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Prevalence of *Acinetobacter baumannii* in Diyala Governorate from Different Clinical Sources and its Antibiotics Profile Analysis

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Acinetobacter baumannii from various clinical sources (Blood, urine, CSF, Ear swab, burn swab, wound swab, sputum and vaginal swab) were isolated from patients were attending to Baquba Teaching Hospital and Al-Betool Teaching Hospital. A total of (27) isolates of A. baumannii bacteria out of (200) samples were isolated from various clinical sources. Diagnoses all *Acinetobacter baumannii* bacteria isolates and AST test by Vitek 2 advice. The maximum isolates were obtained from blood samples 10(37.03%), urine samples 4(14.8%), CSF samples 4 (14.81%), burn swab

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(14.81%), sputum swab 2(7.4%), while 1(3.7) for wound swab, Ear swab, and vaginal swab. All isolates were tested for their resistance to (23) different antibiotics and the results showed that resistant to Amoxicillin, Amoxicillin/Clavulanic acid and Trimethoprim were (96.2%) but lesser to Ticarcillin, Ticarcillin / Clavulanic Acid, Piperacillin/Tazobactam, Ceftriaxone, Imipenem, Ciprofloxacin and Levofloxacin were 88.8%.

Keywords: Acinetobacter baumannii; antibiotic susceptibility test; vitek 2 system and antibiotic.

1. INTRODUCTION

A.baumannii is a Gram-negative bacterium, aerobic and non-motile rod. This opportunistic bacterium has emerged as a significant concern in human health, responsible for a variety of infections, including pneumonia, meningitis, septicemia, and urinary tract infections. It possesses several virulence factors, such as the ability to form biofilms, adhere to surfaces, invade host cells, acquire iron, and induce host cell death [1]. *A. baumannii* easily attaches to both biological and non-biological surfaces, where it can form biofilms. This characteristic is significant for many pathogens as it aids in the colonization of prosthetic materials and plays a role in drug resistance and evasion of the host immune system in vivo [2]. *A. baumannii* has developed resistance to many of the most effective antimicrobial agents, leading to a significant increase in morbidity and mortality rates, particularly in intensive care units across various countries [3]. *A. baumannii* is a significant multidrug-resistant (MDR) opportunistic pathogen commonly associated with nosocomial infections, largely due to its remarkable ability to develop resistance to various groups of antibiotics. Multiple mechanisms contribute to the acquisition of this multidrug resistance [4]. Resistance in *A. baumannii* strains exhibiting the MDR phenotype is attributed to a diverse array of genes responsible for antibiotic resistance, encompassing both intrinsic and acquired mechanisms [5]. There are three mechanisms of antibiotic resistance in *A. baumannii*: First, resistance can arise by reducing membrane permeability or increasing antibiotic efflux, thereby preventing access to the target. Additionally, bacteria may employ genetic changes or post-translational modifications to protect the drug target. Finally, antibiotics can be directly inactivated through hydrolysis or modification processes [6]. This pathogen has developed multidrug resistance (MDR) in recent years, mainly due to the widespread overuse of antibiotics and inadequate antibiotic management. Prolonged hospital stays, use of catheters, and mechanical ventilation are associated with MDR isolates, and invasive infections are more likely to occur in immunocompromised individuals and those who are critically ill [7,8]. The present study therefore aimed to determine the prevalence of *Acinetobacter baumannii* in Diyala governorate from different clinical source and to determine the sensitivity and resistance of isolates to antibiotics.

2. MATERIALS AND METHODS

In the current study, 27 *A. baumannii* isolates were employed. Samples were gathered between January and July of 2024. Blood, urine, CSF, burns, wounds, blood cultures, and sputum were among the items that were taken from Baquba Teaching Hospital and Al-Betool Teaching Hospital. All obtained samples, with the exception of blood, were grown immediately on blood agar and MacConkey agar and incubated for twenty-four hours at 37ºC. The blood specimen must be placed in blood culture bottles that include nutrients that encourage the growth of aerobes bacteria and then cultured on blood agar and MacConkey agar and then incubated for further 24 hours at 37ºC.All bacterial isolates were tested by Vitek 2 system. Bacterial identification based on the biochemical reactions between the bacterial suspention and the culture media existed in the GN-ID Cards loaded manually into the VITEK system. The susceptibility of *A. baumannii* isolates against 23 antibiotics were determined by Vitek 2 system by using Antibiotics Susceptibility Gram-negative (AST-GN).

3. RESULTS

In this study a total of (200) samples were obtained from from (Blood, urine, CSF, Ear swab, burn swab, wound swab, sputum and vaginal swab as shown in Table (1).

