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Prevalence and Resistance Profile of *Acinetobacter baumannii* Clinical Isolates from a Private Hospital in Khartoum, Sudan

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Abstract **Introduction**: *Acinetobacter baumannii* is an important cause of nosocomial infections worldwide. It is difficult to control, and the infections caused by it are difficult to treat, because it is multidrug resistant. **Objectives**: This retrospective study was conducted to determine the prevalence and antibiotic resistance pattern of *A. baumannii* at Royal Care International Hospital, Khartoum, Sudan over a 37 month period. **Methodology**: Antimicrobial susceptibility testing of the isolates was performed by the disk diffusion method as recommended by Clinical Laboratory and Standards Institute CLSI [1]. **Result:** Non duplicate 275 *A. baumannii* were isolated out of a total 2899 pathogenic Gram negative isolates (9.5% prevalence). The most frequently isolated *A. baumannii* was from ICU patients (72%) followed by inpatients (24%) and outpatients (4%). The greatest number of isolates were recovered from sputum (61%) followed by wound (19%). The Resistance rates were higher than most of the internationally reported levels. Cephalosporins, aminoglycoside, aztreonam, fluoroquinolones and carbapenems are becoming practically ineffective, where the colistin elicited the highest susceptibility levels. **Conclusion:** This report shows for the first time (to our knowledge) the prevalence and resistance profile of *A. baumannii* in Sudan. The prevalence will help to conduct better infection control policy, and an update the local antibiogram will improve the knowledge of antimicrobial resistance patterns in our region.

Keywords: *Acinetobacter baumannii, antibiogram, RCIH*

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1. Introduction

The genus *Acinetobacter* is a member of the family *Moraxellaceae* in the order *Pseudomonadales*. More than 25 species within the genus *Acinetobacter* have been described [2]. The most important species of this genus is *Acinetobacter baumannii* which causes 2-10% of all Gram-negative infections in the Unites State and Europe [3]. It possesses little risk to healthy individuals, but generally causes infections in those with weakened immune systems specifically, the intensive care unit (ICU). The latter equipped with ventilators and invasive tools such as catheters that are factors that predispose to *A. baumannii* infections such as Ventilator Associated Pneumonia (VAP), meningitis, wound infection, septicemia, and urinary tract infections [3]. The clinical impact of *Acinetobacter* infection in terms of morbidity and mortality has been discussed widely in which the mortality rates range from 19% to 54% [4].

The infections caused by *A. baumannii* are often treated with cephalosporins including ceftazidime and ceftriaxone, aminoglycosides such as tobramycin and amikacin, carbapenems, and tetracycline. However, to date, most strains of *A. baumannii* have become increasingly resistant to all these currently available antibacterial agents [5]. The clinical significance of *A. baumannii* has grown significantly over the last few decades mainly due to the fact that this species possesses a variety of antibiotic resistance genes on plasmids, transposons and integrons and innate antimicrobial resistance mechanisms such as cell surface structures that prevent the influx of antibiotics which lead to failure of treatment [6].

Due to growing the numbers of *A. baumannii* infections and lack of new forms of antibiotics to treat the infections, some studies are focused to assess the in vitro combination activity of different types of currently used antibiotics against carbapenem-resistant *A. baumannii* such ascarbapenem/ sulbactam combination and colistin/ rifampicin combination. Some reports showed that the in vitro combinations of antibiotics such as imipenem/

sulbactam and colistin/tigecycline, proved effective against carbapenem resistant *A. baumannii* [7].

A. baumannii has already been compared to methicillin-resistant *Staphylococcus aureus* (MRSA), and has even been termed the 'Gram-negative MRSA [8]. Also it has been identified as an ESKAPE pathogen (*Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa*, and *Enterobacter species)*; a group of pathogens with a high rate of antibiotic resistance that are responsible for the a majority of nosocomial infections [9]. Colloquially, *A. baumannii* is referred to as 'Iraqibacter' due to its seemingly sudden emergence in military treatment facilities during the Iraq War [10].

In the literature, various terms have been used to describe the resistance rate of *A. baumannii* to antibiotics like Multidrug Resistant *A. baumannii* (MDR-AB) is used to describe the isolates which are resistant to at least three classes of antibiotics including Penicillins, cephalosporins, fluroquinolones and aminoglycosides. While the term Extreme Drug Resistant (XDR) is used when the isolates are resistant to the three above mentioned families plus carbapenems, Finally the Pandrug- Resistant (PDR) which is used to describe the *A. baumannii* which are (XDR) with resistance to polymyxins [11].

