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Original Research Article

Antimicrobial susceptibility of *Acinetobacter* clinical isolates among ICU Patients in Sana'a City, Yemen

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Abstract

Drug resistant *Acinetobacter* strains are important causes of nosocomial infections that are difficult to control and treat. This study aimed to determine the antimicrobial susceptibility patterns of *Acinetobacter* strains obtained from ICU patients belonging to different age groups at hospitalized patients in Sana'a, Yemen. 88 *Acinetobacter* isolated were collected from the infected patients admitted to the ICU at a private hospital in Sana'a, Yemen, over one year from March 2020 to April 2021. The records were taken from the microbiology department for hospitalized patients. The results showed that out of 88 samples, 87 (98.8%) were Polymyxin B sensitive isolates and only one sample (1.2%) was resistant. Also, the Colistin sensitive isolates were observed in 100% of culture samples. This study found that 94.3% of culture samples were amoxicillin resistant and 90.9% were ampicillin ,sulbactam resistant. In addition*Acinetobacter spp*. resistance for imipenem, moxifloxacin, meropenem, cefepime, ceftazidime, and ceftriaxone was 95.5, 96.6, 95.5, 97.7, 97.7, and 97.7 %; respectively. The study also revealed the alarming trends of resistance of *Acinetobacter* strains for the various classes of antimicrobials. It was concluded that improvement of microbiological techniques for earlier and more accurate identification of bacteria is necessary for the selection of appropriate treatments. More careful monitoring for use of broad-spectrum antibiotics should be instituted.

Keywords: *Acinetobacter*, Antibiotic resistance, Carbapenems, ICU

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Introduction

Bacterial resistance continues to increase, and drug researchers and manufacturing industries are not producing new drugs to replace the existing antimicrobials against which resistance has developed. The European Centre for Disease Prevention and Control (ECDC) had estimated that 25,000 people may die each year from infections related to antimicrobial resistance [1]. Antimicrobial resistance among *Acinetobacter* species has increased substantially in the past decade [2]. *Acinetobacter spp* emerged as one of the leading nosocomial pathogens, particularly in

Intensive Care Units (ICUs). Infections caused by *Acinetobacter* species are acquired due to hospitalization, mechanical ventilation, respiratory failure, inadequate treatment, previous infection, or antibiotic therapy and catheterization [3]. *Acinetobacter* species are becoming increasingly resistant to nearly all routinely prescribed antimicrobial agents, including aminoglycosides, fluoroquinolones, and broad-spectrum β-lactams. The majority of strains are resistant to the cephalosporin class of antimicrobials, whereas the resistance to carbapenems is increasingly reported [4].

According to the literature data, the *Acinetobacter* strains resistance rate varies from 31.8 to 92.1% to ceftazidime; 8.8 to 89.9% vs imipenem, from 12.2 to 89.9% vs Piperacillin / Tazobactam, from 28.8 to 91.6% vs fluoroquinolones and 30 to 90.3% vs aminoglycosides, but colistin is often the only effective treatment option whereas some *Acinetobacter* strains develop resistance to colistin [5].

In mechanisms of drug resistance, production of beta-lactamases enzyme has played a major role against carbapenems, which is identified as the major cause. Hence, these resistant strains are serious therapeutic and clinical challenge for the world and are responsible for the loss of many lives [6].

This study aimed to determine the antimicrobial susceptibility patterns of *Acinetobacter* strains obtained from ICU patients belonging to different age groups.

Methods

The study was performed at a private hospital in Sana'a City, Yemen. Clinical isolates were collected from diagnosis samples performed on patients who were hospitalized in ICU from March 2020 to April 2021. The *Acinetobacter* spp. isolates were studied against several antibiotics. The isolation and identification of bacteria were done by standard microbiological procedures, according to the manufacturer's instructions. The statistical analysis was performed using SPSS Statistics 21.0. The p-values less than 0.05 were considered statistically significant.

