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Susceptibility Pattern of Multidrug Resistantی Acinetobacter Baumannii among Intensive Care Unit Patients

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Abstract: *Acinetobacter baumannii* Gram-negative, opportunistic bacterium is progressively cause hospital acquired infections specially intensive care unites. From May 2025 until September 2025, this study was cross-sectional and performed at Azady Teaching Hospital in Kirkuk, Iraq, to look at the frequency, age distribution, and antimicrobial resistance pattern of *A. baumannii* isolated from many clinical specimens. With the greatest isolation rates from urine and wound swabs (45.2% each), 31 (4.5%) of the 670 cultured samples turned out to be *A. baumannii*. The 45-55 year age range was particularly impacted. While colistin and tigecycline exhibited great efficacy (93.5% sensitivity), antibiotic ssensitivity testing conducted with the VITEK®2 compact system demonstrated high resistance to ampicillin (83.9%), trimethoprim/sulfamethoxazole (67.7%), and ciprofloxacin (64.5%). Resistance profiles differed statistically significantly among drugs ($p < 0.0001$). high level of XDR reported in isolates. These results underline how urgently antibiotic stewardship, infection control, and ongoing surveillance are needed to fight multidrug-resistant *A. baumannii.*

Keywords: VITEK2, Kirkuk, multidrug resistance, *Acinetobacter baumannii*, intensive care unites nosocomial infections.

1.1 Introduction:

Acinetobacter baumannii, a gram-negative coccobacillus, mainly causes hospital acquired infections in immunocompromised, hospitalized patients and antibiotic abuse [1,2] *Acinetobacter baumannii* (*A. baumannii*) is a remarkable opportunistic pathogen responsible for a great proportion of hospital-associated infections such as ventilator-associated pneumonia, urinary tract infections, septicemia, endocarditis, meningitis and wound infections[3]. Direct contact between infected patient with *A. baumannii* and healthcare workers, and indirectly contact with contaminated devises in the hospital and healthcare settings, are among the main method of transmission and spread of *A. baumannii* infection, especially pneumonia [4,5].

Antimicrobial resistance (AMR) is a major problem in the healthcare units worldwide. It has been related with increased morbidity, mortality, and cost [6] *A. baumannii* isolates have developed resistance to the majority of antibiotic classes during the past decades by both of acquired and innate resistance mechanisms [7]. *A. baumannii* has developed multidrug resistance through different mechanisms, for example, lowering expression of outer membrane porins, the expression of efflux pumps, formation of certain β-lactamases, the presence of a "resistance island" expressing multiple resistance genes [8]. *A. baumannii* has developed resistance to a various types of antibiotics from several classes, including aminoglycosides, cephalosporins,

fluoroquinolones, carbapenems, tetracyclines and lipopeptides [9]. Although carbapenem antibiotics such as imipenem and meropenem were the most powerful drugs against *A. baumannii* infections, now a day detected that resistance rates of up to 87 %, making colistin or tigecycline the only available choices for multidrug-resistant *A. baumannii* infections. Despite of, colistin and tigecycline resistance has recently emerged in Europe with a prevalence rate about 3 % to 6 % [10] . The evidence of extensively drug-resistant (XDR) and pandrug-resistant (PDR) isolates of *A. baumannii* is also appeared in different countries [11,12,13] . The World Health Organization (WHO) has assigned *A. baumannii* as a major priority pathogen posing a great threat to human health, and for it which new antibiotics are urgently required [14]. Such medical and public health implications underlie the need to exact diagnose and evaluation to the both of microbial disease and antibiotic resistance classes of this bacteria.

1.2 Objectives:

1. Detection and isolation of causative agent of disease *A. baumannii from intensive care unite*

2. Performance of antibiotic sensitivity to each samples.

3. Evaluate type of antibiotic resistance of *A . baumannii* .

4. identify the pattern of resistance of *A . baumannii* in clinical samples.

Chapter two

Literature review

2.1 Acinetobacter baumannii

Acinetobacter are a species of notoriety among bacterial species, they can be found in soil and water. Patients infected with *Acinetobacter species* frequently get urine, saliva, respiratory secretions, and open wounds cultures. The species are also known to colonize intravenous fluids and other irrigation solutions[15] .