Susceptibility of *A. baumannii* to antimicrobials is considerably different among countries, among centers and even among the wards of a given hospital. These differences may reflect different patterns of antimicrobial usage and different epidemiological situations, including antimicrobial control measures and policies [12].

Regarding Sudan, there are no published records about the prevalence of *A. baumannii* in hospitals. However, some reports are available from other countries. In the Islamic Republic of Iran, for example, a prevalence of 15% was reported [13], in India it was 9.5% [14], and in Kuwait it was 22.1% [15]. In one study carried out in Saudi Arabia, *A. baumannii* was the most common isolated organism among Gram-negative bacteria, with a prevalence of 31.7% [16].The variations in the prevalence and resistance patterns among isolates stress the importance of local surveillance to determine the best antimicrobial therapy for *A. baumannii* infections.

This study aimed to determine the prevalence and antibiotic resistance pattern of *A. baumannii* isolated from various clinical specimens at Royal Care International Hospital (RCIH) Khartoum, Sudan.

2. Materials and Methods

This retrospective study was carried out over a period of 37 month from July 2011 to August 2014 in the department of microbiology, (RCIH) located in Khartoum, Sudan. Consecutive, non-duplicate (275) isolates of *A. baumannii* were recovered from various clinical specimens, namely; Sputum, wound swabs, urine, blood, soft tissue, Central Venous Catheter Tip (CVC) and other body fluids (CSF, synovial and ascitic fluid).

The samples were collected and processed during the course of routine diagnostic work up from patients in the ICU, wards and outpatient departments of the hospital. The specimens received in the laboratory were inoculated on 5% Blood Agar and MacConkey Agar and incubated overnight aerobically at 37°C. Blood specimens were inoculated on tryptone soya broth (Hi-Media, Mumbai) and then sub cultured on chocolate agar and MacConkey agar. *A. baumannii* isolates were initially identified by colonial morphology, Gram staining, growth at 37°C, a negative oxidase test, and oxidation of glucose. API E20 (BioMe´rieux, Marcy l'Etoile, France) were used to confirm the identification of the isolates [17]. Antimicrobial susceptibility was done by disc diffusion method as per the (CLSI) guidelines [1], using Muller-Hinton agar (Hi-Media, Mumbai) and antimicrobial discs (bioanalyse, Turkey and Hi-Media, Mumbai). The following antimicrobial agents (µg) were used: Ceftazidim (30), cefepime (30), cefuroxime (30), gentamicin (10), amikacin (30), ciprofloxacin (5), amoxiclav (30), meropenem (10), cephalexin (30), ceftriaxone (30) aztreonam (30) and colistin (10). The diameter of inhibition zones was measured and data were reported as susceptible and resistant. Quality control of the disks was checked by using reference strains.

3. Results

During the study period the total number of pathogenic Gram negative isolates, was 2899, of which 275 isolates were *A. baumannii* (9.5%). The majority of *A. baumannii* was isolated from sputum 61% followed by wound 19%, blood 9%, urine 3%, and others including: pus, CSF, synovial fluid, bone, soft tissue, CVC tip, ascitic fluid was 8% (Table 1).

Of the 275 *A. baumannii* isolates, 198 were isolated from ICU patients (72%), while 65 (24%) were from inpatients and 12 (4%) from outpatients department (Figure 1).

In this study most of *A. baumannii* isolates were highly resistant to the tested antibiotics, 92% were resistant to cefepime, 96% to ceftazidime, 99% to ceftriaxone, 100% to cefuroxime, 100% cephalexin, 92% gentamicin, 81% amikacin, 91% ciprofloxacin, 98% amoxiclav, 89% meropenem, 95% aztreonamand, 37% colistin (Figure 2).

Table 1. The Numbers and prevalence of *A. baumannii* clinical isolates from various clinical samples

Sample	Number	Prevalence (%)
Sputum	123	61
Wound	47	19
Blood	18	9
Urine	7	3
Pus	5	2
CSF	3	1.5
Synovial fluid	1	0.5
Ascitic fluid	2	1
Bone	1	0.5
Soft tissue	2	1
CVC Tip	3	1.5

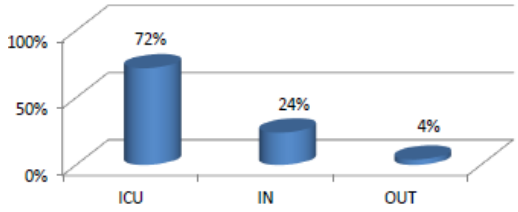

Figure 1. prevalence of the A. baumannii among ICU, In patient (IN) and out patients (OUT) at RCIH

