Multidrug-resistant Acinetobacter baumanii infections – A dreadful superbug to humans

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ABSTRACT

Acinetobacter baumanii is considered to be one of the significant pathogens causing nosocomial infections and outbreaks in hospital settings, especially in ICU. The dreadful concern with Acinetobacter infections is their ability to gain resistance against all commonly used antibiotics like Penicillin, cephalosporins, Fluoroquinolones, carboxypenicillin, carbapenems as a result this Multi-Drug Resistant (MDR) strains increases patient hospital stay, cost of treatment, mortality, and morbidity among affected patients. A total of 146 Acinetobacter isolates were received from various clinical samples. Samples received were routinely subjected to Culture. Gram staining was done. The smear showed Gram-Negative Coccobacilli taken and subjected for further biochemical reactions. Antibiotic susceptibility testing was done by Kirby Bauer disc diffusion method in Muller -Hinton agar plate. The majority of Acinetobacter baumanii isolates were received from the 19-40 age group (45.8%), followed by the 41- 60 (26%) age group. Most of the Acinetobacter baumanii strains were isolated from wound swab 33.5%, followed by urine 29.4%, sputum 17.1%, Blood 10.2%.Antibiotic sensitivity of 146 Acinetobacter baumanii isolates showed Highest resistance to Ampicillin (100%), Gentamycin (70.5%),Cotrimoxazole (68.4%) , Piperacillin Tazobactam (66.4%) , Ciprofloxacin (63%), Nitrofurantoin (61.6%) , Ceftriaxone (61.6%). Levofloxacin, Amikacin, Tigecycline, Colistin were found to be the most effective antibiotics with a sensitivity of 73.2%, 87.6%, 91.7%, 100% respectively. Of 146 isolates 63 (43%) were Multi-Drug Resistant, i.e isolates showing resistance to more than 3 classes of antibiotics. Hence strict infection control and antimicrobial stewardship policies should be implemented in hospitals to reduce mortality and morbidity associated with Acinetobacter baumanii infections.

Keywords: *Acinetobacter Baumanii , Multi Drug Resistant , Antimicrobial Stewardship*

1. BACKGROUND

Acinetobacter species is a Gram Negative Cocco Bacilli, Catalase positive , Oxidase negative, non motile , non fastidious , aerobic , pleomorphic organism , which are saprophytic in nature. They are commensal of skin, intestinal and respiratory tract [1,2] . Globally *Acinetobacter baumanii* is considered to be one of the significant pathogen causing nosocomial infections and outbreaks in hospital settings especially in ICU [1,2]. They have a predominant role as nosocomial pathogen especially as causative agent of Ventilator Associated Pneumonia , they can also cause Community acquired pneumonia , Catheter Associated Urinary tract infections, septicemia , meningitis , Endocarditis , Necrotizing fasciitis [3,4] .

Acinetobacter has remarkable ability to survive in unfavorable conditions like in wide range of temperature and PH , in moist and dry surfaces, thrives in hospital environment even after exposure to various disinfectants [2,5] .There are various risk factors associated with Acinetobacter infection such as patients with prosthetic devices , indwelling urinary catheters , Central lines , Ventilator , Immunosuppressive state , previous exposure to broad spectrum antibiotics, prolong stay in ICU [2,3,4].

The dreadful concern with *Acinetobacter* infections is their ability to gain resistance against all commonly used antibiotics like Penicillin, cephalosporins, Fluoroquinolones , carboxypenicillin , carbapenems as a result these Multi Drug Resistant (MDR) strains increases patient hospital stay , cost of treatment , mortality and morbidity among affected patients [1,2,4] . The reasons for development Multi Drug Resistance in *Acinetobacter baumanii* are alteration in outer membrane porin channel , overexpression

of efflux pump , synthesis of antibiotic modifying enzymes like beta lactamases , target mutation in lipopolysaccharides or ribosomes [2,6].The estimated mortality rate with Acinetobacter infection is 26–68% [2].

Now a days Pan drug resistant Acinetobacter baumanii strains have been reported which shows resistance to Carbapenms , Colistin and Polymixins [6]. Hence the local antibiotic susceptibility pattern is essential in treating this notorious pathogen . With the above background this study was aimed to isolate Acinetobacter baumanii from various clinical specimen and to study their antibiotic sensitivity pattern .