The genus *Acinetobacter* classed under the family *Moraxellaceae*, class γ-proteobacteria, and it considered as coccobacili Gram-negative, aerobic, non-lactose fermenting, saprophytic bacteria [16].

Acinetobacter baumannii implicated in a number of infections in both hospital and communty atmosphere [17]. Nosocomial infections are most commonly seen in critically ill patients; specific risk factors for developing an *A. baumannii* infection include prolonged hospital residents, immune compromised, elderly, major trauma or burns, recurrent antibiotic use, invasive procedures, indwelling catheters or mechanical ventilation. Main reason is poor prognosis of critically ill patients who acquire A. baumannii infections, it is difficult to attribute a definitive mortality rate, however morality rates range about 23 to 68% [18]. Although recent genomic and phenotypic analyses of *A. baumannii* have showed several virulence factors expressible for its pathogenicity, merely few virulence factors have been identified in *A. baumannii*, in compare with the other Gram-negative pathogens [19].

Lipooligosaccharide:

Lipooligosaccharide of *A. baumannii* present in the surface appendages, adhesins, and glycoconjugates, like capsular polysaccharides, glycosylated proteins, lipooligosaccharide (LOS), and peptidoglycan are important virulence factor[20].

2.2 Biofilm:

The formation of biofilm in *A. Baumannii* increase its risk factors and resistance to antibiotic treatments because the bacteria become metabolically inert in the deeper layers of the biofilm posing a difficulty for antibiotic action to reach the bacteria affecting its antibiotic susceptibility. Therefore, the bacteria are able to tolerate harsh conditions and resist antibiotic treatments owing

to the biofilm matrix that surrounds them. Consequently, current treatments for infections caused by *A. baumannii* biofilms are unsuccessful[21].

2.3 Motility:

A. baumannii has no flagella-mediated motility, it move by twitching or surface-associated motility. Twitching motility is a coordinated multicellular movement caused by the extension, attachment, and retraction of type IV pili, which are shared in surface adherence and biofilm formation [22].

2.4 Clinical Aspects:

A. Baumannii affects moist tissue the likes of mucus membranes, or undermined exposed skin membranes. Skin infection take place in clear vesicles then Hemorrhagic bullae and further leads to necrosis of the tissue, if the infection is not treated completely it will lead to septicemia and death. *A. baumannii* can also cause UTIs, secondary meningitis and infective endocarditis [23].

2.5 Diagnosis:

Identification of *Acinetobacter baumannii* can be carry out by cultural growth characteristics, biochemical tests and molecular diagnosis. They are classified as aerobic, Gram-negative, oxidase-negative, catalase-positive, indole-negative, urease-negative, haemolysis-negative, non-motile and non-lactose fermenter rods [24]. other methods of diagnosis include:

The most famous and exact detection methods include characterization via a phenotypic system and commercial phenotypic methods (e.g., the VITEK 2 system [Biomerieux] and the API 20 NE system) or DNA-based testing such as PCR (e.g., 16S rRNA gene amplification), which have been used to successfully identify all Acinetobacter species [25].

2.6 Treatment:

A. Baumannii routinely develops resistance to many families of antibiotics, such as β-lactam antibiotics, cephalosporins, aminoglycosides, fluoroquinolones and carbapenems. very few drugs like polymyxin B, colistin and tigecycline, are effective antibiotics for *A. Baumannii* infections [26].

Chapter Three

Materials and Methods

3.1 Administrative Arrangement:

The official permission is obtain from approval from Kirkuk Health director and laboratory manager in order to interviewing each Medical staff and finally agreement to participate in the interview to answer the.

3.2 Patients and sample collection

Cross sectional study carried out in Azady teaching general hospital in Kirkuk city during the period from May 2025 until September 2025, questionnaire form had filed for every patient including name, age, gender, type of specimen that obtained, the patient under medication or not (no antibiotic intake for 3 days before collection of specimen for culture)

In current study 686 different clinical specimens cultured included (sputum, urine, wound swabs, and blood) only 31 *A. baumannii* isolates were obtained. All those ssamples cultured on Blood agar and MacConkey agar and brain heart infusion broth (BHI) incubated 24 hours at 35+2 ºC, then oxidase test and catalase test and biochemical reactions had done for exact species identification, which had performed by VITEK®2 GN ID card.

