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Clinical Spectrum and Antibiogram of Acinetobacter Infections in Children: Study from a Tertiary Care Centre, India

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Abstarct:- Acinetobacter is an aerobic, pleomorphic, non-motile bacillus that is Gram-negative. In the last 35 years, Acinetobacter baumannii has emerged as the most problematic bacterium in the hospital and community due to its genetic makeup and antibiotic resistance. Infections of the skin, soft tissues, central nervous system, and bones are on the rise due to strains that are resistant to antibiotics and can survive for a long period. This study aims to study the epidemiological and clinical characteristics and antibiogram of different species of Acinetobacter. Antimicrobial susceptibility testing was performed at the Manipal hospital in Bangalore, India, using VITEK 2 AST-N090 automated system for amikacin, amoxicillin-clavulanate, cefepime, ciprofloxacin, colistin, gentamicin, imipenem, meropenem, piperacillin-tazobactam, tetracycline, tigecycline and trimethoprim-sulfamethoxazole.

Ethics-related considerations were granted. Acinetobacter species have emerged as a significant offender in both the hospital and the community. Predominance of infections among infants under one month old, primarily those in neonatal intensive care units, suggests that preterm and newborn infants are more susceptible to acinetiobacter infections. Pneumonia was the most frequent clinical manifestation in this study, with risk factors such as long-term invasive procedures, prolonged ventilation, and broad-spectrum antibiotic use. Acinetobacter has become less susceptible to antibiotics over time, and polymyxin is the only therapeutic choice for MDR infections in environments with restricted resources.

Colistin and polymixn were the most efficient drugs, while carbapenems showed just 10% sensitivity. Mortality rates ranged from 17% to 63%, with preterm babies having increased mortality rates. Acinetobacter infections in children are on the rise, mostly affecting neonatal and paediatric intensive care units. A multicentric study is needed to research the risk factors, interventions, and antibiogram of the organisms. Treatment costs increase due to resistance to oral antibiotics. Acinetobacter strain identification using culture and routine local antibiogram will help clinicians understand the pattern of sensitivity for improved treatment.

Keywords:- *Acinetobacter, oral antibiotics, infections, Treatment, Clinicians.*

I. INTRODUCTION

Children who are severely unwell and hospitalised now face a therapeutic challenge due to the emergence of Acinetobacter infections and the expansion of multidrug-resistant strains. These organisms are linked to a higher mortality risk and a lengthier hospital stay. Acinetobacter is an aerobic, pleomorphic, non-motile bacillus that is Gram-negative. In the last 35 years, there have been major modifications to the genus Acinetobacter. Acinetobacter baumannii has emerged as the most problematic bacterium in the hospital and community out of the several species that make up this genus. It has been noted that several species' genetic makeup and antibiotic resistance have changed during the past few years. There are now strains of Acinetobacter baumannii that are immune to every antibiotic now in use. These microorganisms frequently attack seriously unwell hospitalised patients. The most frequent infection caused by this bacterium, according to reviews dating back to the 1970s(1), is still hospital acquired pneumonia. the capacity of organisms to endure for an extended period of time in a hospital setting, strengthening their potential for nosocomial transmission. Infections of the skin, soft tissues, central nervous system, and bones are on the rise as a result of strains that are resistant to antibiotics and can survive for a long period. Both the scientific community and the general public are now much more interested in Acinetobacter. Understanding of this intriguing organism has advanced significantly. Present study is intended to study the epidemiological and clinical characteristics and antibiogram of different species of Acinetobacter.

II. MATERIAL AND METHODS

Identification of patients in the laboratory: Laboratory records were consulted for patient information. Clinical samples were taken from the patients and grown on 5% defibrinated sheep blood agar, Chocolate, and Mac Conkey's agar for 24 hours at 37°C. The isolated bacteria were identified using both the traditional approach and the automated VITEK 2 technology (bioMerieux Inc, Mercy L'etoil, France).

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Antimicrobial Susceptibility Testing: Antibiotic sensitivity testing was performed through VITEK 2 AST-N090 (bioMerieux Inc, Mercy L'etoil, Fransa) automated system for amikacin, amoxicillin-clavulanate, cefepime, ciprofloxacin, colistin, gentamicin, imipenem, meropenem, piperacillin-tazobactam, tetracycline, tigecycline and trimethoprim-sulfamethoxazole. CLSI (The Clinical and Laboratory criteria Institute) criteria were used to interpret results.

Ethics-related considerations: The Manipal hospital in Bangalore's ethical committee granted their clearance.

Definitions: A. baumannii isolation from pulmonary secretions along with contemporaneous infiltrates on chest radiography and clinical signs and symptoms of infection are required for the diagnosis of pneumonia.

