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Research Article

MULTIDRUG RESISTANT *ACINETOBACTER BAUMANNII*: RISE OF THE SUPERBUG !

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Abstract- Introduction-Infections due to *Acinetobacter baumannii* has become a global medical challenge. Multidrug resistant *Acinetobacter baumannii* isolates are causing catastrophic consequences in healthcare settings particularly in the critical care areas. The purpose of this study was to isolate *A. baumannii* species from different clinical specimens and to determine their antimicrobial resistance pattern. Methodology- The study was done in Department of Microbiology, RMC, Loni. The clinical samples were subjected to Gram staining, aerobic culture using MacConkey and blood agar. *Acinetobacter baumannii* species were identified by standard microbiological identification methods. Antimicrobial susceptibility testing was done by Kirby Bauer disc diffusion technique. Result- A total of 114 *Acinetobacter baumannii* species were isolated. Maximum number of *Acinetobacter baumannii* isolates were recovered from pus sample (41.23%) followed by tracheal secretions (30.7%). Rate of isolation of *A. baumannii* was highest from critical care areas (42.11%). Highest resistance was noted against Tobramycin (100%) followed by Cefotaxim (98.4%), Piperacillin (96.8%), and Ceftazidime (96.2%). All strains were sensitive to Polymyxin B & Colistin. Multidrug resistant *A. baumannii* isolates were found to be 77.19%. Conclusion- Stringent infection control protocols, regular practice of hand hygiene and strict implementation of antibiotics policy may help to control multidrug resistant ICU bugs.

Keywords- *Clinical Microbiology, Bacteriology, Acinetobacter baumannii, Nonfermenters, Multi-drug resistance, ICU infections*

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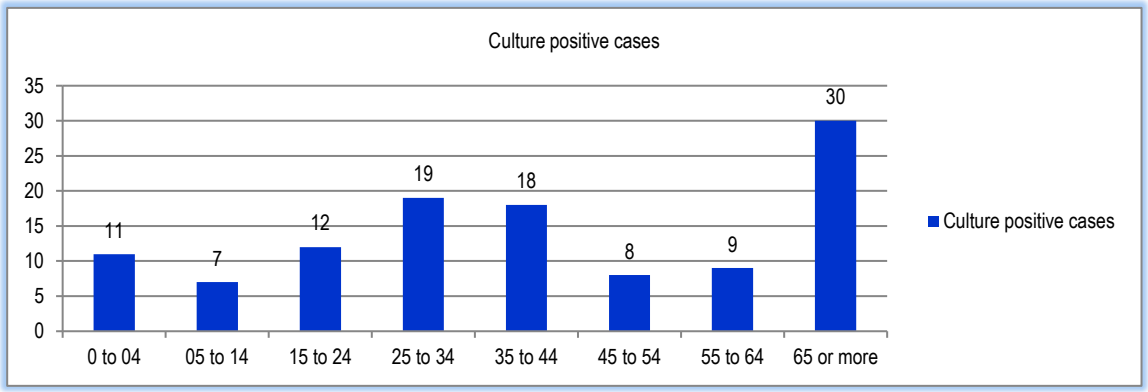
Introduction

Acinetobacter baumannii (*A. baumannii*) is a nonfermenter, gram-negative, nonmotile, oxidase negative cocco-bacillus, which live and multiply not only in soil and water, but also on the skin of humans, especially in health care settings [1]. *A. baumannii* does not need fastidious growth factors for survival and it can grow at various temperatures and pH [2]. The versatile organism uses a variety of carbon and energy sources. These exceptional characteristics can explain its survival in moist or dry conditions and ubiquitous presence in the healthcare environment, which helps contributing to transmission [3]. The most notorious problem encountered is the capacity of these species to acquire the different mechanisms of resistance and the emergence of strains that are resistant to all commonly used antibiotics coupled with the scarcity of development of new antibiotics; this has resulted in a limited choice of antibiotics for treatment of multidrug resistant *Acinetobacter baumannii*. (MDRAB) [4]. MDR *A. baumannii* infections usually occur in immunocompromised patients or in the patients having serious underlying condition, also in the patients who are on antibiotics for a long time. It is also associated with certain invasive procedures [5]. They are known to cause variety of healthcare associated infections including bacteremia, meningitis, urinary tract infections and ventilator associated pneumonias [6]. *A. baumannii* also causes, although less commonly, complicated skin and soft tissue, abdominal, and central nervous system infections [7]. The mortality in patients who are suffering with the *A. baumannii* infections can be high as 75% [8]. Infections due to Multidrug resistant *Acinetobacter baumannii* isolates are difficult to treat. Until now, Carbapenems, Sulbactam and Colistin were most effective antibiotics used in the management, but carbapenem resistance is on the rise globally.[9]It is believed by some of the medical practitioners, that the isolation of *A. baumannii* in the hospitalized patient is an indicator of severe illness.