2. MATERIALS AND METHODS
The study was carried out in Microbiology department at Sree Balaji Medical College and Hospital, Chennai over duration of 1 year from JUNE 2020 to JUNE 2021. A total of 146 *Acinetobacter* isolates received from various clinical samples. Samples received were routinely subjected to culture on Nutrient agar, Blood agar, MacConkey agar, Chocolate agar and incubated at 37 deg C overnight. Culture which showed significant pure growth were taken for further evaluation. Culture Smear Gram staining was done. The smear which showed Gram Negative Coccobacilli taken and subjected for further biochemical reactions. Antibiotic susceptibility testing was done by Kirby Bauer disc diffusion method in Muller -Hinton agar plate and the plates were incubated at 37 deg C for 24 hours, The interpretation of the zones of inhibition was done using the chart adapted from Clinical and Laboratory Standards Institute (CLSI 2021) [7].The isolates were tested for their susceptibility to following antibiotics:

Table 1: Concentration of antibiotic used.

ANTIBIOTICS	CONCENTARATION
Ampicillin	10ug
Ceftriaxone	30ug
Piperacillin- tazobactem	100/10ug
Imipenem	10ug
Meropenem	10ug
Nitofurontoin	300ug
Gentamycin	10ug
Cotrimaxazole	1.25/23.75ug
Ciprofloxacin	5ug
Amikacin	30ug
Ceftazidime	30ug
Cefepime	30ug
Levofloxacin	5 ug
Tigecycline	15 ug
Colistin.	10 ug

3. RESULTS
Of 146 *Acinetobacter baumanii* isolates received , 60% of isolates from female patients and 40% from male patients (figure 1).
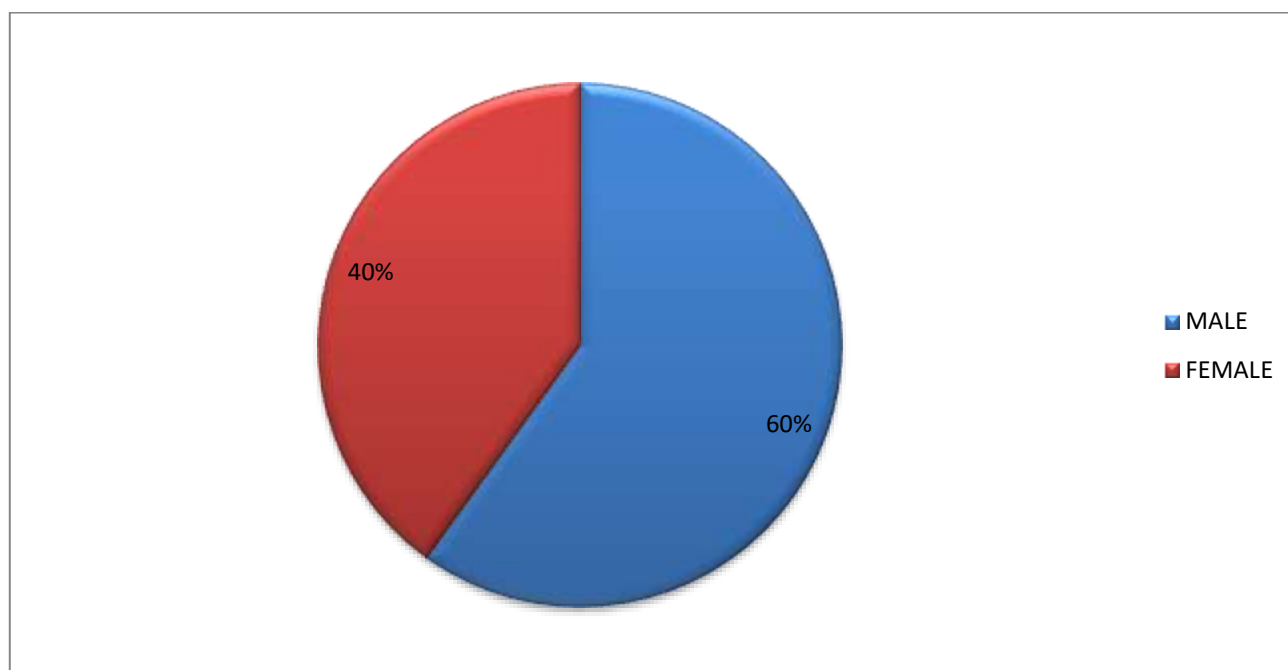

Fig. 1 : Sex wise distribution of *Acinetobacter baumanii* isolates.

