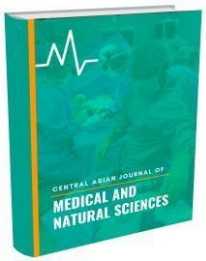

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Article

Multidrug-Resistant *Acinetobacter baumannii* Isolated from Clinical Samples in Al-Najaf City, Iraq

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Abstract: Background: *Acinetobacter baumannii* has emerged as a major cause of opportunistic pathogens associated with hospital-acquired infections and multidrug resistance worldwide. **Objectives:** The currwnt study aimed to detect the antimicrobial susceptibility patterns of *Acinetobacter baumannii* isolated from different clinical samples at Al-Najaf city, Iraq. **Methods:** A cross-sectional study was performed over a period of six months (March to September 2024). A total of 25 clinical isolates *A. baumannii* were obtained from several clinical specimens. Antimicrobial susceptibility testing was achieved using minimum inhibitory concentration (MIC) methods using the VITEK-2 automated system according to standard guidelines. Statistical analysis was performed using SPSS software, and a p-value ≤ 0.05 value was considered statistically significant. **Results:** Females revealed a slightly higher infection rate (56%) than males (44%). Sputum were the most common source of isolation (32%), followed by urine (28%) and blood samples (20%). A high resistance levels were observed against ceftazidime (80%), cefotaxime (72%), and imipenem (68%). Colistin showed the highest sensitivity rate (92%) with highly significant difference (P=0.0001). **Conclusion:** The study showed a high spread of multidrug-resistant *Acinetobacter baumannii* particularly in intensive care units settings. Colistin remains the most effective antimicrobial agent. Continuous surveillance and effective antibiotic stewardship are important to limiting the prevalence of resistant strains.

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1. Introduction

Acinetobacter baumannii (A. baumannii) is an aerobic, Gram-negative, coccobacili that has emerged as one of the most important opportunistic bacteria associated with hospital-acquired infections [1], especially in hospitalized and critically ill patients [2], [3]. Its clinical importance is largely attributed to its extraordinary ability to persist in hospital environments, colonize medical devices, and resist desiccation and disinfectants, facilitating its persistence and transmission within healthcare settings [4], [5]. These characteristics make it a major cause of hospital-acquired infections, particularly in intensive care units (ICUs), where it is responsible for a extensive range of infections especially infections that difficult to treat such as pneumonia associated with ventilator, bloodstream infections, urinary tract infections, and wound infections [6], [7]. These infections associated with higher patient morbidity rates, death, and treatment expenses

[8]. Infections with *A. baumannii* has caused high mortality rates over the past decade, ranging from 30% to 75% in different parts of the world [9].

Multidrug-resistant *A. baumannii* are particularly prevalent in intensive care units due to the heavy use of invasive medical equipment and broad-spectrum antibiotics [4], [10], [11]. In recent years, there has been an increasing number of reports of MDR-resistant A. baumannii strains worldwide, exhibiting high rates of resistance to commonly used antibiotics, especially cephalosporins, carbapenems, and fluoroquinolones [12]. The emergence of carbapenem-resistant strains poses a serious public health threat, as carbapenems are often used as last-line treatment for severe infections [13]. Different mechanisms of resistance may be acquired by *A. baumannii*, which can eventually become resistant to all routinely used antibiotics in certain situations which significantly limit therapeutic options [14].

However, some antibiotics such as colistin still demonstrate relatively preserved activity against certain isolates. Bostanghadiri,s meta analysis study reported a decline in the prevalence of colistin resistance was observed among *A. baumannii* isolates responsible for infections worldwide during the period from 2000 to 2023 [15]. However, there is a high prevalence of isolates with colistin resistant in some countries [16]. In ICUs there are widespread use of antibiotics in immunocompromised patients, combined with the lack of programs related with antibiotic stewardship in hospitals, has led to the emergence of multidrug-resistant (MDR) pathogens and widwspread drug-resistant (XDR) strains. As a result, clinicians have been forced to rely on colistin as a last antibiotic for treating infections caused by *A. baumannii* [15], [17].

In Iraq and many developing countries, limited data are available regarding the resistance patterns of *A. baumannii*. Therefore, continuous monitoring of antimicrobial susceptibility is essential for effective treatment and infection control. Hence, the study purpose to evaluate the distibution and antimicrobial susceptibility patterns of A. baumannii isolated from clinical samples in Al-Najaf City, Iraq, in order to provide valuable data for improving patient management and controlling the spread of resistant strains.