Antimicrobial susceptibility testing for *A. baumannii* performed by using the VITEK® 2 compact system (bioMérieux, France) isolates from pure colonies on blood and MacConkey agar

plates used for identification and antimicrobial susceptibility testing cards (GN kit, AST N222 kit), bacterial suspension turbidity must be 0.5 McFarland as it is standard form.

3.3 Data analysis

Systematically all data analyzed by SPSS Statistics employing simple prevalence of *A. baumannii* across different units and clinical specimens. The antibiotic resistance pattern of *A. baumannii* was explained and compared last studies and papers.

Chapter four

Results

Results:

4-1 Frequency of *Acinetobacter baumannii* isolates in different clinical samples:

The current study had done in Azady teaching hospital in Kirkuk city, In this study 686 different clinical samples cultures from (sputum, urine, wound swabs, and blood) only 31 *isolate of them were A. baumannii* ,urine 14 isolates (45.2%), wound 14 (45.2%), blood 2 (6.4%), sputum 1 isolate (3.2%) as shown in **(Table 4-1)**

(Table 4-1) Frequency of *Acinetobacter baumannii* isolates in different clinical samples

Specimen Types	Number of Isolates	Percentage (%)
Urine	14	45.2%
Wound	14	45.2%
Blood	2	6.4%
Sputum	1	3.2%
Total	31	100%

4-2 Prevalence of *Acinetobacter baumannii according to age group*

Measuring age variable, high percentage of *A. baumannii* were amonge age group (45-55) 25.8% and age group (25-35) 19.3% respictevly, while lowest percentage found in age group (10-15) about 3.2 % that shown by **(Table 4-2)**.

Table 4-2 Prevalence of *Acinetobacter baumannii according to age group*

Age group	Number	Percentage (%)
< 10 years	3	9.7
10-15	1	3.2
15-25	5	16.1
25-35	6	19.3
35-45	3	9.7
45-55	8	25.8
55-65	2	6.5
65 >	3	9.7
Total	31	100 %

4-3 Antibiotic susceptibility test for *Acinetobacter baumannii* isolates

In the current study antibiotic sensitivity test had been done for all *A. baumannii isolates, highest level of antibiotic resistance percentage recorded for ampicillin 26* (83.9 %), Trimethoprim/sulfamethoxazole 21(67.7 %), Ciprofloxacin 20 (64.5 %), Piperacillin19(61.3%) respectively, and 18(58.1 %) for Ceftriaxone, imipenem, Levofloxacin respectively. Gentamycin and Imipenem resist about 17 (54.8%), while lowest *level of antibiotic resistance percentage*

reported for Tigecycline and Colistin 2(6.5 %), minocycline 1(3.2 %), only one isolate was Extended-spectrum beta-lactamases (ESBLs) 1(3.2%), as shown in **(Table 4-3) (Fig. 4-2)**