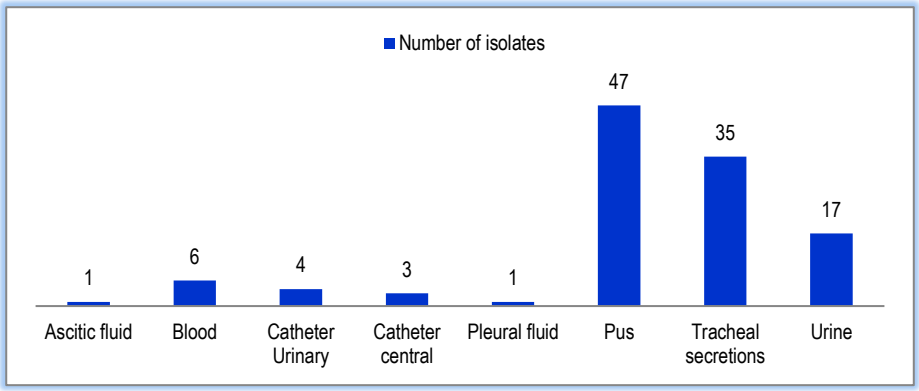
The purpose of this study is to isolate *Acinetobacter baumannii* species from different clinical specimens and to determine their antimicrobial resistance pattern as well as to know the rate of Multidrug resistant strains from isolated species.

Methodology

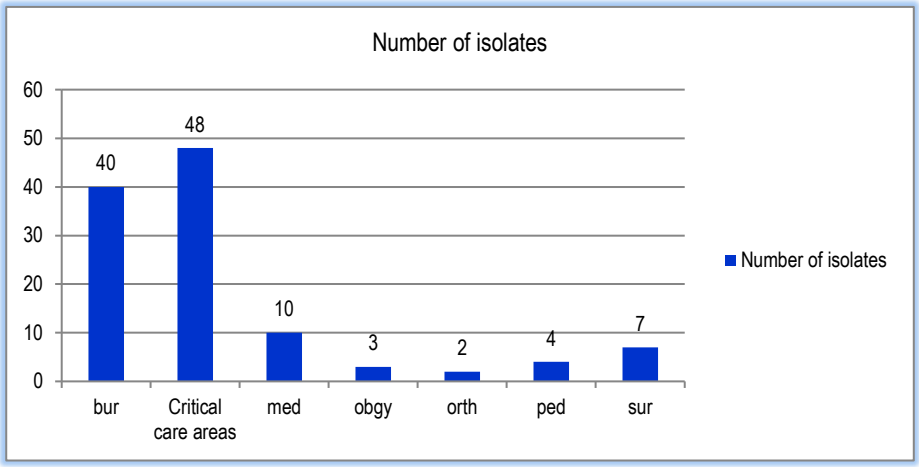
The study was done in Department of Microbiology, Rural Medical College, Pravara Institute of Medical Sciences, (DU) Loni. All clinical specimens received from in patient departments and outpatient departments from Pravara Rural Hospital at the Department of Microbiology. From these processed specimens only *A. baumannii* isolates were included for the present study. Same isolate from repeat sample and the isolates other than *A. baumannii* species were excluded. All the samples were subjected to Gram staining and aerobic culture. The clinical specimens were inoculated on to blood agar & MacConkey agar plates and which were incubated at 37° C for 18 hours. *Acinetobacter baumannii* species were identified by colony morphology, Gram stain, catalase, oxidase test, OF glucose, Growth at 42°C and other standard microbiological identification methods.[10] Antimicrobial susceptibility testing were done by Kirby Bauer disc diffusion technique using Hi Media discs, E strips(wherever required) and the result were interpreted according to CLSI guidelines [11]. Multidrug resistant *Acinetobacter baumannii* isolates were defined as those strains which were resistant to more than three classes of antibiotics according to the CDC definitions. The antibiotic potency of the disks was standardized against the reference strains of *E. coli* ATCC 25922 as the negative control and *A. baumannii* ATCC 19606 as the positive control. All the patients' information details like age, gender, diagnosis, OPD/IPD were recorded. The appropriate statistics were applied wherever needed.