According to clinical, radiographic, and microbiologic criteria established by the Centres for Disease Control and Prevention, ventilator-associated pneumonia (VAP) is diagnosed (58).

According to Acute renal Injury Network (AKIN) guidelines (59), all children were given the diagnosis of having an acute renal injury.

Septic shock is characterised by the presence of sepsis and malfunction of the cardiovascular system (60).

Statistical Analysis: The Statistical Package for Social Sciences (SPSS), version 13.0, was used to analyse the data. Data is displayed as frequency and percentage.

III. RESULTS

Table 1: Age wise distribution of patients

Age group	No.of patients	Percentage
0-1 month	107	38.91
>1M-1 Y	43	15.64
1-5 Y	34	12.36
6 -10 Y	38	13.82
10-18 Y	53	19.27
Total	275	100%

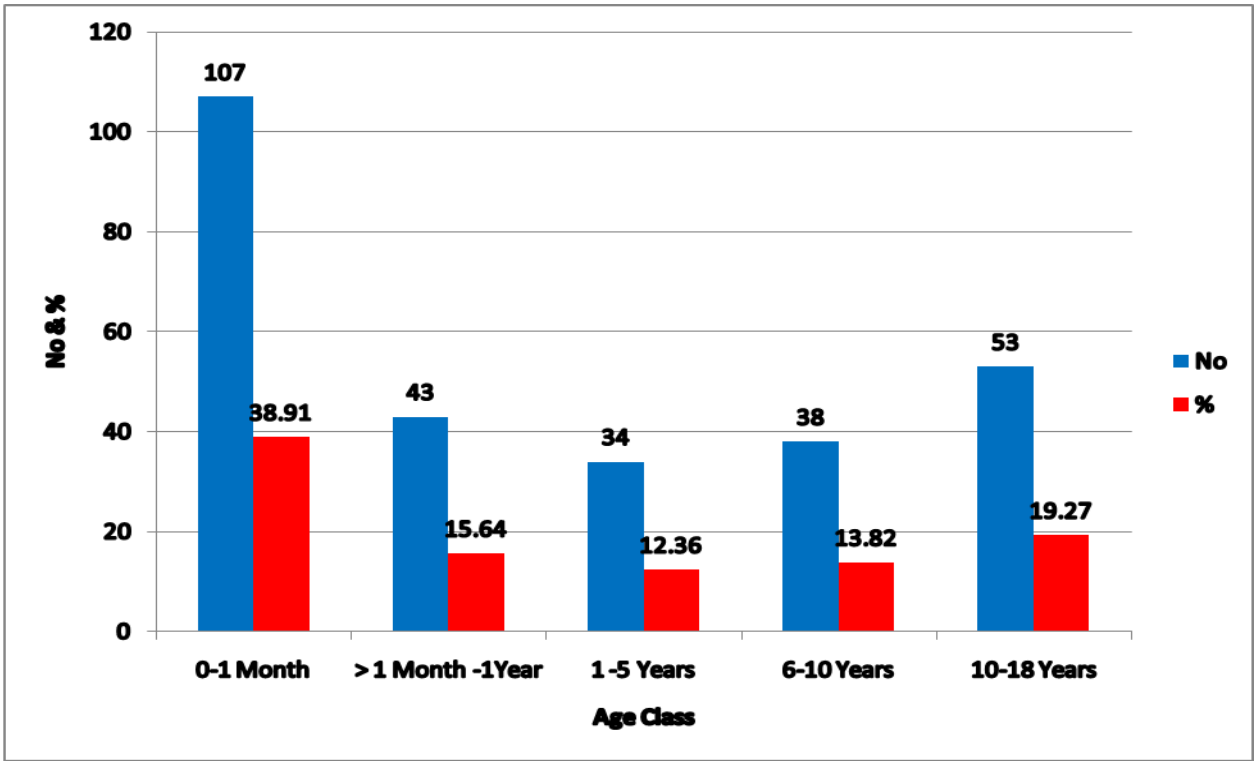

Fig. 1: Age distribution.

In our study, maximum children were less than 1 month of age (38.91%), followed by 10-18 yr(19.27). Least number (12.36%) were in the age group of 1-5 yrs.