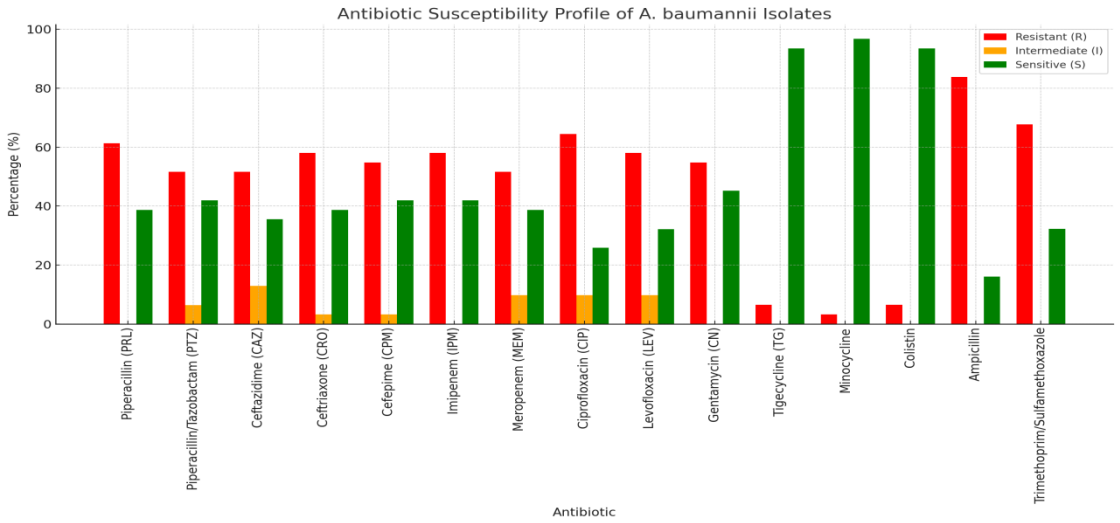

Figure 4-2Antibiotic susceptibility profile of *Acinetobacter baumannii*

Table 4-3 Antibiotic susceptibility for *Acinetobacter baumannii* isolates

Antibiotics	S	I	R
	NO. / %	NO. / %	NO. / %
Piperacillin (PRL)	12 (38.7 %)	0	19 (61.3%)
Piperacillin/Tazobactam(PTZ)	13 (41.9 %)	2 (6.5 %)	16 (51.6 %)
Ceftazidime (CAZ)	11 (35.5 %)	4 (12.9 %)	16 (51.6 %)
Ceftriaxone (CRO)	12 (38.7 %)	1 (3.2 %)	18 (58.1 %)
Cefepime (CPM)	13 (41.9 %)	1 (3.2 %)	17 54.8 %)(
Imipenem (IPM)	13 (41.9 %)	0	18 (58.1 %)
Meropenem (MEM)	12 (38.7 %)	3 (9.7 %)	16 (51.6 %)
Ciprofloxacin (CIP)	8 (25.8 %)	3 (9.7 %)	20 (64.5 %)
Levofloxacin (LEV)	10 (32.2 %)	3 (9.7%)	18 (58.1 %)
Gentamycin (CN)	14 45.2 %)(	0	17 54.8 %)(
Tigecycline (TG)	29 (93.5 %)	0	2 (6.5 %)
Minocycline	30 (96.8 %)	0	1 (3.2 %)
Colistin	29 (93.5 %)	0	2 (6.5 %)
Ampicillin	5 (16.1 %)	0	26 (83.9 %)
Trimethoprim/	10	0	21

Sulfamethoxazole	**(32.3 %)**		**(67.7 %)**
p-value=3.54 × 10^{-16}, indicating a **highly significant difference** in resistance patterns among the antibiotics tested			

*No. (Number), S (sensitive), I (intermediate), R (resistant).

4.4 Prevalence of antimicrobial resistance pattern in *Acinetobacter baumannii* isolates

In current study 31 isolates of *A. baumannii* obtained 19 of them showed different pattern of resistance, 5(26.2%) were multidrug resistant(MDR), 9(47.4%) extensive drug resistant(XDR), 4(21%) pan drug resistant(PDR), and one (5.3%) was extended spectrum beta lactamase (ESBL) as showed in **(Table 4-4**).

Table 4-4 Prevalence of antibiotic resistance pattern in *Acinetobacter baumannii* isolates

Resist type	Number	Percentage %
MDR	5	26.2
XDR	9	47.4
PDR	4	21
ESBL	1	5.3
Total	19	%100

Chapter five

Discussion

5. Discussion :

Acinetobacter baumannii, is a pathogenic bacteria major causer of hospital-acquired disease and resistance against several antibiotics. *A. baumannii* form common nosocomial infection that that is life threatening for patients in the ICU, the rate of adaptation to the hospital environment and misuse of antibiotics lead to the emergence of MDR *Acinetobacter* strains, which increased the levels of mortality and morbidity [1,3,10], our analysis at Azady Teaching Hospital revealed 31 isolates (45.2%) mostly from urine and wound samples that agree with Lahiri KK that reported predominance of bacteria in urine (21-27%) [27].

As many worldwide studies that usually link *A. baumannii* with elderly patients or those in intensive care units, one of big problems of this bacteria urinary tract infections (UTIs), in patient indwelling urinary catheters, in current study all wound samples obtained from burn unit which expressed as intensive care units,. Moreover, it is unusual for this organism to cause uncomplicated UTI in healthy outpatients agree with our result (45.2%) of isolate was from urine and wound swabs [28], also Saba Abbas mentioned (50%) isolated from wound infection and sputum respectively, and percentage of *A. baumannii* was (33.3%) in urine samples [29].