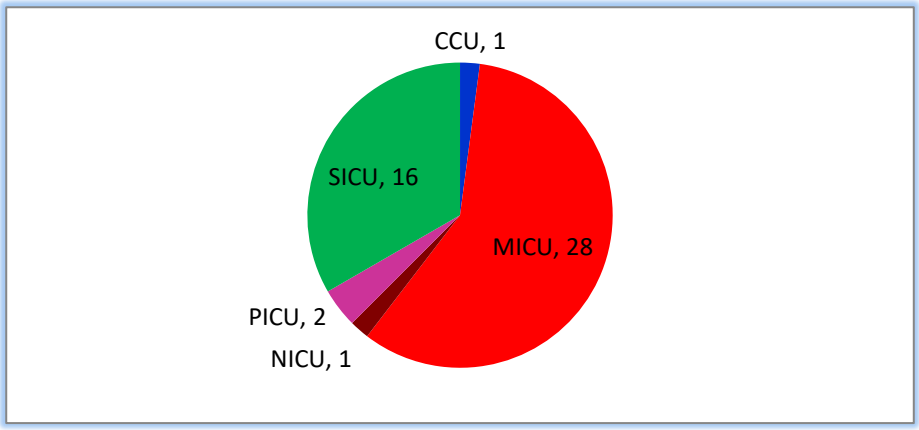
Graph-1 Age wise distribution of the cases
X axis- age group in years, Y axis- No of culture positive cases for *A. baumannii*.



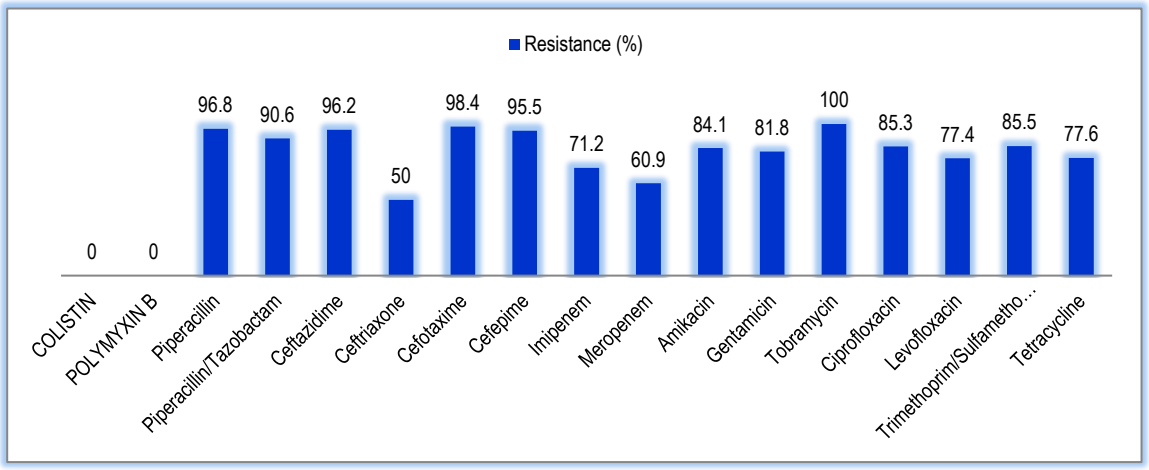
Graph-2 Sample wise distribution of the *A. baumannii* isolates