In this study most of *A. baumannii* isolates were highly resistant to the tested antibiotics as shown in Table (2). The high resistance of *A.*

baumanniii isolates to antibiotics shown in this study, 26 isolates were resistance 3 antibiotics (96.2%), 25 isolates were resistance 4 antibiotics with the rate (92.5%), while 7 isolates were resistance 24 antibiotics with the rate (88.8) as shown in Table(2).

Resistance to broad-spectrum antimicrobial agents in *A. baumannii* is now an emerging issue globally. In the present study, Tigecycline was found the most effective antimicrobial against isolated *A. baumannii* strains, with a 40.7% sensitivity rate, followed by trimethoprim-sulfamethoxazole by 37.03%, Minocycline and Colistin whth a 33.3% while showed a high resistance rate to Amoxicillin , Amoxicillin/ Clavulanic acid and Trimethoprim by (96.2%), Cefuroxime, Cefixime, Cefotaxime and Ceftazidime by (92.5%), Ticarcillin, Ticarcillin / Clavulanic Acid, Piperacillin , Ceftriaxone, Ciprofloxacin and Levofloxacin (88.8%), and Cefepime, Imipenem, Meropenem, Gentamicin, Piperacillin, Tobramycin which exhibited the low level of antimicrobials effectiveness against *A. baumannii* strains.

Table 1. Distribution of samples and number of *Acinetobacter baumannii* isolates

Type of specimen	Total specimen	Number of isolates	%
blood	30	10	37.03
Urine	55	4	14.81
CSF	15	4	14.81
Ear swab	5	1	3.7
Brun swab	30	4	14.81
Wound swab	45	1	3.7
Sputum swab	15	2	7.4
vaginal swab	5	1	3.7
Total	**200**	**27**	**100**

Table 2. Antibiotic susceptibility test test on *A. baumannii* isolates

AB	*Acinetobacter baumannii* bacteria (27 isolated)	
	S(100%)	R(100%)
Amoxicillin	1(3.7)	26(96.2)
Amoxicillin/Clavulanic acid	1(3.7)	26(96.2)
Ticarcillin	3(11.1)	24(88.8)
Ticarcillin / Clavulanic Acid	3(11.1)	24(88.8)
Piperacillin	3(11.1)	24(88.8)
Piperacillin/Tazobactam	6(22.2)	21(77.7)
Cefuroxime	2(7.4)	25(92.5)
Cefixime	2(7.4)	25(92.5)
Cefotaxime	2(7.4)	25(92.5)
Ceftriaxone	3(11.1)	24(88.8)
Ceftazidime	2(7.4)	25(92.5)
Cefepime	4(14.8)	23(85.1)
Imipenem	3(11.1)	24(88.8)
Meropenem	4(14.8)	23(85.1)
Gentamicin	5(18.5)	22(81.4)
Ciprofloxacin	3(11.1)	24(88.8)
Levofloxacin	3(11.1)	24(88.8)
Tigecycline	11(40.7)	16(59.2)
Minocycline	9(33.3)	18(66.6)
Colistin	9(33.3)	18(66.6)
Tobramycin	6(22.2)	21(77.7)
Trimethoprim	1(3.7)	26(96.2)
Trimethoprim/Sulfamethoxazole	10(37.03)	17(62.9)