The distribution by age a showed high percentage of *A. baumannii* were amonge age group (45-55) 25.8% and age group (25-35) 19.3% respictevly, while lowest percentage found in age group (10-15) about 3.2 % that shown by **(Table 4-2)**, agreed with Noor (et al) there isolates were most commonly reported (36.1%, 64.3%,50%, 100%) in the age group of 50–75 years of wounds, Tonsils, urine, and C.S.F, followed by the age group of 30–50 years as (72.7%) in diabetic foot ulcer and age group of 10–30 years as (45.5%) in burn swab, so the infection is very common in elderly and this agree with study of [30,31,32].

This phenomenon may be attributable to a compromised immune system and the concomitant chronic diseases that are prevalent in these age groups [33,34].

Profile of antimicrobial susceptibility begs serious questions. Reflecting resistance rates in India, Iran, and parts of Europe, more than 50% of isolates were resistant to carbapenems (imipenem, meropenem), cephalosporins, and fluoroquinolones. *highest level of antibiotic resistance percentage recorded in our study for ampicillin 26* (83.9 %), Trimethoprim/sulfamethoxazole

21(67.7 %), Ciprofloxacin 20 (64.5 %), Piperacillin19(61.3%), Most often occurring (83.9%), ampicillin resistance confirmed results by Prashanth and Badrinath [4] and others claiming this agent's ineffectiveness.

Although developing resistance in other areas warns against complacency, encouragingly tigecycline and colistin preserved >93% efficacy that agreed with current study results (93.5%) sensitive to it (10,12,14). The statistically substantial differences in susceptibility profiles across antibiotics ($p < 0.0001$) confirm the requirement of customized treatment directed by local antibiograms [6,15].

Complicated and multifaceted, mechanisms of resistance in *A. baumannii* include efflux pumps, outer membrane changes, enzymatic degradation (β-lactamases), and biofilm development [7, 19, 20]. Regarding to colistin (93.5%) of isolate were sensitive to it that agreed with Victoria (et al) (57.89%) was *A. baumannii*. All *A. baumannii* strains were sensitive to colistin [35]. Resistance pattern of *A. baumannii* observed 19 of isolates showed different pattern, 5(26.2%) were multidrug resistant(MDR), 9(47.4%) extensive drug resistant(XDR), 4(21%) pan drug resistant(PDR), and one (5.3%) was extended spectrum beta lactamase (ESBL) as mentioned in **(Table 4-4**), MDR result agreed with study reported 44 (39.6%) isolates were MDR strains. Acinetobacter have a great ability to develop antibiotic resistance rapidly [36], also Victoria (et al) mentioned three isolate only of *A. baumannii* in their study almost our result [35]. While there were some difference between our result MDR (26.3%) XDR (47.4%) and study carried out in Baghdad. Many reports mentioned *A. baumannii* isolates as multi-drug resistant (MDR) (98%), and the other reports recorded (2%) were extensively drug-resistance (XDR) to the majority of antibiotics discs [37]. Many reasons could be due to the increase drug resistance, inappropriate antibiotic usage, self-medication, non-adherence to prescribed treatments, dissemination of resistant strains among individuals, and the distribution of inferior pharmaceuticals. Regional customs significantly influence the exponential growth of resistance, as most persons resort to acquiring prescription medications from pharmacies without valid prescriptions or consideration of shelf life [38].

Chapter six

Conclusions and Recommendations

6.1 Conclusion:

Current study highlights the clinical and microbiological importance of *Acinetobacter baumannii* in intensive care unites in Azady teaching hospital in Kirkuk. The organism was predominantly isolated from urinary and wound specimens, with a peak incidence in old ages. High resistance levels to commonly tested antibiotics discs, including ampicillin, ciprofloxacin, trimethoprim/sulfamethoxazole and cephalosporins, were observed, limiting therapeutic actions. However, high sensitivity rate to recorded to colistin and tigecycline.high level of XDR in isolates. These findings demand quick response in research on new treatment strategies,, and studies of new treatments.

6.2 Recommendations:

1. Strict monitoring of antibiotics efforts will help to reduce inappropriate use and slow development of resistance.

2. Especially in ICUs and surgical units, establish strict infection control measures,to direct empirical therapy, routinely update local antibiograms and resistance trend data.

3. Encourage molecular characterisation of isolates to detect origins of resistance genes and epidemic causes.

4. Promote research of non-traditional agents (e.g., bacteriophages, peptides) and alternative therapeutics including combination regimens.

5. Healthcare professionals should receive regular guidance on handling multidrug-resistant pathogens.

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