Majority of *Acinetobacter baumanii* isolates were received from 19-40 age group (45.8%), followed by 41- 60 (26%) age group (figure 2).
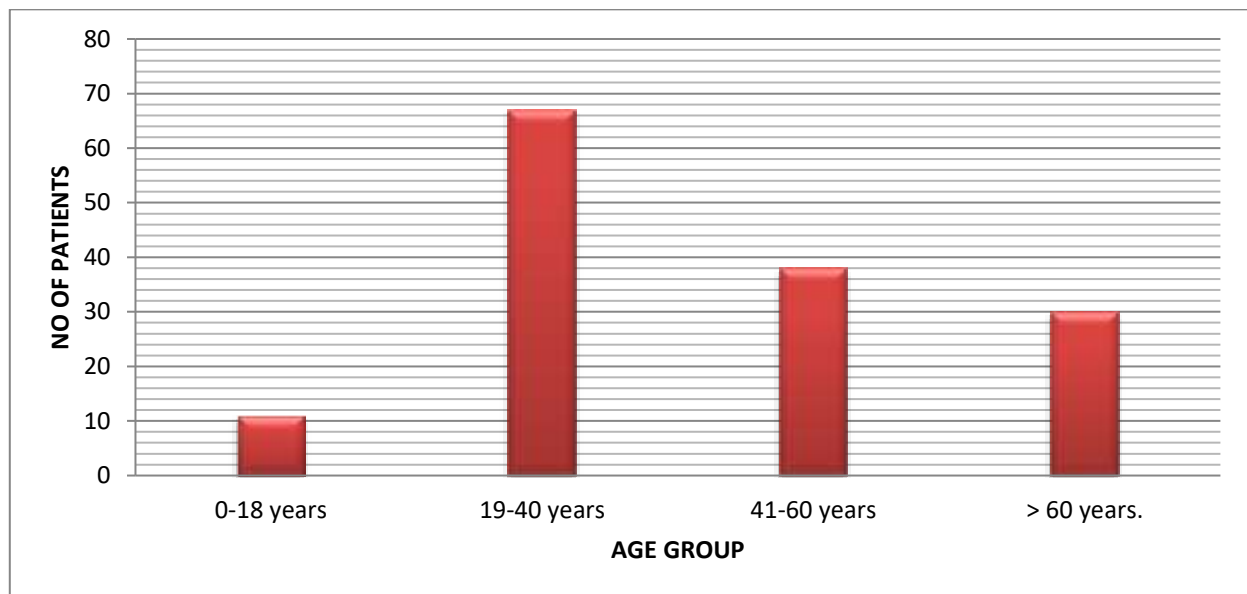
Fig.2: Age wise distribution of *Acinetobacter baumanii* isolates.

Most of the *Acinetobacter baumanii* strains were isolated from wound swab 33.5%, followed by urine 29.4%, sputum 17.1%, Blood 10.2% (table 2).

Table 2: Sample wise distribution of *Acinetobacter baumanii* isolates.

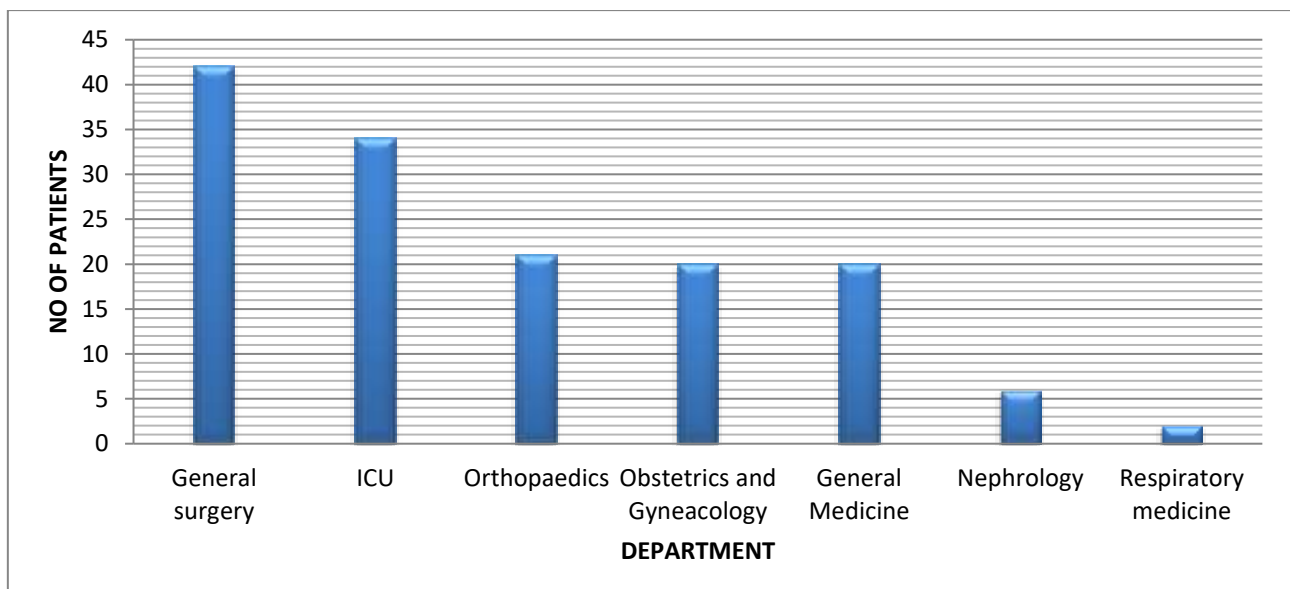| TYPE OF SAMPLE	n (%)
Wound swab	49 (33.5%)
Urine	43 (29.4%)
Blood	15 (10.2%)
Sputum	25 (17.1%)
Pus	5 (3.4%)
BAL	4 (2.7%)
Tissue	1 (0.68%)
Endotracheal tube sample	2 (1.3%)
Ear swab	1 (0.68%)
Ascitic fluid	1 (0.68%)

