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Original Research Article

Carbapenem resistant *Acinetobacter baumannii* in ICU patients in a tertiary care hospital: A retrospective study highlighting their demographic and clinical profile, impact on ICU stay and mortality

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ABSTRACT

Background: *Acinetobacter baumannii* was considered as a leading cause of nosocomial respiratory infection and bacteremia in many hospitals all over the world. However, there was a still a debates whether colonization and/or infection with *Acinetobacter baumannii*, increases morbidity and mortality independently of the effect of other risk factors.

Aim of the study was to isolate *Acinetobacter baumannii* among ICU patients, to detect carbapenem resistant *Acinetobacter baumannii* among ICU patients with *Acinetobacter baumannii* infections and to determine specific risk factors and outcome of the infections due to CRAB isolates.

Materials and Methods: A retrospective study was carried out at Vydehi Institute of Medical Sciences and RC in Bangalore, in the ICU department from June 2021 to May 2022.

Results: Among all the patients carbapenem resistance was detected more in patients above 60 years of age, males were predominant than females, most of the patients were on ventilation and in sepsis and mortality rate was high with the increased duration of ICU stays.

Conclusion: *Acinetobacter baumannii* is a highly prevalent microorganism among ICU patients, while its potential to acquire resistance toward commonly used antibiotics represents it as a grave threat to the health care industry. Therefore, signifying the need for its regular monitoring in the health care setups. VAP due to CRAB and excess use of intravascular devices are the most important risk factors for CRAB bacteremia in our ICU. Early implementation of appropriate antimicrobial therapy, particularly in critically ill ICU patients with Carbapenem resistant *Acinetobacter baumannii* infections, with two or more co morbidities, can be crucial for survival.

1. Introduction

Acinetobacter baumannii is globally recognized as a main nosocomial pathogen, causing severe infections in critically ill patients hospitalized in Intensive care units. International studies have shown that Acinetobacter spp. infections represent 7.9% of ventilator associated pneumonia and 5.7% to 15.7% of blood stream infections in the ICUs. It affects mostly the debilitating patients in the intensive care units setting all over the world.[1]

Previously considered as an organism of low virulence, most commonly capable of colonizing than infecting, it has become invasive, causing life threatening infections in hospital patients especially among the critically ill, resulting in a significant morbidity and mortality.

Many studies detected that *Acinetobacter baumannii* infections may be associated with considerable mortality, however some of them support the possibility that the clinical course of debilitating patients may be influenced

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by many factors that subsequently the infection with *Acinetobacter baumannii* may not independently lead to worst results.

This micro organisms has also become a matter of great concern due to its extraordinary capability of acquiring resistance to commonly used antibiotics.[2] Carbapenems are usually the antimicrobial agents of choice for treatment of serious infections caused by multidrug resistant Acinetobacter baumanii, however there has been an increasing incidence of carbapenem resistant *Acinetobacter baumannii* (CRAB) infections reported worldwide in recent years and are of great importance because they limit the treatment options and may contribute to an increased mortality.[3]

Although numerous clinical studies regarding *Acinetobacter baumannii* infections have been published, only few have focused on carbapenem resistant *Acinetobacter baumannii* infection and none of them exclusively in ICU patients. Thus, information concerning the incidence, the risk factors, the effect of CRAB infection and clinical outcome in ICU patients is still limited. Hence, the present study was choosen with the following objectives:

1. To detect carbapenem resistant *Acinetobacter baumannii* isolates among ICU patients with *Acinetobacter baumannii* infections.
2. To determine specific risk factors and outcome of the infections due to CRAB isolates.

2. Materials and Methods

The study was conducted in Vydehi Institute of Medical Science and Research Centre, a tertiary care hospital located in Bangalore, Karnataka.

Ethical approval for the study has been obtained from Vydehi Institutional Ethics Committee.

We performed a retrospective study on all symptomatic ICU patients of any age and sex acquired *Acinetobacter baumannii* infection after 48 hours of hospital admission from June 2021 to May 2022 (12 months).

Patients who had *Acinetobacter baumannii* infection before and at the time of hospital admission and patients with incomplete medical records were excluded from the study**.** Medical records of all patients with carbapenem resistant *Acinetobacter baumannii* bacteremia episodes, symptoms, and signs of infection were reviewed.

As it was a Retrospective study hence all *Acinetobacter baumannii* positive cases isolated during the study period were included in the study.

For patients with two or more positive blood cultures, only the result of the first antimicrobial susceptibility test was included in the resistance analysis of *Acinetobacter baumannii* isolates.

Total 84 Carbapenem resistant *Acinetobacter baumannii* positive cases isolated from ICUs were studied.

2.1. Data collection

Medical records were reviewed, an extensive data collection sheet was designed and the following data were collected among the ICU patients infected with CRAB isolates were analysed:

The clinical and demographic data such as Age, Gender, Patients Co morbidities, Duration of ICU stays, Mortality rate.