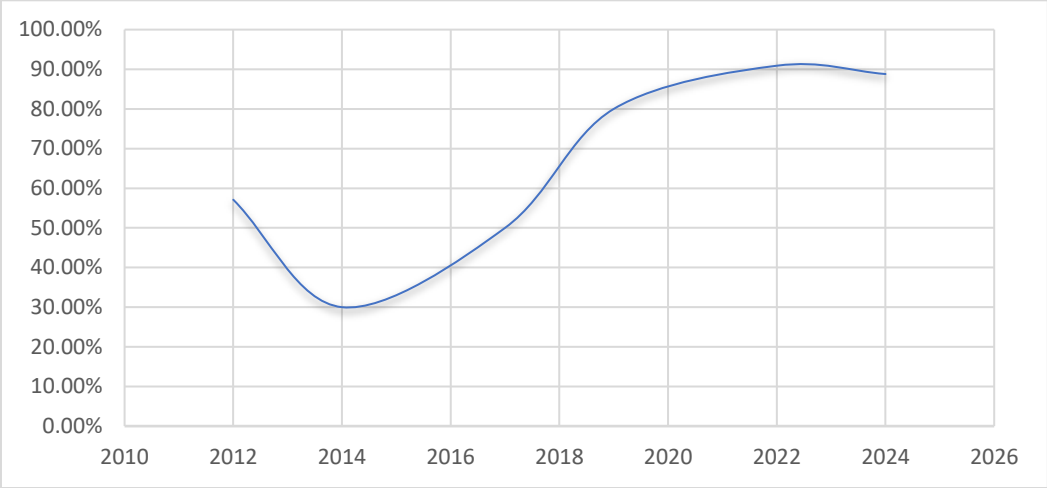

Fig. 1. Increase Imipenem resistance of *A. baumannii* clinical isolates in Iraq

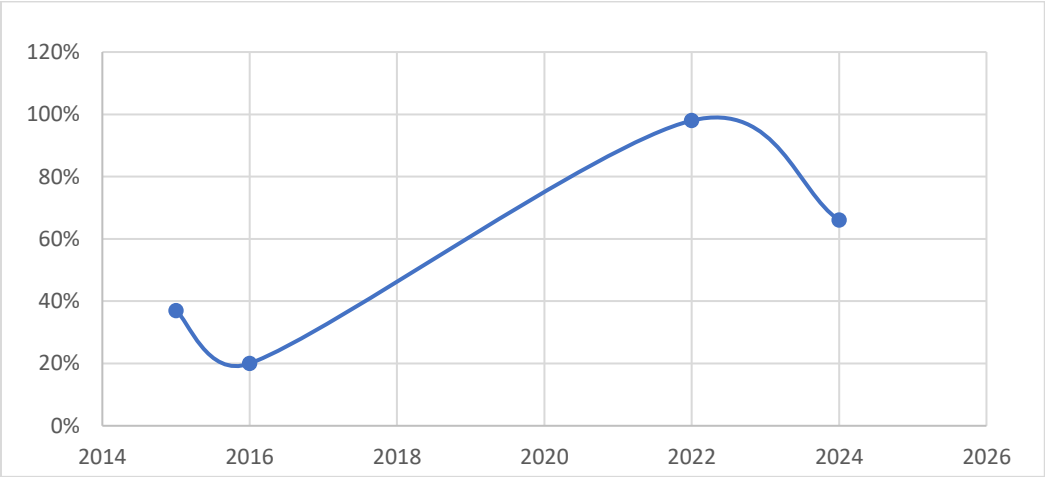

Fig. 2. Increase Colistin resistance of *A. baumannii* clinical isolates in Iraq

These local investigations show that multidrug resistant *A. baumannii* is becoming more common in Iraqi hospitals. One such example is Imipenem (Fig. 1) and the other example is Colistin (Fig. 2); the reason for these discrepancies in the results might be the overuse of antimicrobial medications in the hospitals over the past few years (8).

4. DISCUSSION

The results shown in Table (1) appeared that from the total 27 isolates 10(37.03%) from blood, 4(14.81%) isolated from Urine, CSF, Brun ,2(7.4%) from sputum respectively. The lowest number and percentage of *A. baumannii* was Wound, Ear, vaginal swabs 1(3.7%). Urine is often only detected when an indwelling urinary catheter is present. While it is infrequently linked to pyelonephritis and urosepsis, it is seldom invasive and typically just affects the lower urinary tract [9,10]. This result was compared to the result obtained by [11,12] and [13] have isolated *A. baumannii* from urine rate reaching to (16,10% and 11.5%) respectively. The results of this study shows that *A. baumannii* bacteria can be isolated from burn and this result agreed with previous study [14], who has isolated these bacteria from burn samples at rate of (17%). Around the world, burns are a serious public health problem and one of the most prevalent and destructive types of trauma [14,15]. The presence of an ample amount of oxygen in the respiratory tract, especially the lower part of it, encourages bacteria to settle and invade the region because it is a forced wind [16]. A bacteriological study stated that more than 60% of hospital-acquired pneumonia infections are caused by Negative bacteria including *A. baumannii* the reason for this may be attributed

to their ability to blind adhesion to epithelial cells in the respiratory tract as a result of inhibitory substances such as bacteriocins, was as the presence of mucous matter [17].

Because *A. baumannii* may form biofilms in the skin and cause infections in soft tissues, it is present in wounds and occlusive dressings [7]. Because many bacterial species have particular receptors for these chemicals, bacteria can readily colonize the surfaces of burn wounds. The reason for the difference in the isolation ratio is due to the number of samples taken the time of collection of the samples, the environment from which the samples were isolated, the health conditions in which the patients lived, and the length of time they stayed in Hospitalization, indiscriminate use of antibiotics excessively and the difference in the number of samples taken for a study and variance. Numerous dangerous nosocomial infections, including as urinary tract infections, meningitis, wound infections, bloodstream infections, and ventilator-associated pneumonia, can be caused by A. baumannii. individuals in the high-risk groups include individuals who are mechanically ventilated, have indwelling foreign devices, are debilitating patients, and are hospitalized to intensive care units (ICUs) [18,19].