Fig.3: Ward wise distribution of *Acinetobacter baumanii* isolates.

Most of the samples were received from general surgery ward (28.7%), followed by ICU (23.2%), Orthopedics (14.3%) (figure 3)
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Table 3: Antibiotic resistant pattern of *Acinetobacter baumanii* isolates.

ANTIBIOTICS	NO OF RESISTANT ISOLATES n (%)
Ampicillin	146 (100%)
Gentamycin	103 (70.5%)

Cotrimaxazole	100 (68.4%)
Piperacillin Tazobactem	97 (66.4%)
Ciprofloxacin	92 (63.0%)
Nitrofurantoin	90 (61.6%)
Ceftriaxone	90 (61.6%)
Ceftazidime	74 (50.6%)
Cefepime	71 (48.6%)
Levofloxacin	39 (26.7%)
Imipenem	46 (31.5%)
Meropenem	42 (28.7%)
Amikacin	18 (12.3%)
Tigecycline	12 (8.2%)
Colistin	0 (0%)

Antibiotic sensitivity of 146 *Acinetobacter baumanii* isolates showed Highest resistance to Ampicillin (100%), Gentamycin (70.5%),Cotrimaxazole (68.4%) , Piperacillin Tazobactem (66.4%) , Ciprofloxacin (63%), Nitrofurantoin (61.6%) , Ceftriaxone (61.6%). Levofloxacin , Amikacin , Tigecycline , Colistin were found to be the most effective antibiotics with sensitivity of 73.2%, 87.6% , 91.7% , 100% respectively (table 3).

Of 146 isolates 63 (43%) were Multi Drug Resistant, i.e isolates showing resistance to more than 3 classes of antibiotics.

4. DISCUSSION
The infections by *Acinetobacter baumanii* is of greater concern as it has an ability to survive for longer time on an inanimate objects facilitating its spread in hospital environment , their ability to inherit resistant gene from *Pseudomonas* and *Salmonella* species via plasmids horizontally (2).

In our study most of the *Acinetobacter baumanii* strains were isolated from male patients (60%) and 40% from female patients (figure 1).This observation was similar to the finding made by Rajkumar et al from Tamilnadu in 2017 [5] in which 73.2% of *Acinetobacter baumanii* strains were isolated from male patients . In a study by Angeline Anjali from Chennai in 2020 [1] showed that female patients predominated over male patients with the ratio of 1.9:1.

Most of the *Acinetobacter baumanii* strains in the current study was isolated from 19-40 age group (45.8%), followed by 41- 60 (26%) age group (figure 2). These results were in accordance with the observation made by Angeline Anjali from Chennai in 2020 [1] in which majority of infection with *Acinetobacter baumanii* happened in 21 – 40 years followed by the age group 41-60 years and with the study by Saranya, A.S et al from Tamilnadu in 2017 [3] who observed 25% of positive cases from 21-30 years. Rajkumar et al from Tamilnadu in 2017 [5] observed that 56% of > 55 years patients had infection with *Acinetobacter baumanii*.