2.2. Definitions

A critical care stay was noted when a patient had a stay at the Intensive Care Unit (ICU), the Cardiac Care Unit(CCU), or the Cardiothoracic Surgery Unit(CSU) for more than 24 hours.

Bacteraemias were classified as primary and secondary. A bacteremia was considered to be secondary when the source is known (pulmonary, gastrointestinal, uinary, wound). A primary bacteremia was either line related or when no apparent source was evident and it was assumed that the patient acquired *Acinetobacter Baumannii* Bloodstream infection through colonization of their skin.[2]

ICU acquired Acientobacter baumannii bacteremia was defined as bacteremia due to A. baumannii that occurred more than 48 hours after ICU admission. Blood culture specimens were ordered by attending physicians in the presence of signs and symptoms of systemic inflammatory response syndrome (SIRS), or when infection was suspected on clinical rounds[2]. Sources of bacteremia were defined according to the Centers for Disease Control and Prevention criteria. Documentation of more than one source was defined as multiple -source bacteremia.

Carbapenem resistance in A baumannii was defined as in vitro resistance to imipenem and /or meropenem. The term “recent CRAB ventilator associated pneumonia “was defined as the presence of lower respiratory tract infection wirth CRAB,prior to A.baumannii bacteremia detection. VAP was diagnosed in patients who presented a new or progressive infiltrate on chest radiograph, after being on mechanical ventilation longer than 48 hours, purulent bronchial secretions and presence of signs and symptoms of SIRS.

Exposure to antimicrobial drugs was defined as antimicrobial therapy given during the ICU stay prior to the first blood sample collection that subsequently revealed A baumannii. To examine the impact of CRAB on mortality, the empiric antibiotic treatment given by the attending physicians was also recorded. “Appropriate” initial empiric therapy was defined on the basis of in vitro susceptibility data. If a patient received at least one antimicrobial agent to which the A.baumannii strain was susceptible,within 48 h

of blood culture collection, the initial antimicrobial therapy was considered appropriate.If none of the antibiotics to which A baumannii was susceptible were included in the treatment within 48 h,antimicrobial therapy was considered inappropriate.[4]

Mortality was assessed at the time of discharge from the ICU.

Microbiological testing and organisms identification and susceptibility classification:

Tracheal aspirate,blood, urine samples were collected for culture and sensitivity on the day of admission and every week thereafter during the ICU stay. Antibiotic sensitivity was performed for all the routine antibiotics and for imipenem and meropenem among the carbapenems. Biomerieux vitek 2 compact automated identification and sensitivity equipment was used. Carbepenem resistance reports were given based on the minimum inhibitory concentration (MIC) of the antibiotics.

2.3. Statistical analysis

Data were analysed using SPSS version 19. Continuous variables were summarized as mean±SD.

Catagorical variables were presented as frequency and percentages.Chi square test were applied for the significant association. Outcome variable, mortality rate were analysed as frequency and percentage.

3. Result

The demographic and clinical profiles of the 84 patients included in the study are presented in Table 1. Forty (48%) patients were referred from other hospitals, Thirty eight (45%) were transferred to ICU from the various wards, and six (7%) were admitted directly without any prior hospitalization.

Sixty one (73%) patients required mechanical ventilation at some time during their ICU stay. Forty seven (56%) were expired, thirty-seven (44%) were discharged.

Table 1: Demographic and clinical profile of study patients

Age	Number	Percentage(%)
<10 years	0	0
11-20 years	2	2
21-30 years	6	7
31-40 years	9	11
41-50 years	11	13
51-60 years	24	29
>60 years	32	39
Total	84	100

Among all 84 carbapenem resistant Acinetobacter baumanii positive patients resistance to carbapenem was more detected in aged patients (>60 yrs).

Mean age for all 84 patients was 53 and standard deviation was 13.8.

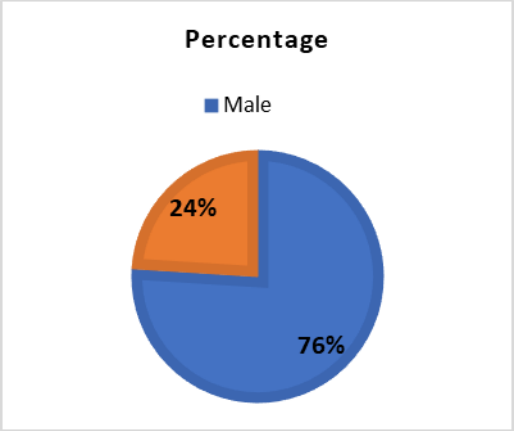

Fig. 1: Sex distribution

Among all 84 patients 64 (76%) were male and 20 (24%) were female. Male : female ratio was 16 : 5

3.1. Co-morbidities

Among all 84 patients all patients had co morbidities like Diabetes mellitus, Hypertension, Coronary artery diseases, Renal calculi etc.

