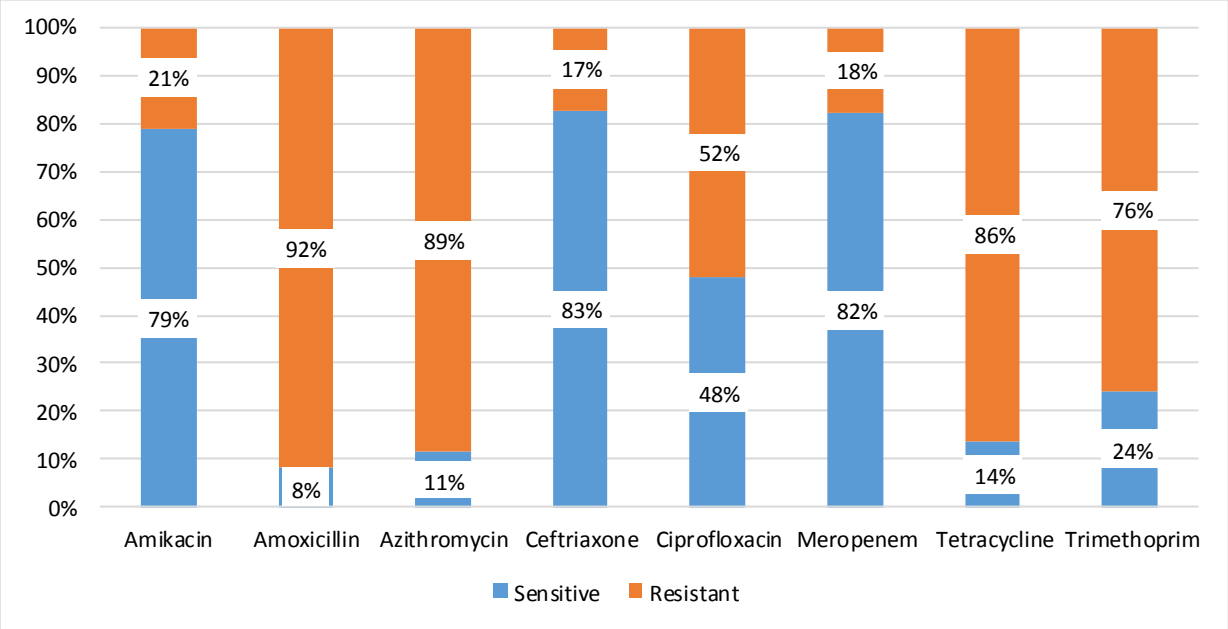

Figure 3: The antimicrobial susceptibility of Acinetobacter baumannii isolates

Discussion

Distribution of A. baumannii and P. aeruginosa

The operating room has also been the subject of extensive investigation because it is the most susceptible location for infection because of direct contact between the infection and exposed tissues as well as interaction between surgical instruments and patients, for example (12). Among the most significant and potentially fatal causes of contamination for hospitalized patients is thought to be operating room contamination. Ventilation systems, disinfection solutions, and operating rooms are contaminated by a variety of sources (13).

In the study, the total number of samples and the overall contamination percentage are shown. The percentage of pollution in hospital rooms is displayed in Table (1). Even though hospital rates vary slightly, it is observed that some areas have relatively high rates. This is because some people are careless and leave operation room doors open after sterilization, which allows air currents contaminated with various germs to enter the room and contribute to the contamination of the surrounding area. Since hospitals receive visitors with various ailments, they are considered germ-infested environments (14).

Many factors, including sanitary practices for hospital staff, environmental conditions, isolation and identification techniques, social and cultural level of patients, differences in the prevalence of infection from one country to another, and differences in patients, may inhibit or stimulate the growth and distribution of bacteria in hospitals (15). (56%) that produced fruitful outcomes for us Due to A. baumannii potential to induce nosocomial infections and resistance to a variety of antibiotics, this alarming rate may be caused by the bacterium. Furthermore, A. baumannii is more resistant to desiccation than other Acinetobacter species due to its capacity to produce biofilm, which aids in cell attachment on epithelial cells and the smooth surfaces of medical devices such as lung tubes and urinary catheters (16).

Additional investigation has revealed that a significant number of individuals have selected medications from community pharmacies over hospital medications that significantly impact P. aeruginosa resistance to wound infections. In the area, self-medication has grown to be a significant public health concern and a possible source of antibiotic resistance. P. aeruginosa frequently develops resistance to antibiotics and antiseptics in the

environment, which makes it similar to a patient who has serious burns and must deal with this opportunistic bacterium before the wound can heal (17).

Antimicrobial resistance

Multidrug resistance among these species can cause serious problems in the clinical setting. Pseudomonas aeruginosa is a well-known nosocomial pathogen that is intrinsically resistant to many antibiotics. The multiple-antibiotic resistance of Pseudomonas aeruginosa has been attributed to an impermeable selective outer membrane, an efflux pump mechanism, and the production of an inducible chromosomal beta-lactamase, which explains the high levels of resistance to Amoxicillin (93%) which is consistent with previous studies (18-19).

The antimicrobial resistance rates among Pseudomonas aeruginosa strains were found to be high in our study toward Tetracycline (92%) which inhibit protein synthesis this agrees with the finding of Ibrahim and Sabbar (2018) (71.16%) (20).

The resistance of Azithromycin (89%) was also high this indicates that Pseudomonas aeruginosa had develop resistance to amino glycosides through various mechanisms, such as mutations in ribosomal genes or the acquisition of plasmids that encode amino glycoside-modifying enzymes this agrees with the findings of Abdul sahib (2020) 71.6% of isolates were resistant to Azithromycin (21).

While the resistant to the DNA replication inhibitor Ciprofloxacin was (89%) this high level of resistant to the fluoroquinolones is a result of miss use of drugs and the horizontal transfer of resistance genes among deferent strains, the results are smellier to the findings of Al-Azzawi and Abdullah (2018) (22) with resistant level of (74%) to Ciprofloxacin but disagreed with many other studies (23-24).

The fast development of Acinetobacter baumannii to become broadly multidrug-resistant is regarded to be a major critical problem which is; the incorrect usage of antibiotics. Amoxicillin resistant was the highest (92%) this finding agrees with earlier study Narjis and Mahdi (2023) with (98%) resistant to Amoxicillin in clinical isolates from Baghdad hospitals (25). Azithromycin resistance was among the highest in the current study (89%) this result agrees with previous work done in Duhok city hospitals by Qader (2021) with resistant percentage of (80%). (26). Similar Iraqi study in 2016 found that A. baumannii clinical isolates were (70%) resistant to Tetracycline

which agrees with the current study (86%). (27). Trimethoprim resistance was (76%) which follows the pattern in earlier studies including Ghaima and colleagues done in (2015) with (84.4 %) resistance of Acinetobacter baumannii clinical isolates to Trimethoprim and (88%) of the isolates were resistant in the study of Mahmood, 2022.

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