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High Antibiotics Resistance Observed in *Acinetobacter baumannii* Isolated from South East Nigeria

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Abstract

Acinetobacter baumannii is an increasingly problematic healthcare-associated pathogen, especially in critical care unit; these organisms have a capacity for long-term survival in the hospital environment. This study was designed to determine the antimicrobial susceptibility patterns of *A. baumannii* strains isolated from different wound specimens obtained from burn patients and other patients with wound infections. *A. baumannii* was identified using conventional microbiological technique and antimicrobial susceptibility testing was performed and interpreted according to Clinical and Laboratory Standards Institute (CLSI) guidelines. A total of 198 non-duplicate *A. baumannii* was isolated with most isolates being resistant to two or more drugs tested. Antibiotic resistance pattern of *A. baumannii* showed that high resistance was observed in Sulfamethoxazole-Trimethoprim 81.3%, Chloramphenicol 80.8%, Amikacin 81.3%, Nitrofurantoin 78.2%, while moderate resistance was observed in Ciprofloxacin 44.9%, Ceftazidime 45.9% and Imipenem 51.5% respectively. Statistical analysis showed there was no statistical difference in the rate of resistance among isolates from burn patients and non-burn patients ($P < 0.05$). Our findings highlight the critical need for a comprehensive monitoring and infection control policy as well as a national susceptibility review program that evaluates antibiotics resistant *A. baumannii*. Therefore, continuous monitoring of antibiotics susceptibility and strict adherence to infection prevention guidelines are essential to eliminate major outbreaks in the future.

Keywords: *Acinetobacter baumannii; antibiotic resistance; Nigeria*

Introduction

Acinetobacter is a genus of Gram-negative coccobacilli, which are non-motile, oxidase-negative, and catalase-positive, and occur in pairs under magnification [1]. These species are opportunistic pathogens with increasing relevance in both community-acquired and hospital-acquired infections, especially among patients in intensive care units and risk factor patient [2,3]. *A. baumannii* have been implicated in different nosocomial infections, including ventilator-associated pneumonia, endocarditis, meningitis, wounds, blood and infections of the skin, soft tissues, urinary tract infections, and those originating from other hospital environment [3]. *A. baumannii* can be isolated from numerous sources such as soil, water, animals, and humans [4,5]. The *Acinetobacter* infection prevalence is variable depending on the geographical localization and the patient's socio-economic status [6-8]. In an international study in ICUs, the *Acinetobacter* infections rate was 19.2% in Asia; 17.1% in Eastern Europe; 14.8% in Africa; 13.8% in Central and South America; 5.6% in Western Europe; 4.4% in Oceania and 3.7% in North America [9]. It is 15% in South African HIV-positive patients [7] and 13% in Canadian burn care units [8]. In south east Nigeria data on Acinetobacter prevalence is lacking.

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 cephalosporin class of antimicrobials, whereas the resistance to carbapenems is increasingly reported [10]. The antimicrobial susceptibility testing showed differences

between Acinetobacter species, with *Acinetobacter baumannii* being the most resistant strains [11,12]. Multidrug resistant *A. baumannii* (MDR) usually retained in vitro susceptibility to carbapenems [13]. Imipenem remain drugs of choice, but their efficacy can be compromised by the increasingly spread of resistance in several countries [14-16].

This study was designed to determine the antimicrobial susceptibility patterns of *A. baumannii* strains isolated from different wound specimens obtained from burn patients and other patients with wound infections in a tertiary hospital in south east Nigeria.

Materials and Methods

Specimen collection, cultivation and identification of Acinetobacter baumannii

Wounds and abscesses swabs specimens from burn patients and other patients with wound were cultured onto 7% sheep blood agar and incubated aerobically overnight at 37°C. *A. baumannii* was identified using conventional microbiological tests -Gram-negative coccobacilli, non-motile, oxidase-negative, and catalase-positive [17].

Antibiotics Susceptibility Testing

The antibiotics susceptibility pattern of the isolates was determined using the disk diffusion method [17], on Mueller Hinton agar. Inhibition zone diameter values were interpreted using standard recommendations of the Clinical Laboratory Standard Institute [18]. Susceptibility was tested against Cotrimoxazole (25 µg), Ceftriaxone (30 µg), Imipenem (10 µg), Tetracycline (30 µg), Amikacin (30 µg), Cefoxitin (30 µg), Gentamicin (10 µg), Ciprofloxacin (30 µg), Ceftazidime (30 µg), Sulfamethoxazole-Trimethoprim (5 µg), Chloramphenicol (30 µg), and Nitrofurantoin (30 µg). *E. coli* ATCC 25922 was included as a quality control strain.

Statistical Analyses

Comparative resistance rates for *A. baumannii* strains from burn and non-burn patients were statistically analyzed by paired comparisons. Comparative rates among the two groups of patients were analyzed by ANOVA, results were considered significant at 99% confidence level.

