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Analysis of Carbapenem Susceptibility Pattern among *Acinetobacter* isolates in a Tertiary Care Hospital

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A B S T R A C T

Acinetobacter baumannii has emerged as an extensively-drug-resistant pathogen implicated in healthcare associated infections (HCAIs) such as ventilator associated pneumonia, urinary tract infection, bacteremia, septicemia, secondary meningitis, wound infection etc. In the recent past carbapenems had been drugs of choice for serious infections with *Acinetobacter baumannii*, but carbapenem resistant strains are rapidly emerging. This study assesses the prevalence and mechanisms of resistance for Meropenem, Imipenem among *Acinetobacter* species isolated from a tertiary care center. Aim is to study the carbapenem susceptibility pattern among *Acinetobacter* isolates in a tertiary care hospital. This is a prospective study carried out in a tertiary care teaching hospital in the coastal district of Tamilnadu. A total of 1411 samples were obtained from July to December 2017 were analysed. All the *Acinetobacter* isolates from the clinical samples were included in this study. Bacterial isolates were identified using standard methods. Antibiotic susceptibility testing was done by Kirby Bauer disc diffusion method according to the Clinical and Laboratory Standards and Institutional guidelines. The prevalence of *Acinetobacter baumannii* is 6.54% and maximum number of positive samples belongs to patients above the age of 60 years with a mean age of 57.13. Majority of the culture positive isolates belong to males with the maximum number of samples were from pus. 45% of the culture positive isolates were sensitive of Meropenam with 100% resistance to imipenam. The sensitivity of Meropenam in urine, pus, sputum, other samples were 55.6%, 47.06, 66.67% and 20% respectively. For body fluids and blood both Meropenam and imipenam were resistant to all samples.

Introduction

Acinetobacter baumannii has emerged as an extensively-drug-resistant pathogen implicated in healthcare associated infections (HCAIs) such as ventilator associated pneumonia, urinary tract infection, bacteremia, septicemia, secondary meningitis, wound infection etc.(1) Increasing incidence of *Acinetobacter* species causing serious nosocomial infections in hospital intensive care units are being reported worldwide. Most frequently encountered species is *Acinetobacter baumannii* and it is commonly associated with infections, such as bacteremia, urinary tract infection, meningitis, skin and soft tissue infections and pneumonia with high mortality rate of 30-75% in hospitalised patients.(2) One of the most striking features of *Acinetobacter baumannii* is its extraordinary ability to develop resistance against major antibiotic classes.(3) In the recent past carbapenems had been drugs of choice for serious infections with

Acinetobacter baumannii, but carbapenem resistant strains are rapidly emerging. There are several factors leading to carbapenem resistance in *Acinetobacter baumannii*, most important being the acquisition of carbapenem hydrolysing β-lactamases. Other mechanisms include the presence of mobile genetic elements, reduced expression of outer membrane proteins, altered affinity or expression of penicillin-binding proteins and multidrug efflux pumps.(4) Acquired resistance mechanisms can act synergistically and integrate genes encoding antibiotic-inactivating enzymes, efflux pumps, ribosomal binding site mutations and down regulation of porin channels on the cell membrane giving rise to multidrug-resistant (MDR) isolates.(5) Because of frequent resistance to commonly used antibiotics, carbapenems have become important for managing *Acinetobacter* infections. However, their effectiveness is being increasingly compromised due to enzymatic modification of antibiotic molecules especially by carbapenemases and expression of efflux pumps. Acquired carbapenemases can be either metallo-beta-lactamases (MBLs) such as VIM and IMP, or non-MBL. MBL genes are mostly detected in class integrons' structures and these integrons are detected in a high proportion of *Acinetobacter* isolates.(6) carbapenamases are β-lactamases, which include serine-β-lactamases (KPC, OXA, GES, etc.) and metalloβ-lactamases (MBLs).