Results

According to the present study, the mean age of the study samples (n=88) was 50.8 years (with SD ± 19.1 years), ranged between 8 and 100 years. Out of 88 samples, 87 (98.8%) were Polymyxin B sensitive isolates and only one sample (1.2%) was resistant. The Colistin sensitive isolates were also observed in 100% of culture samples. From the study findings, 94.3% of culture samples were amoxicillin resistant and 90.9% were ampicillin\sulbactam resistant. In addition, the *Acinetobacter* spp. resistance for imipenem, moxifloxacin, meropenem, cefepime, ceftazidime, and ceftriaxone was 95.5, 96.6, 95.5, 97.7, 97.7, and 97.7 %; respectively. Based on the study results, Hospital Acquired Pneumonia was 85.2 %, whereas Community Acquired pneumonia was 14.8%. (70.5%) of total patients were males and (29.5%) were female. Among 88 of the patients, (38.6%) were aged between 41- 60 years and 30.7% were more than 60-year-old. (Table 1).

Table 1. Distribution of Study variables

Variable		Level of variable	Frequency	Percent (%)
Sex		M	62	70.5
		F	26	29.5
		Total	**88**	**100**
Age order		<= 20	9	10.2
		21-40	18	20.5
		41-60	34	38.6
		More than 60	27	30.7
		Total	**88**	**100**
Type of Antibiotic g	Polymyxin B	S	87	98.8
		R	1	1.2
	Colistin (Polymyxin E)	S	88	100
		R	0	0
	Doxycycline	S	31	35
		R	53	65
	Amikacin	S	24	40.1
		R	52	59.1
	Gentamicin	S	26	30.7
		R	61	69.3
	Amoxicillin	S	2	5.7
		R	83	94.3
	AmpicillinSulbactam\	S	2	9.1
		R	80	90.9
	Imipenem	S	2	4.5
		R	84	95.5
	Moxifloxacin	S	2	3.4
		R	85	96.6
	Meropenem	S	2	4.5
		R	84	95.5
	Cefepime	**S**	2	2.3
		R	86	97.7
	Ceftazidime	S	2	2.3
		R	86	97.7
	Ceftriaxone	S	2	2.3
		R	86	97.7
Pneumonia		Hospital Acquired	75	85.2
		Community Acquired	13	14.8
Patient State		Cured	45	51.1
		Death	43	48.9
Sample Type		Respiratory secretions	76	86.4
		Others: blood and swap	12	13.6

The results in Table 2 indicated that the relationship between age group and patient state was statistically significant (P-value = 0.001). Also, the study findings reported that 51.1% of total patients (45) were cured. However, 48.9% of patients were death state.

Table 2. Distribution of Patient State according to Age Group

Variable		Patient State		Total	*P-value*
		Cured	Death		
Age Group	<= 20	9	0	9	**0.001**
	21-40	4	14	18	
	41-60	20	14	34	
	>60	12	15	27	
	Total	**45 (51.1%)**	**43 (48.9%)**	**88 (100%)**	

The relationship between Antibiotics (ceftazidime, Polymyxin B, Carbapenem, Cefepime, Moxifloxacin, and Ampicillin Sulbactam) resistant and age\ group was analyzed in the table 3. Results in this table showed that there was no significant relationship*P-value* = (0.815, 0.658**,** 0.861, 0,815, 0.807, and 0.807 respectively).

Table 3. Distribution of Antibiotics Resistant according to Age Group

Type of Antibiotic	States	Age Group				Total	*P-valu*
		<= 20	21-40	41-60	>60		
Ceftazidime	S	0	0	1	1	2	0.815
	R	9	18	33	26	86	
	Total	**9**	**18**	**34**	**27**	**88**	
Polymyxin B	S	9	18	**33**	**27**	87	0.658
	R	0	0	**1**	**0**	1	
	Total	**9**	**18**	**34**	**27**	**88**	
Carbapenem	S	0	0	1	1	2	0.861
	R	9	18	32	25	84	
	Total	**9**	**18**	**33**	**26**	**86**	
Cefepime	S	0	0	1	1	2	0.815
	R	9	18	33	26	86	
	Total	**9**	**18**	**34**	**27**	**88**	
Moxifloxacin	S	0	0	1	1	2	0.807
	R	9	18	33	26	86	
	Total	**9**	**18**	**34**	**27**	**88**	
Ampicillin\Sulbactam	S	0	1	4	2	2	0.807
	R	9	17	30	24	80	
	Total	**9**	**18**	**34**	**26**	**82**	

Discussion

This study aimed to characterize *Acinetobacter* samples obtained from the infected patients at

the ICU and the antimicrobial susceptibility of these isolates to various antibiotics commonly used in clinical practice. The higher isolation rates of *Acinetobacter* from the respiratory samples are in agreement with the results reported previously in other countries.