2. Materials and Methods

This cross-sectional study was conducted in Al Najaf city, Iraq over a six-month period (March to September 2024). A total of 25 *A. baumannii* isolates were recovered from various clinical samples including sputum, urine, blood, wound swabs, and ear swabs. Standard microbiological diagnostic criteria were used to isolate and identify the clinical isolates of *A. baumannii*, including colony morphology, Gram staining and conventional tests of biochemical. All samples were subjected to antimicrobial susceptibility testing using automated system (VITEK-2).

3. Results and Discussion

Result

A total of 25 clinical isolates of *Acinetobacter baumannii* from different specimens and locations, different age groups and different sex. Females constituted a slightly higher proportion of cases than males. The wide age range indicates that *A. baumannii* infections affect all age groups, with a higher frequency among adults and elderly patients, (Table 1).

Respiratory samples represented the most common source of isolation, indicating that *A. baumannii* is predominantly associated with respiratory tract infections, particularly in hospitalized patients, (Table 2).

Tables 1. Demographic characteristics of patients infected *with Acinetobacter baumannii.*

Variable	Category	No. (%)
Gender	Male	11 (44.0)
	Female	14 (56.0)
Age (years)	Minimum	10
	Maximum	77
	Mean (approx.)	41

Table 2. Distribution of *A. baumannii* isolates according to clinical sample

Clinical sample	No. (%)
Sputum	8 (32 %)
Urine	7 (28 %)
Blood	5 (20 %)
Wound swab	4 (16 %)
Other (ear swab)	1 (4 %)
Total	25 (100 %)

Nearly half of the isolated samples were taken from ICU patients, highlighting the role of intensive care units as a major reservoir for *A. baumannii* infections (Table 3). The distribution of resistant and sensitive isolates, along with corresponding p-values, is summarized in Table 4. Among the 25 tested isolates, the highest level of resistance was observed to ceftazidime in 80% (20/25), followed by cefotaxime at 72% (18/25) with p=0.003 and p=0.028, respectively, that are statistically significant (indicating a non-random distribution of resistance patterns.

Table 3. Distribution of isolates according to hospital location

No. (%)	Hospital location
11 (44 %)	Intensive Care Unit (RCU/ICU)
9 (36 %)	Outpatient department (OP)
5 (20 %)	Inpatient wards (IP)
25 (100)	Total

Among carbapenems, resistance to imipenem and meropenem was observed in 68% (17/25) and 64% (16/25) of isolates, respectively. Although these findings did not reach statistical significance ($p > 0.05$), the high prevalence of carbapenem resistance was notable. Fluoroquinolone resistance was also common, with ciprofloxacin resistance identified in 60% (15/25) of isolates and levofloxacin resistance in 52% (13/25). No statistically significant differences were observed for this antibiotic class ($p > 0.05$).

Table 4. Antimicrobial Susceptibility Pattern of *Acinetobacter baumannii* Isolates (n = 25)

Antibiotic	25 isolates		p value
	Resistant (%)	Sensitive (%)	
Amoxicillin/Clavulanic acid	11 (44%)	14 (56%)	0.548
Piperacillin–Tazobactam	15 (60%)	10 (40%)	0.317
Ceftazidime	20 (80%)	5 (20%)	0.003
Cefotaxime	18 (72%)	7 (28%)	0.028
Ceftriaxone	16 (64%)	9 (36%)	0.161
Cefepime	14 (56%)	11 (44%)	0.548
Imipenem	17 (68%)	8 (32%)	0.073
Meropenem	16 (64%)	9 (36%)	0.161
Ciprofloxacin	15 (60%)	10 (40%)	0.317
Levofloxacin	13 (52%)	12 (48%)	0.841
Gentamicin	12 (48%)	13 (52%)	0.841
Amikacin	10 (40%)	15 (60%)	0.317
Trimethoprim/Sulfamethoxazole	14 (56%)	11 (44%)	0.548
Colistin	2 (8%)	23 (92%)	0.0001

Regarding aminoglycosides, amikacin demonstrated comparatively higher activity, with 60% (15/25) of isolates remaining sensitive, whereas gentamicin sensitivity was observed in 52% (13/25) of isolates. These differences were not statistically significant ($p > 0.05$). Resistance to trimethoprim/sulfamethoxazole was detected in 56% (14/25) of isolates, indicating limited effectiveness against the studied strains. In contrast, colistin showed the highest antimicrobial activity (92%). This result was highly statistically significant ($p<0.001$).