Graph-3 Department- wise distribution of the *Acinetobacter baumannii* isolates
(bur-Burn, Critical care area, med-Medicine, obgy- Obstetrics & Gynecology, ped- Paediatrics, Sur- Surgery)



Graph-3(A): Distribution of *A. baumannii* isolates in critical care areas.
(CCU- critical care unit, MICU- Medical intensive care unit, NICU- neonatal intensive care unit, PICU- Pediatric intensive care unit, SICU- Surgical intensive care unit)



Graph-4 Antimicrobial resistance pattern of the *A. baumannii* isolates

The study was conducted after dual approval was obtained from the institutional ethical committee.

Result

The study was conducted in Department of Microbiology, Rural Medical College, Loni. During this study period 4873 clinical samples were received in the department, out of that, a total of 114*Acinetobacter baumannii* species were isolated. Maximum rate of isolation (30/114) was from the patients who were above 65 years age group [Graph-1]. Rate of isolation was more common in males 74 (65%) compared to females 40 (35%). Maximum number of *Acinetobacter baumannii* isolates were recovered from pus sample 47(41.23%) followed by tracheal secretions 35(tracheal aspirates, ETT tips, tracheostomy tube tips). Least isolation was from abdominal fluid (1) and pleural fluid (1) [Graph-2]. Rate of isolation of *A. baumannii* was highest form critical care areas 48 [CCU (1), MICU (28), NICU-(1), PICU-(2), SICU-(16)] followed by burn dept 40(35.08%) [Graph-3,3A]. 110 isolates were recovered from in patient department, whereas 4 isolates were recovered from outpatient department. Highest resistance was noted against Tobramycin (100%) followed by Cefotaxim (98.4%), Piperacillin (96.8%), Ceftazidime (96.2%), Cefepime (95.5%) and other antibiotics [Graph-4]. High level of resistance was also found against Imipenem (71.2%) Meropenem (60.9%), Ceftriaxone (50%). All isolates were susceptible to Colistin and Polymyxin B [Graph-4]. Multidrug resistant *A. baumannii* isolates were found to be 88 (77.19%).