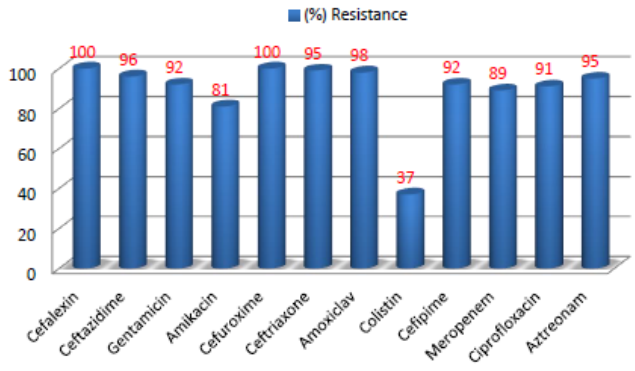

Figure 2. Resistance pattern of A. baumannii isolates against different antibacterial agent

4. Discussion

In this study, the prevalence of *A. baumannii* in RCIH, Sudan was 9.5% which is identical or similar to those from developing countries like India where the rate were 9.5% [14], 9.4% [18] and 11% [19] respectively. In Japan the prevalence rate was 18% [20], in Kuwait 22.1 [15] and in Saudia Arabia 31.7 [16] which are higher than that in the current study.

Among the source of the isolates, most of *A. baumannii* was isolated from sputum specimen (61%).Other studies similar to this, were carried out by Jaggi *et al.*, *[19]* where the maximum isolates were obtained from sputum 54.6% and Villers*et al.*, [21] reported a predominance of *A. baumannii* in tracheo-bronchial secretions 48.8%. All these findings may support the presence of *A. baumannii* as a common colonizer in the respiratory tract, Its isolation from sputum without clinical signs and symptoms and may not necessary mean that they are causing infection. They can be only colonizer [22].

In this study the *A. baumannii* was mostly isolated from ICU patents (72%) followed by inpatient (24%) and outpatient (4%).This is in agreement with most of the global studies that reported the predominance of *A. baumannii* isolated from ICU patients, [18,23,24,25] They concluded that *A. baumannii* is the ICU Superbug. These results collaborates the truth that a lot of risk factors connected with *A. baumannii* infection exist in the ICU like potential environmental reservoirs for *A. baumannii*, opportunities for cross transmission, immunocompromised patients who are colonized, patients having multiple wounds and indwelling devices and frequent contamination of the hands of health care workers responsible for patient care.

In the community, *A. baumannii* has been found to be associated with community acquired pneumonia (in patients with COPD, renal failure, diabetes mellitus, heavy smokers or excessive alcohol consumers or bacteremia in Asia and Australia, although rare in USA as evidenced by previous studies [26]. This supports the isolation of *A. baumannii* from the outpatient department in this study.

The resistance profile of the *A. baumannii* isolates at (RCIH) hospital showed that 97% were MDR which resistant to three groups of antibiotics include aminoglycosides, fluoroquinolones and cephalosporins. 89% were Extreme XDR. This is considered high resistance rate when compared to two other studies in one of which MDR were 82.4% of his isolates and XDR 65.0% [27] and in the other MDR were 72% and XDR 58% [28]. The differences observed between the studies can be due to the methods and resistance patterns which are influenced by environmental factors and antimicrobial susceptibility pattern used [29].

The emergence of PDR *A. baumannii* represents a major problem in health care settings because the colistin is the only therapeutic option available for treatment of infections caused by PDR

A. baumannii. Unfortunately, resistance to colistin was reported worldwide (Marchaim *et al.*, 2011 [30]; Mammina *et al.*, 2012 [31]; Lesho *et al.*, 2013 [32]). In the present study, colistin resistance has been reported as 37% which is considered high when compared to other reports like the recent study from Malaysia carried out by Soo-Sum Lean *et al.*, [33] in which the resistant rate was (25.9%). Therefore, rationale use of colistin is highly recommended whenever possible to reduce the emergence of resistance to such antibiotic.

In conclusion, we report for the first time in Sudan the prevalence and resistance rate of *A. baumannii*. This study is limited because it does not sharply identify patients with true infections versus those who are colonized but the present report is alarming because the emergence and increase in the rate of PDR *A. baumannii* which can be due to excessive antibiotic misuse in our region.