The latter require metal ion zinc for their activity, which is inhibited by metal chelators like EDTA and thiol-based compounds but not by sulbactam, tazobactam and clavulanic acid.

The genes responsible for MBL production may be chromosomal or plasmid mediated and poses a threat of horizontal transfer among other Gram-negative bacteria. (7) This study assesses the prevalent mechanisms of resistance for imipenem, meropenum among *Acinetobacter* species isolated from a tertiary care center.

The main objectives of this study to study the carbapenem susceptibility pattern among *Acinetobacter* isolates in a tertiary care hospital.

Materials and Methods

This is a prospective study carried out in Sree Mookambika Institute of Medical Sciences kulashekaram, Kanya kumari, Tamil nadu. A total of 1411 samples were obtained from July to December 2017. All the clinical isolates of *Acinetobacter* from urine, pus, sputum, blood cultures, vaginal swabs, ear swab, aspirated body fluids (pleural, peritoneal, ascitic), wound swabs from OPD and IPD of all departments. All the *Acinetobacter* isolates from the clinical samples were included in this study. Samples were collected from all age groups.

Samples those held for more than two hours at room temperature and those without proper labelling were excluded from the study. Bacterial isolates were identified using standard methods. Antibiotic susceptibility testing was done by Kirby Bauer disc diffusion method according to the Clinical and Laboratory Standards and Institutional guidelines. Antibiotic discs (Meropenem- 10 micrograms and Imipenem - 10 micrograms) were obtained from HIMEDIA, India.

Results and Discussion

Prevalence of *Acinetobacter baumannii*

Total Samples analysed = 1411. Out of the total 1411 samples analysed 611 came to be culture positive i.e. 43.3 % of the total sample is culture positive. Of that 611 culture positive specimens 40 grew *Acinetobacter* species i.e. prevalence of *Acinetobacter* species in culture positive samples is 6.54%.

Table.1 Distribution of *Acinetobacter* among various age groups

Age (Years)	Number	Percentage (%)
Less than 1 year	3	7.50
1-30 years	3	7.50
31-60 years	10	25
Above 60 years	24	60
Total	**40**	**100.00**

The mean age being 57.13

Table.2 Distribution of culture positive samples based on the gender of patients

Gender	Number	Percentage (%)
Male	27	67.50
Female	13	32.50
Total	**40**	**100.00**

Table.3 Distribution of *Acinetobacter* among the culture samples

Culture samples	Number	Percentage (%)
Urine	9	22.5
Blood	2	5
Pus	17	42.5
Sputum	6	15
Body fluids	1	2.5
Others	5	12.5
Total	**40**	**100.00**

Table.4 Sensitivity and resistance pattern of Carbapenems

Drugs	Sensitivity		Resistance	
	Number	Percentage (%)	Number	Percentage (%)
Meropenam	18	45	22	55
Imipenem	0	0	40	100

Table.5 Sensitivity and resistance pattern of Carbapenems in urine samples

Drugs	Sensitivity		Resistance	
	Number	Percentage (%)	Number	Percentage (%)
Meropenam	5	55.6	4	44.4
Imipenem	0	0	9	100

Table.6 Sensitivity and resistance pattern of Carbapenems in blood samples

Drugs	Sensitivity		Resistance	
	Number	Percentage (%)	Number	Percentage (%)
Meropenam	0	0	2	100
Imipenem	0	0	2	100

Table.7 Sensitivity and resistance pattern of Carbapenems in pus samples

Drugs	Sensitivity		Resistance	
	Number	Percentage (%)	Number	Percentage (%)
Meropenam	8	47.06	9	52.94
Imipenem	0	0	17	100

Table.8 Sensitivity and resistance pattern of Carbapenems in sputum samples

Drugs	Sensitivity		Resistance	
	Number	Percentage (%)	Number	Percentage (%)
Meropenam	4	66.67	2	33.33
Imipenem	0	0	6	100