Discussion

Infections due to *Acinetobacter baumannii* has become a global medical challenge. The curiosity among researchers for this organism has been increasing because of the emergence of MDR strains, some of which are pan resistant to antimicrobial agents. Because MDR *Acinetobacter* infection generally occur in severely ill patients admitted in the ICU, the associated crude mortality rate is quite high, which ranges from 26% to 68% [12]. Out of total 4873 specimens, which were received in the Department of Microbiology during the study period, 114 *Acinetobacter baumannii* species isolated. The rate of isolation was more common in male patients (65%) as compared to females. (35%).Maximum rate of isolation (30/114) was from the patients who are above 65 years age group. Talukdar, *et al.,* (2018) reported maximum rate of isolation of *A. baumannii* was from patients older than 60 years [13]. Infections caused by *A. baumannii* are usually associated with lengthy hospital stay, the male gender and older age [14,15]. In a present study, maximum isolates were recovered from pus sample including wound swabs (41.23%) followed by tracheal secretions (30.7%). Muthusamy, *et al.,* (2012) reported maximum isolates from tracheal secretions (aspirates, tracheal tips, endotracheal tips) followed by wound swabs [8]. Kulkarni, *et al*., (2017) observed that maximum *Acinetobacter* isolates were recovered from pus sample followed by miscellaneous samples [4]. *Acinetobacter baumannii* is now recognized as causing abroad range of severe nosocomial infections, including skin and soft tissue infections, wound infections, ventilator associated pneumonia, blood stream infections with high mortality rate [16]. Infections due to *A. baumannii* usually affect patients with severe underlying disease, and are associated with major surgical procedure, burns or trauma [17]. In our study, rate of isolation of *A. baumannii* was highest from critical care areas (48) followed by burn department (40) [Graph-3, 3A]. Talukdar, *et al.,* (2018) also reported maximum isolates from critical care areas [13]. Muthusamy, *et al.,* (2012) reported 35 % isolates from ICU dept followed by neurosurgery department (19%) [8]. In recent years, frequency of *A. baumannii* infections have been increasingly reported, mostly in intensive care, burn and surgical units.[18][19] Resistant strains of *A. baumannii* are endemic in some units like , burns and ICUs and have been spread from institution to institution.[20]Antimicrobial resistance may provide certain strains of *A. baumannii* with a selective advantage in an environment, such as the modern ICU, where these bacteria are confronted with extensive exposure to antimicrobials [14]. In a present study, 110 isolates were recovered from in patient department, whereas 4 isolates were recovered from outpatient department. Similar finding was reported by Jaggi, *et al.,* (2012) [21]. It is well known that *A. baumannii* is a pathogen of healthcare settings. Less commonly, *A. baumannii* can also cause community-acquired infections, including pneumonia, bacteraemia, skin, soft tissue infections, ocular infections, meningitis and endocarditis [22, 23]. In our study, highest resistance was found against Tobramycin (100%) followed by Cefotaxim (98.4%), Piperacillin (96.8%), Ceftazidime (96.2%) and Cefepime (95.5%). High level of resistance was also found against Imipenem (71.2%), Meropenem (60.9%), Ceftriaxone (50%). All isolates were susceptible to Colistin and Polymyxin B. (Graph 4) Jaggi, *et al*., (2012) reported resistance rates as Ceftazidime (92.1 %), Amikacin (90.3%), Cefepime (90.3%), Imipenem (89.6%), Meropenem (89.6%). Least resistance was found for Colistin (1.2%)& Polymyxin B (1.9%) [21]. Carbapenem resistance in *A.baumannii* in our study is alarming as past studies done in India have reported resistance rates ranging from 9.8 to18.5% [24]. Though antimicrobial resistance is a global problem, it is the first and foremost a local problem. Selection for and amplification of resistant bacterial species which are present in healthcare settings and communities, which then helps to spread it globally. In present study, Multidrug resistant (MDR) *A. baumannii* isolates were found to be 77.19%. The rate of MDRAB reported by Talukdar, *et al.,* (2018) was 75. Ghaima, *et al*., (2016) observed 87.5% of the isolates as MDR, while Dent, *et al.,* (2010) found it as 72% [17,25]. Castilho, *et al*., (2017) has reported 91.1% of MDR *A. baumannii* isolates in ICU settings [26]. Infection or colonization with Multidrug resistant *A. baumannii* has been shown to be associated with increasing morbidity and mortality [25]. The most alarming challenge we are facing globally in a healthcare setting is the ability of *Acinetobacter* species to acquire the multiple mechanisms of antimicrobial resistance and the rise in number of the strains that are resistant to all commonly used antibiotics. In addition to that, there is scarcity in the development of new antibiotics; this has resulted in a limited choice of drugs for management of multidrug resistant *Acinetobacter* infections. Antibiotics were once called 'wonder drugs' or 'miracle', it seems to be as an overworked miracle!

Conclusion

Multidrug resistant *Acinetobacter baumannii* isolates are causing catastrophic consequences in healthcare settings particularly in the Critical care areas globally. This study demonstrates alarming nature of multidrug resistant organism in critical care area. Stringent vigilance, regular surveillance in critical areas to prevent colonization as well as cross infection is recommended. Therefore, strategic infection control protocols, regular practice of hand hygiene among healthcare workers, strict implementation of antibiotics policy may help to control multidrug resistant ICU bugs. The combination therapy for patients with multidrug *A. baumannii* infections should also give importance by clinicians in critical care areas.

Abbreviations

ATCC- American type culture collection
CLSI- Clinical and Laboratory Standards Institute
ICU- Intensive care Unit
IPD- In patient department
MDR- Multidrug Resistant
MDRAB- Multidrug Resistant *Acinetobacter baumannii*
OPD-Out patient Department

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Author Contributions: All author equally contributed

Author statement: All authors read, reviewed, agree and approved the final manuscript

Conflict of Interest: None declared

Ethical Committee Approval: The study was conducted after dual approval was obtained from the Institutional Ethical Committee of Pravara Institute of Medical Sciences, (DU), Loni, Maharashtra, India.

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