Hence we recommend: (1) Further molecular epidemiology study recommended to observe any MDR clone spreading in our region and to compare our MDR clone to any international clones that are spreading worldwide. (2) Judicious use of antibiotics by making an attempt to distinguish colonization from true infections and treatment should be only given to the clinically confirmed infections and not colonization. (3) Continuous monitoring and updating the antibiogram of bacteria in the hospitals. (4) Applying standardized infection control policies to minimize the spread of multidrug resistant bacterial infections.

References

[1] Wayne, PA: Clinical and Laboratory Standards Institute; 2011. CLSI. Performance standards for antimicrobial susceptibility testing. 20th Informational Supplement. CLSI document M100-S21. Schreckenberger PC, Daneshvar MI, Weyant RS, Hollis DG. *Acinetobacter*, *Achromobacter*, *Chryseobacterium*, *Moraxella*, and other nonfermentative gram-negative rods. In: Murray PR, Baron EJ, Jorgensen JH, Pfaller MA, Yolken RH, editors. Manual of Clinical Microbiology. Washington, DC: ASM Press, 2007; 8: 770-779.

[2] Fournier, P. E., D. Vallenet, V. Barbe, S. Audic, H. Ogata, L. Poirel*et al.*, Comparative genomics of multidrug resistance in *Acinetobacter baumannii*. PLOS Genet. 2006; 10: 2-7.

[3] Eveillard M, Soltner C, Kempf M, Saint-Andre J P, Lemarie C, Randrianarivelo C. e*t al*,.The virulence variability of different *Acinetobacter baumannii* strains in experimental pneumonia. J Infect. 2010; 60 (2): 154-61.

[4] Howard A, O'Donoghue M, Feeney A, Sleator RD. *Acinetobacter baumannii*: an emerging opportunistic pathogen. Virulence, 2012; 1: 3 (3): 243-50.

[5] Kraniotaki E, Manganelli R, Platsouka E, Grossato A, Paniara O, Palù G. Molecular investigation of an outbreak of multidrug-resistant *Acinetobacter baumannii*, with char-acterisation of class 1 integrons. Int J Antimicrob Agents. 2006; 28: 193-9.

[6] Song JY, Kee SY, Hwang IS, Seo YB, Jeong HW, Kim WJ. *et al.*, In vitro activities of carbapenem/sulbactam combination, colistin, colistin/rifampicin combination and tigecycline against

carbapenem-resistant *Acinetobacter baumannii*. J Antimicrob Chemother. 2007; 60 (2): 317-22.

[7] Rello J. *Acinetobacter baumannii* infections in the ICU: customization is the key. Chest1999*;* 115*:* 1226-1229.

[8] Rice, LB. Federal funding for the study of antimicrobial resistance in nosocomial pathogens: no ESKAPE. *J Infect Dis.* 2008; 197 (8): 1079-81.

[9] Drummond, Katie. Pentagon to Troop-Killing Superbugs: Resistance Is Futile. *Wired.com*. Condé Nast. Retrieved 8 April 2013.

[10] Manchanda V, Sanchaita S, and Singh NP. Multidrug Resistant *Acinetobacter*. J Glob Infect Dis.: 2010; 2 (3): 291-304.

[11] Cisneros JM, Rodriguez-Bano J. Nosocomial bacteremia due to *Acinetobacter baumannii*: epidemiology, clinical features and treatment. Clin. Microbiol. Infect: 2002; 8: 687-69.

[12] Shakibaie MR, Adeli S, Salehi MH. Antibiotic resistance patterns and extended-spectrum β-lactamase production among *Acinetobacter spp*. isolated from an intensive care Unit of a hospital in Kerman, Iran. Antimicrob Resist Infect Control: 2012; 1: 1-8.

[13] Patwardhan RB, Dhakephalkar PK, Niphadkar KB, Chopade BA.A study on nosocomial pathogens in ICU with special reference to multiresistant *Acinetobacter baumannii* harboring multiple plasmids. Indian J Med Res: 2008; 128: 178-187.

[14] AbdAllah S *et al*., Nosocomial infections and their risk factors at Mubarak Al-Kabeer hospital, Kuwait. Medical Journal of Cairo University, 2009, 78: 123-131.

[15] Al Johani SM1, Akhter J, Balkhy H, El-Saed A, Younan M, Memish Z. Prevalence of antimicrobial resistance among gram-negative isolates in an adult intensive care unit at a tertiary care center in Saudi Arabia. Ann Saudi Med.: 2010; 30: 364-369.