Discussion

This study demonstrates the high burden of *Acinetobacter baumannii* with multidrug-resistant (MDR) in healthcare facilities in Al-Najaf City, Iraq, confirming its role as a major opportunistic pathogen associated with healthcare-associated infections. Demographic findings show that infections occurred in both males (44%) and females (56%), with a mean age of approximately 41 years and a wide age range (10–77 years). A Saudi study has also documented the presence of *A. Baumannii* across various age groups and gender in different regions over several years18. These findings support the concept that *A. baumannii* is an opportunistic pathogen whose spread is more closely linked to healthcare settings [3], [19], [20], than the host demographic factors.

In the current study, the predominance of isolates taken from respiratory samples (32%), particularly sputum samples, in consistent with the findings of similar studies by Adeyemi et al. [21], and aligns with previous reports indicating that *A. baumannii* is closely associated with respiratory infections, especially ventilator-associated pneumonia (VAP) in hospitalized and ICU patients. Similar results have been reported in studies from various countries, where respiratory tract infections constituted the majority of *A.*

baumannii isolates [18], [22]. The high percentage of urinary and blood isolates (28% and 20%, respectinely) observed in this study highlights this organism's ability to cause serious invasive infections, including bacteremia and catheter-associated urinary tract infections, which are associated with high mortality rates. These findings underscore the invasive nature and clinical severity of *A. baumannii* infections [8], [23], [25]. The current study demonstrated the widespread prevalence of multidrug-resistant *A. baumannii*, particularly among ICU patients. Similar findings have been reported globally, with ICU serving as the primary reservoir for this pathogen [4], [11], [18], [26]. Selecting effective antibiotic therapy for infections with *A. baumannii* has form challenging as the prevalence of MDR, extensive drug resistance (XDR), and pandrug resistance (PDR) infections. Analyzing antibiotic resistance patterns over time may give valuable insights into the optimal treatment approach. This research examined the prevalence of MDR-A. baumannii in Al-Najaf city, Iraq.

Antibiotic susceptibility results revealed alarmingly high percentage of resistance to β-lactam antibiotics, particularly third-generation cephalosporins. Resistance to ceftazidime (80%) and cefotaxime (72%) with p value 0.003 and 0.028 respectively was considered statistically significant, indicating widespread resistance to these commonly used antibiotics. These findings are consistent with recent global reports showing resistance rates exceeding 70% for third-generation cephalosporins [27]. A recent study showed that more than 90% of *A. Baumannii* isolates exhibited resistance to the antibiotic ticarcillin/clavulanic acid, piperacillin/tazobactam, ceftazidime, ciprofloxacin, imipenem, and meropenem [28], [29]. In contrast, our results showed low resistance to ceftazidime (80%), imipenem (68%), meropenem (64%), and 60% for both piperacillin/ tazobactam and ciprofloxacin (Table 2). The high resistance to carbapenems observed in this study is particularly concerning, as carbapenems have long been considered the antibiotics of choice for severe *A. baumannii* infections. Similar resistance rates have been reported in recent global studies showing that carbapenem resistance exceeding 85% in many countries, particularly in developing countries [28], [33]. The increased resistance observed in this study reflects the global prevalence of carbapenem-resistant *A. baumannii* (CRAB), which the World Health Organization has classified as a high-priority pathogen [34].

Aminoglycosides showed relatively lower resistance rates, with resistance to gentamicin and amikacin observed in 48% and 40% of isolates, respectively. The relatively better activity of aminoglycosides observed in this study is consistent with previous reports idicating that amikacin is one of the most effective antibiotics against MDR *A. Baumannii* [21]. However, the moderate resistance rate still limits its efficacy as a reliable empirical treatment option.

Colistin demonstrated the highest sensitivity and remained the most effective antibiotic, with sensitivity observed in over 90% of isolates. These findings are consistent with recent reports in Iraq, Sudia, Iran, Jourden, India [18], [20], [35], [37]. This finding also aligns with local and international studies that continue to consider colistin as a last-line treatment option against MDR and XDR *A. Baumannii* [35], [38], [41]. The emergence of multidrug resistance may be attributed to overuse, biofilm formation, production of lytic enzymes, altered metabolic status, decreased in permeability of bacterial membrane, altered targets of antibiotic, increased of efflux pumps, and gene transfer mechanisms [42], [46]. However, the emergence of colistin-resistant strains worldwide [16], raises

serious concerns about future treatment options, emphasizing the need for cautious and judicious use due to its toxic effects on the kidneys and nervous system.

4. Conclusion

The present study showed a high prevalence of multidrug-resistant *Acinetobacter baumannii* as an important nosocomial pathogen in Al-Najaf city, particularly in ICU settings. Colistin remains the most effective antibiotic. Continuous monitoring is needed to identify emerging *A. baumannii* resistance patterns and to implement effective antibiotic management to limit the spread of resistant strains.

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