Many authors have reported the predominance of *Acinetobacter* strains in broncho-pulmonary samples. In this study, the main isolation site of these clinical isolates was also broncho-pulmonary (86.4 %) followed by blood cultures and others (13.6%) [5].

Colistin or tigecycline remain the treatment options for the management of most of the cases of infections caused by multidrug resistant *Acinetobacter* strains. The results of this study showed that only 0.7% of isolated strains were resistant to colistin [4]. On the other hand, in a surveillance study in Europe, the resistance of A. baumannii against polymyxin B was shown to be 2.7% [7]. Another surveillance study in Greece showed that 3% of *Acinetobacter* strains isolated from ICU patients were resistant to colistin [8].

The analyses of antibiotic resistance patterns according to the age groups showed that there was not significantly relationship. The differences in the *Acinetobacter* susceptibility to different antimicrobial agents between different age groups have not been reported before [8].

In general, the *Acinetobacter* isolates are known for their resistance to various antibiotics despite their weak virulence limiting the control and infections treatment due to these microorganisms [5].

In the present study, the *Acinetobacter* spp. resistance for imipenem, moxifloxacin, meropenem, cefepime, ceftazidime, and ceftriaxone was 95.5, 96.6, 95.5, 97.7, 97.7, and 97.7 %, respectively [9]. This study showed that the rate of antibiotic resistance in our hospital is generally high and variable.

A high resistance rate to imipenem and meropenem in *Acinetobacter* spp. isolates may lead to extensive use of polymyxins.

Our result was higher than a report from the ICUs in Turkey that revealed resistance rates of 80.3% and 71.2% for imipenem and meropenem, respectively.

A recent report from a single ICU in Bulgaria found that carbapenem-resistance was 75% [10] while in the UK a retrospective study on 399 *Acinetobacter* bacteraemias over eight years identified a tremendous increase in carbapenem resistance from 0% in 1998 to 55% in 2006 [11]. Furthermore, in Spain, the rate of resistance to imipenem in *Acinetobacter* species is 58% [12].

Peleg et al. demonstrated the emergence of carbapenem resistance among Australian baumannii isolates; it was significantly linked to increased use of meropenem [13]. Similarly, in Taiwan, Ye et al. found that the only independent risk factor for the appearance of imipenem-resistant isolates in patients formerly with imipenem-sensitive isolates is the use of carbapenem [14].

The high proportion and the high resistance of these microorganisms in ICUs are related to the existence of numerous risk factors associated with *Acinetobacter* infection, such as immunocompromised persons, longer duration of stay in hospitals, invasive devices use on patients, the broad-spectrum antibiotics therapy, possible and frequent contaminations, and cross transmission of this bacteria through environmental reservoirs and hands of healthcare workers [5].

Major efforts are needed to slow down the rising problem of MDR. A comprehensive approach is necessary to prevent antimicrobial resistance in ICUs: 1) prevent infections; 2) diagnose and treat infections; 3) prudent and rational use of antimicrobials; and 4) prevent transmission [15], Joined efforts of healthcare providers, hospital administrators, policy makers, and patients will certainly be necessary (up to an international level) to reduce and optimize the overall antibiotic consumption. This should especially affect those most vulnerable patients, at the highest risk for fatal outcomes, namely those in the ICU, because

local efforts limited to the ICU will have too little impact. “Antibiotic stewardship,” or the optimization of antibiotic usage for therapy and prophylaxis, is certainly a keystone to tackle this problem [16].

Conclusion

The present study revealed the alarming trends of resistance of *Acinetobacter* strains for the various classes of antimicrobials. The improvement of microbiological techniques for earlier and more accurate identification of bacteria is necessary for the selection of appropriate treatments. More careful monitoring for the use of broad-spectrum antibiotics should be instituted.

Conflict of Interest

The authors declare that they have no competing interests

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