[16] Forbes BA, Sahm DF, Weissfeld AS. Bloodstream infections. In: Wilson L, editor. Bailey and Scott's Diagnostic Microbiology, 12 th ed. St Louis: The Mosby Company; 2007; 778-97.

[17] Jaggi, Namita; Sissodia, Pushpa; Sharma, Lalit, *Acinetobacter baumannii* isolates in a tertiary care hospital: J Microbiol Infect Dis: 2012; 2 (2) p 57.

[18] H. Siau, KY Yuen, SSY Wong. The epidemiology of *Acinetobacter* infections in Hongkong, J Med Microbiol 1996; 44: 340-347.

[19] Endo S., Yano H., Hirakata Y., Arai K., Kanamori H., Ogawa M.,*et al*. Molecular epidemiology of carbapenem-non-susceptible *Acinetobacter baumannii* in Japan. *J. Antimicrob. Chemother*: 2012; 67 (7): 1623-1626.

[20] Villers D, Espaze E, Coste-Burel M, Giauffret F, Ninin E, Nicolas F. *et al*,. Nosocomial *Acinetobacter baumannii* infections: Microbiological and clinical epidemiology. Ann Intern Med 1998; 129: 182-189.

[21] Dijkshoorn, L, Nemec, A, Seifert, H. An increasing threat in hospitals: multidrug-resistant *Acinetobacter baumannii*. Nat Rev Microbiol.: 2007; 12: 939-51.

[22] Seifert H, Dolzani L, Bressan R, Van Der RT, van Strijen B, Stefanik D, Heersma H, *et al*,. Standardization and interlaboratory reproducibility assessment of pulsed-field gel electrophoresis-generated fingerprints of *Acinetobacter baumannii*. J ClinMicrobiol 2005; 43 (43) 28-35.

[23] Wilks M, Wilson A, Warwick S, Price E, Kennedy D, Ely A, *et al*,. Control of an outbreak of multidrug-resistant *Acinetobacter baumannii-calcoaceticus* colonization and infection in an intensive care unit (ICU) without closing the ICU or placing patients in isolation. Inf Control HospEpidemiol, 2006; 27: 654-8.

[24] Munoz-Price LS, Weinstein RA. Current concept: *Acinetobacter* Infection. N EnglJ Med 2008; 358: 1271-81.

[25] Glow RH.,Moellering RC, Kunz LJ. Infections with *Acinetobacter calcoaceticus* (Herelleavaginicola): Medicine (Baltimore): 1977; 56: 79-97.

[26] Evans BA, Hamoud, A, Towner S.A, Khan S.A, Amyes S.G. High prevalence of unrelated multidrug-resistant *Acinetobacter baumannii* isolates in Pakistani military hospitals. Int J Antimicrob Agents: 2011; 37: 580-581.

[27] Dent L, Dana R M, Siddharth P. Multi-drug resistant *Acinetobacter baumannii*: a descriptive study in a city hospital. BMC Infectious Diseases: 2010; 10: 196-204.

[28] Rit K, Saha R. Multidrug-resistant Acinetobacter infection and their susceptibility patterns in a tertiary care hospital. Niger Med J.: 2012; 53: 126-8.

[29] Marchaim D, Chopra T, Pogue JM, Perez F, Hujer AM, Rudin S, *et al*,. Outbreak of colistin-resistant, carbapenem-resistant *Klebsiella pneumoniae* in metropolitan Detroit, Michigan. Antimicrob. Agents Chemother: 2011; 55 (2): 593-599.

[30] Mammina C, Bonura C, Di Bernardo F, Aleo A, Fasciana T, Sodano C.*et al*,. Ongoing spread of colistin-resistant *Klebsiella pneumoniae* in different wards of an acute general hospital, Italy, Euro Surveill: 2011; 17 (33): 20-48.

[31] Lesho E, Yoon EJ, McGann P, Snesrud E, Kwak Y, Milillo M, *et al*. Emergence of colistin-resistance in extremely drug-resistant *Acinetobacter baumannii* containing a novel pmrCAB operon during colistin therapy of wound infections. J. Infect. Dis.: 2013; 208 (7): 1142-1151.

[32] Lean SS, Suhaili Z, Ismail S, Rahman NI, Othman N, Abdullah FH, *et al*,. Prevalence and Genetic Characterization of Carbapenem-and Polymyxin-Resistant *Acinetobacter baumannii* Isolated from a Tertiary Hospital in Terengganu, Malaysia. ISRN Microbiology Vol 2014 (2014), Article ID 953417, 9.