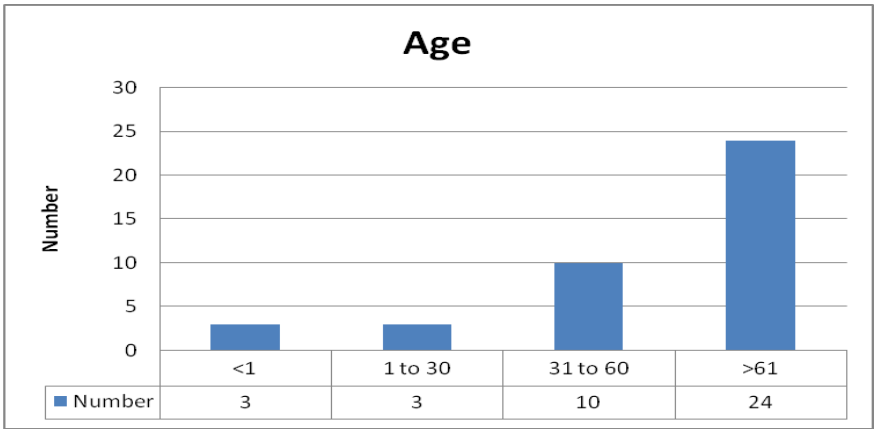
Table.9 Sensitivity and resistance pattern of Carbapenems in body fluids

Drugs	Sensitivity		Resistance	
	Number	Percentage (%)	Number	Percentage (%)
Meropenam	0	0	1	100
Imipenem	0	0	1	100

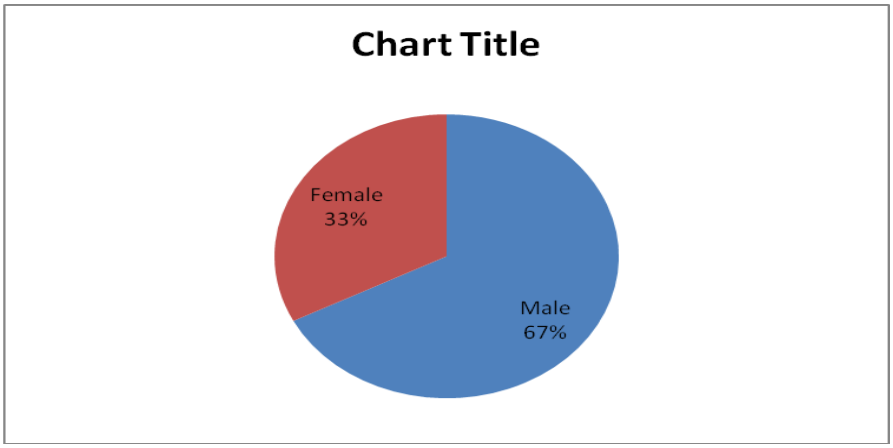
Table.10 Sensitivity and resistance pattern of Carbapenems in other samples

Drugs	Sensitivity		Resistance	
	Number	Percentage (%)	Number	Percentage (%)
Meropenam	1	20	4	80
Imipenem	0	0	5	100

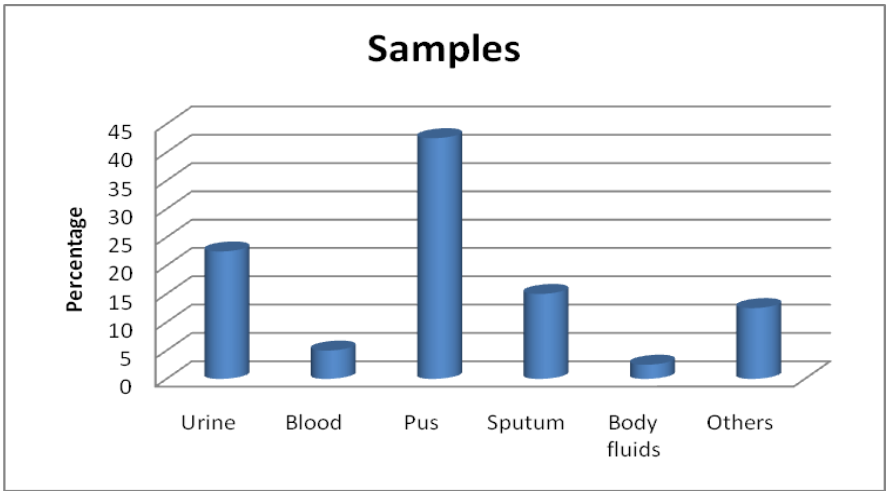
Graph.1 Distribution of *Acinetobacter* among various age groups