Table 2: Clinicalprofile of the patients

Diagnosis	Number of patients (%)
Sepsis	23 (28%)
VAP	12 (14%)
Severe sepsis &Septic shock	8 (10%)
Intracranial hemorrhage	13 (15%)
Postoperative patients	18 (21%)
Others (renal failure, pancreatitis)	10 (12%)

Table 3: Number of days of ICU stay and mortality rate

Number of patients	ICU stay (days)	Mortality rate
5	27	4(80%)
2	13	1(50%)
14	10	0 (0%)
21	15	6 ((29%)
19	17	8 (42%)
23	11	1 (48%)

Among 84 carbapenem resistant *Acinetobacter baumannii* positive patients 5 patients had prolonged ICU stay (27 days).

Mortality rate was high with the increased duration of ICU stays.

4. Discussion

Acinetobacter infections have grown from a limited problem affecting disaster victims and tropical populations

to a major cause of hospital acquired infections worldwide.[5] *Acinetobacter baumannii* is the most clinical significant pathogen that responsible for the rapidity with which it develops antimicrobial resistance. The ability of the bacterium to survive on inanimate surfaces for prolonged time periods extending from 3 days to 5 months, facilitates its spread in health-care settings thus, it can be easily detected on various common and routine use health care set up items as sinks, floors, cupboards, bed linens, mattresses, bed rails, curtains, hospital trolleys, and ventilation equipment such as respirators and AMBU bags.[6] The MDR isolates of Acinetobacter sp. are globally emerging as a serious opportunistic nosocomial threat particularly in the ICUs. The multidrug-resistant (MDR) Acinetobacter sp. is defined as the one which is resistant to all three classes of antimicrobial agents as - penicillins, cephalosporins, fluoroquinolones, and aminoglycosides.[7] The extensive drug resistant (XDR) Acinetobacter sp. shall be the MDR isolates which are also resistant to carbapenems (IPM and MRP). Infections with *Acinetobacter baumannii* affecting mostly ICU patients with urinary tract and wound infections and sometimes local infections may develop bacteraemia and sepsis.[8]

Along the twelve months of this study, 84 carbapenem resistant *Acinetobacter baumannii* positive cases isolated from ICUs were substracted for this retrospective study. The present study found that among all the patients carbapenem resistance was detected more in patients above 60 years of age, males were predominant than females, most of the patients were on ventilation and in sepsis and mortality rate was high with the increased duration of ICU stays.

Jean uwingabiye, abdelhay lemnouer, sabina baidoo in 2015-16 in Moroccan teaching hospital observed that among 964 patients hospitalized in the ICUs, 81 developed *Acinetobacter baumannii* infections, and mortality rate was 74%; septic shock and older age was significantly associated to mortality risk in patients with *Acinetobacter baumannii* infections.[1]

Another study done by Vikas Manchanda, Sinha Sanchita, Singh NP on multidrug resistant Acinetobacter in University college of medical sciences and Guru Teg bahadur hospital, Delhi in 2018 stated that prolonged lenght of ICU stay, receipt of mechanical ventilation, recent surgery, invasive procedures, underlying severity of illness are the commonest risk factor for developing CRAB infection.[9]

Tanvir Kaur, Chayanika Putatunda, Aroma Oberoi, Gaurav Kumar in Christian medical college in Ludhiana in 2018 obsereved that out 298 clinical samples collected from a various set of ICU patients 42% were allocated to Acinetobacter specieces and more than 95% of Acinetobacter spp were CRAB.[6]

A Study published by Ajay Kumar, Valinderjeety Singh Randhawa et al. in 2011 in lady Harding medical college, New Delhi, stated that out of 474 newborns admitted in neonatal ICU, 65 (13.7%) developed A baumannii infection; 33(7%) of these were CRAB at an incidence of 0.5 case per 1000 patient days.[7]

C Routsi, M Pratikaki, E Plastsouka et al. in Greece, from September 2004 to January 2006 stated that among 842 consecutively admitted ICU patients with an ICU stay of more than 48 hours, 96 developed *Acinetobacter baumannii* infections, 66 due to carbapenem sensitive *Acinetobacter baumanni* and 30 due to carbapenem resistant *Acinetobacter baumannii*. And the mortality rate for patients with CRAB infection was 45.8%. Patient who dies were older and were more likely to have additional intravascular devices than patients who survived.[3]

5. Conclusion

In conclusion, *Acinetobacter baumannii* is not so far as a cause of nosocomial infection with subsequent long ICU stays and high mortality. Emerging *Acinetobacter baumannii* resistant strains is considered real threat in ICU.[10] Among our ICU patients with *Acinetobacter baumannii* bacteremia, CRAB isolates frequently are implicated. Recent VAP due to CRAB and excess use of intravascular devices were the most important risk factors for CRAB bacteremia development. Patients with CRAB, although had a lower illness severity on admission, had a deteriorating ICU course.

6. Source of Funding

None.

7. Conflicts of Interest

No conflicts of interest.

8. Acknowledgement

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