The results of the current study demonstrated that the highest resistance to almost all β-lactam antibiotic classes under study was as follows cephalosporins (Amoxicillin, Amoxicillin/ Clavulanic acid ,Cefuroxime, Cefixime Cefotaxime, Ceftriaxone, Ceftazidime, Cefepime, Piperacillin ,Oxacillin) These findings were close to local studies related to A. baumannii isolates by Adnan S *et al.* [20,21], who found that (100%) of A. baumannii isolates in Iraqi hospital environment resisted Oxacillin, Ceftazidime and Cefepime. Another study in Iran hospital by Maryam R *et al*. [22] found (100% resistance rate to (Cefoxitin, Cefoxitin, Oxacillin, Ceftazidime, Cefepime). The three main types of resistance mechanisms are: (1) enzymes that deactivate antimicrobials; (2) bacterial targets are less accessible; or (3) mutations that alter targets or cellular activities. Regarding the first group, a variety of β-lactamases found in Acinetobacter species hydrolyze and provide resistance to cephalosporins, carbapenems, and penicillins. Chromosome-encoded AmpC cephalosporinases provide resistance to broad-spectrum cephalosporins [23].

As the isolates of bacteria *A.baumannii* resistance to Gentamicin in the percentage (81.4%). The results are consistent with [24]. which was reached by the resistance rate (62%). While the resistance to isolates of the antibiotic Imipenem (88.8%), Meropenem (85.1%). This close with the results of the current study, which gave a100% resistance to this antibiotic.

The results of Ciprofloxacin and Levofloxacin are agreed with [25] research, which was reached by the resistance rate (85%), and also agreed with [26] research. The resistance rate was (80%), Another local study revealed that A. baumannii clinical isolates were 100 % resistant to Ciprofloxacin [27]. resistance of A. baumannii for Tobramycin, were (77.7%) consistent with the study of [28]. that showed 100% resistance for Tobramycin.

Because of its low rates of resistance, tigecycline could be the treatment of choice for managing infections at this facility. Although The results of resistance to trimethoprim /sulphandmethoxole also had a low resistance rate in our present study, were close to the results reached by the researcher in the research [24] and also close to the results of the research of [29] who recorded that the Acinetobacter baumannii resist to a wide range of antibiotic including trimethoprim / sulphandmethoxole in the percentage (81%). fewer patients were treated by this antibiotic, as its side effects of nephrotoxicity and neurotoxicity [30].

These bacteria are resistant to nearly all antibiotics for a variety of reasons. Among these, the most significant one is the existence of efflux pump families [31]. There are several families of efflux pumps in *A. baumannii*, but the most significant family is the existence of Resistance. These families allow us to exclude antibiotics, heavy metals, and a host of other substances. The three pump groups that make up the nodulation cell division (RND) family are each in charge of resisting a particular kind of antibiotics. Clinical isolates of A. baumannii were reported to be 37% resistant to colistin in a previous investigation conducted in Sudan in 2015 [32]. Previous study in Iraqi in 2016 found that *A. baumannii* clinical isolates were 20% resistant to colistin [33]. Previous study has reported that A. baumannii from clinical isolates were 96% resistant to colistin [34]. Colistin-resistant A. baumannii may become resistant to colistin due to modifications of the outer membrane which may increase the permeability to other cell wall antimicrobial agents. Previous studies have reported that colistin-resistant *A. baumannii*

strains were more susceptible to other antimicrobial agents than colistin-susceptible strain [35].

Previous study in Iraq in 2012 shown that resistance to Imipenem was 57.1% [36]. Previous study in Iraq in 2014 shown that low resistance to Imipenem 30% [37]. Other study also in Iraq shown that One (10%) isolate was observed to be imipenem and meropenem resistant [38]. Iraqi study in 2017 found that A. baumannii clinical isolates were 68.7% and 50% resistant to Ceftazidime and Imipenem respectively [39]. *A. baumannii* clinical isolates in previous study were 68.7% and 90.9% resistant to Imipenem [40,41].

In present study appeared to have resistance to Cefotaxime (92.5%) compare to previous study shown that all isolates appeared to have resistance to Cefotaxime (60%) [37]. previous study has reported that most isolates of A. baumannii are considered to be resistant to Cefotaxime in rate reach to (80%) and (60%) respectively [42,43]. Other previous study found that (12.2%) of isolates were resistant to Cefotaxime [44].

5. CONCLUSION

A.baumannii has demonstrated a high level of resistance to the majority of tested antibiotics, earning it the reputation of being the most therapeutically significant Acinetobacter species globally. It has become a significant nosocomial opportunistic pathogen in hospital infection epidemics.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

CONSENT

It's not applicable.

ETHICAL APPROVAL

It's not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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