Results and Discussion

The antibiotic resistance pattern of the *A. baumannii* isolates is shown in Table 1. Overall, twelve different antibiotics were tested, and the isolates were resistant to at least two or more of the antibiotics. Among the 198 isolates tested, the resistant rate to each of the antibiotics are as follows: Ciprofloxacin 44.9%, Ceftazidime 45.9%, Imipenem 51.5%, Cefoxitin 53.0%, Ceftriaxone 61.1%, Cotrimoxazole 70.2%, Gentamicin 77.8%, Tetracycline 78.8%, Nitrofurantoin 78.2%, Chloramphenicol 80.8%, Amikacin 81.3% and Sulfamethoxazole-Trimethoprim 81.3% respectively. Statistical analysis showed there was no statistical difference in the rate of resistance among isolates from burn patients and non-burn patients ($P < 0.05$).

In the last few years, *A. baumannii* infection has become a critical challenge to healthcare systems and has contributed to increased morbidity and mortality among patients worldwide. Control of *A. baumannii* infections is always difficult because of *A. baumannii* resistance to several antimicrobial agents, including imipenem, which remains as the drug of choice. The antibiotic resistance data collected around the world demonstrated that the resistance rates of Acinetobacter species to imipenem ranged from 0 - 40% between 2000 and 2004 [19]. The prevalence of imipenem resistance in Acinetobacter species increased from zero in 1991 to 50% in 2001, as shown in a study conducted in a Spanish hospital [20]. In this study, 51.5% of *A. baumannii* isolates were resistant to imipenem and most of the isolates were multidrug resistant. The resistance rates of *A. baumannii* to imipenem obtained in this study were higher than those reported in previous studies in Kuwait (42%) [21], Taiwan 10% [22], and (3.2%) in Japan [23]. Regional variation in imipenem resistance was also noted when North America (4.5% of isolates) and Latin America (11% of isolates) were compared [24]. Antimicrobial susceptibility of 490 *A. baumannii* strains collected in 37 centers in 11 European countries from 1997 to 2000, imipenem and meropenem were the most active agents with resistance rates of 16% and 18% respectively. However, the rate of *A. baumannii* resistance to imipenem observed in this study is considerably lower than the rates found in other countries, including Pakistan (100%), Turkey (98%), United Arab Emirates (76%), and Saudi Arabia (63%) [25-28].

Antibiotics	Burn Patients		Non-Burn Patients		Total	
	No. Resistant n = 198	% Resistant	No. Resistant n = 198	% Resistant	No. Resistant n = 198	% Resistant
Cotrimoxazole	89	44.9	50	25.3	139	70.2
Ceftriaxone	67	33.8	54	27.3	121	61.1
Imipenem	63	31.8	39	19.7	102	51.5
Tetracycline	65	32.8	91	45.9	156	78.8
Amikacin	62	31.3	99	50	161	81.3
Cefoxitin	66	33.3	39	19.7	105	53.0
Gentamicin	75	37.9	79	39.9	154	77.8
Ciprofloxacin	50	25.3	39	19.7	89	44.9
Ceftazidime	44	22.2	47	23.7	91	45.9
Sulfamethoxazole-Trimethoprim	70	35.4	91	45.9	161	81.3
Chloramphenicol	71	35.9	89	44.9	160	80.8
Nitrofurantoin	79	39.8	76	38.3	155	78.2

Table 1: *The Antibiotics Resistance rates of the A. baumannii isolated from Burn Patients and Non-Burn Patients.*

The high rates of resistance observed in this may be due to probably non-compliance with the recommendations for mastery the hospital environment [29], lack of hands hygiene and misuse of antibiotics [30]. Some studies have reported that this microorganism which has emerged worldwide as a pathogen causing serious infections in hospitalized patients has the ability to persist in the environment for a long period of time, colonize patients or healthy subjects and can develop into a true infection at any time [31]. Taken together, this study identified the differences in the antibiotic resistance of *A. baumannii* isolates obtained from hospitalized patients in south east Nigeria. *A. baumannii* strains have the capacity to acquire antimicrobial resistance rapidly, and therefore, the resistance to even newer antimicrobials is reported worldwide. This allows them to cause nosocomial outbreaks in hospitals. Therefore, decreasing the pace of the emergence of antimicrobial resistance of Acinetobacter species is crucial, through the restricted use of antimicrobials, and the enforcement and surveillance of antibiotic Stewardship Programs in health care settings.

Conclusion

Our data has shown that antibiotics resistance among *A. baumannii* isolates from Nigeria is very high and also reveals a 5.5% rate in imipenem. This worrisome trend of resistance implies that imipenem may soon be rendered ineffective in treatment of patients with *A. baumannii* infections in Nigeria, which may be strongly associated with prior use of carbapenems. Fortunately, imipenem-resistant MDR *A. baumannii* isolates have remained susceptible to colistin, which is viable agent in controlling MDR *A. baumannii* outbreaks, especially in developing countries. Our data highlights the urgent need for a comprehensive national antimicrobial drug resistance survey program in charge of monitoring *A. baumannii* isolates from various parts of the country towards a rigorous nationwide effort in controlling antibiotic resistant *A. baumannii* outbreaks. This study also contends that successful global control measures against *A. baumannii* necessitates policies and concerted efforts that should incorporate local epidemiological data for *A. baumannii* antimicrobial susceptibility profile from all countries in this region, including Nigeria.

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