Graph.2 Gender based distribution of culture positive samples



Graph.3 Distribution of *Acinetobacter* among the culture samples



Statistical analysis

The data was expressed in number and percentage. Micro soft excel 2009 software.

Carbapenem resistance in *Acinetobacter* species is an emerging problem and is a cause of concern as many nosocomial *Acinetobacter* are detected to be resistant to most other antibiotics. Several modalities of phenotypic and molecular typing are used to detect the origin of infection, route of spread and prevalence of bacterial isolates. However, certain simple tests may be performed to determine a few common mechanisms of resistance, and these can be performed in most laboratories. In the present study, the prevalence of *Acinetobacter* were 6.54 % among 43.3% culture positive samples when compaired with a study done by Amandeep Kaur *et al.,* 8.8% (48/545) *Acinetobacter baumannii* isolates were obtained from different samples.

In our study, 25% of samples were within the age group of 31 to 60 years. 60% of samples were above the age group of 60 years (Table 1 and Graph 1). Dr. Jhansi Charles *et al.*, proved in a study that 80.8% were above 40 yrs. Similar study by Anuradha *et al.*, showed more than 60 years was the common age involved. The involvement of old age group is mainly due to co morbid conditions and waning immunity which are commonly seen in the aged. Distribution of *Acinetobacter* infection among various isolates has been studied, which showed more predominance among males (67.50%) than female patients (32.50%) (Table 2 and Graph 2).

The total percentage of distribution of *Acinetobacter* among the culture samples showed more distribution among pus samples (42.5 %) followed by urine (22.5%) (Table 3 and Graph 3). When compaired with a study conducted by Abhisek routray et al showed predominant distribution of *Acinetobacter* is among pus samples (43%).

Amomg 40 clinical isolates of *Acinetobacter*, 40 (100%) were found to have resistant zone sizes for Imipenem and 22 (55%) showed resistance to Meropenam when tested by disk diffusion method. In our study antibiotic resistance to imipenem was 100% among clinical isolates of *Acinetobacter*, whereas in a study by Amarjeet Kaur, Resistance to imipenem was observed in 40.3% of A. baumannii isolates (Table 4-10).

A study from Dr. M. Anuradha *et al.*, Imipenem resistance was found to be 9.5%. Whereas a study by Gaur A, from USA imipenem resistance was found to be 23.1%. The study by Gulseran Baran *et al.,* who showed that 53.7% were imipenem resistant in their study due to colonisation of these organisms in the devices used on these patients.

This study revealed that Imipenem resistant *Acinetobacter* was very common in June which is post summer and October which is post monsoon. In a study conducted by Amandeep Kaur, meropenem susceptibility is 21.8 (43.8%) and 27 (58.2%) were resistance. Similarly in a study of Sinha, 21 (14%) isolates were detected to have resistant zone sizes for meropenem.

The present study demonstrates the presence of high level of multiple antibiotic resistance among carbapenem resistant *Acinetobacter baumannii* isolates.

A coordinated effort to limit inappropriate use of broad-spectrum antibiotics, effcient hospital antibiotic policies, vigilant detection of resistant *Acinetobacter*s, rigorous surveillance and infection-control protocols are needed to control the increasing incidence of highly resistant *Acinetobacter*s.

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