In the present study, most of the *Acinetobacter baumanii* strains were isolated from wound swab 33.5%, followed by urine 29.4% , sputum 17.1%, Blood 10.2% (table 1). Suryawanshi N M in 2017 from Maharashtra [4] showed most of the *Acinetobacter* species was from pus and wound swab (31.5%) which is similar to our observation . But Angeline Anjali from Chennai in 2020 [1] and Rajkumar et al from Tamilnadu in 2017 [5] showed that Maximum number of isolates were recovered from Urine 34.4% and 44% respectively which were discordant with our results.

Most of the samples in our were recovered from general surgery ward (28.7%) , followed by ICU (23.2%) (figure 3) , which were similar to observation by Angeline Anjali from Chennai in 2020 [1] in which predominant infections with *Acinetobacter baumanii* was from general wards 67(54.9%) followed by ICU 33(27%).

The present study showed of 146 *Acinetobacter baumanii* isolates Highest resistance was shown to Ampicillin (100%), Gentamycin (70.5%),Cotrimaxazole (68.4%) , Piperacillin Tazobactem (66.4%) , Ciprofloxacin (63%), Nitrofurantoin (61.6%) , Ceftriaxone (61.6%). Levofloxacin , Amikacin , Tigecycline , Colistin were found to be the most effective antibiotics with sensitivity of 73.2%, 87.6% , 91.7% , 100% respectively (table 3). Most of the studies by Angeline Anjali from Chennai in 2020 [1] , Suryawanshi N M in 2017 from Maharashtra [4] , Saranya, A.S et al from Tamilnadu in 2017 [3], Rajkumar et al from Tamilnadu in 2017 [5] showed that most of the *Acinetobacter baumanii* isolates showed highest resistance to Penicillin , cephalosporin , Aminoglycosides , fluroquinolones group of antibiotics while all these studies showed 100% sensitivity to Polymixin group and colistin , these observations were similar to our study.

43% of *Acinetobacter baumanii* isolates were Multi Drug Resistant which is the worrying aspect of present study, Angeline Anjali from Chennai in 2020 [1] in their study showed 60.7% of isolates were Multi Drug Resistant, Rajkumar et al from Tamilnadu in 2017 [5] showed 66% of multidrug resistance in *Acinetobacter baumanii* isolates.

5. CONCLUSION
The present study provides information about antibiotic resistant pattern of *Acinetobacter baumanii* in this particular region which will be helpful in starting empirical treatment for critically ill patients and showed increased prevalence of Multi Drug Resistant strains which were resistant to most of the commonly used antibiotics like Penicillin, Cepahlosporins , Fluroquinolones , Carbapenems . Hence strict infection control and antimicrobial stewardship policies should be implemented in hospitals to reduce mortality and morbidity associated with *Acinetobacter baumanii* infections.

6. ACKNOWLEDGEMENT

7. CONFLICT OF INTEREST

8. FUNDING

9. REFERENCES

[1] Angeline Anjlai A , Abiramasundari V.K. Prevalence and antibiotic susceptibility of Acinetobacter in a tertiary care hospital. International Journal of Current Pharmaceutical Research. 2020 ; 13(1) :35-40.

[2] Kaur T, Putatunda C, Oberoi A, Vyas A, Kumar G. PREVALENCE AND DRUG RESISTANCE IN ACINETOBACTER SP. ISOLATED FROM INTENSIVE CARE UNITS PATIENTS IN PUNJAB, INDIA. Asian J Pharm Clin Res. 2018Jul.27 ;11(14):88-3.

[3] Saranya, A.S., Suresh, M., Mohammed Saleh Al Aboody., Rath, P.K Berhanu Kibemo and Moorthy Kannaiyan. PREVALENCE OF METALLO-B- LACTAMASES IN CARBAPENEM RESISTANT ACINETOBACTER BAUMANNII ISOLATED FROM TRACHEAL SECRETIONS. January 2017 ; 8(1) : 15197-15202.

[4] Suryawanshi N M , Mangalkar S M, Davane M S. Prevalence of infection by Acinetobacter species and their antibiogram at a tertiary care hospital. *MedPulse International Journal of Microbiology.* March 2017; 1(3): 43-45.

[5] Rajkumar S et al.2017, Prevalence And Antimicrobial Resistance of Clinical Acinetobacter Baumannii From A Major Diagnostic Laboratory In Coimbatore City-South India. Int J Recent Sci Res. 8(7), pp. 18347-18351.

[6] Smiline Girija A.S., Vijayashree priyadharshini . CLSI based antibiogram profile and the detection of MDR and XDR strains of *Acinetobacter baumanii* from sample.MJIRI.2019 (feb 18) ;33.3.

[7] CLSI AST New Update 2021.