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Table 2: Sex wise distribution of patients

Sex	No. of patients	Percentage
Male	176	64.23
Female	99	35.76
Total	275	100

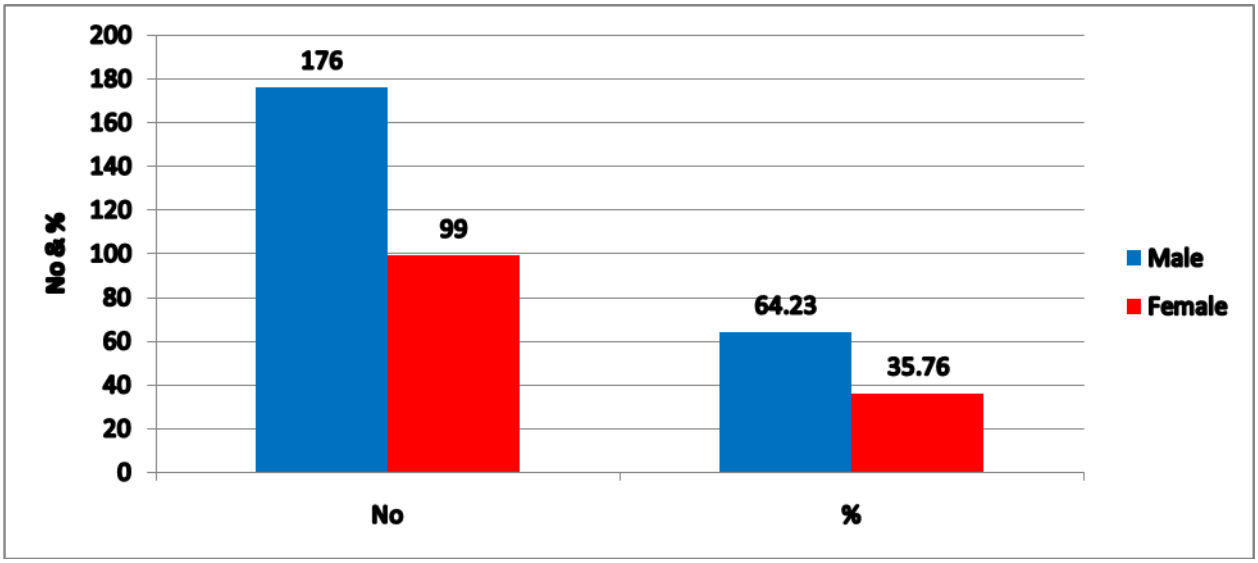

Fig. 2: Gender distribution

In our study majority were male patients (64.23%). Females accounted for 35.76%.

Table 3: Location of patient when acinetobacter sps. Isolated.

Location	Number of patients	Percentage
ICU	159	57.82
WARD	68	24.73
Outpatient	48	17.45
Total	275	100

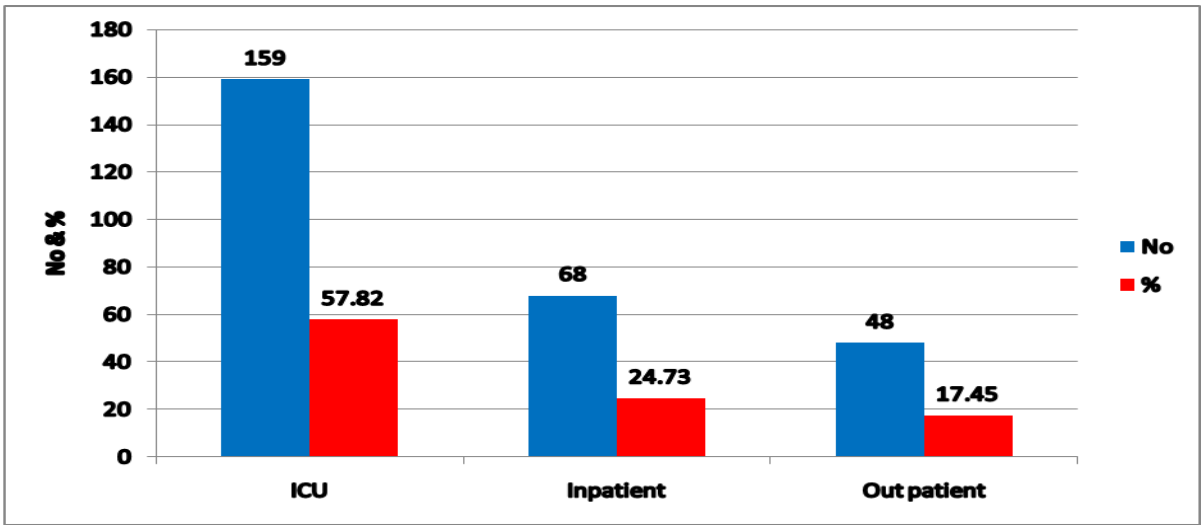

Fig. 3: Patient location

Most of the acinetobacter sps isolates were from ICU (57.82 %) and majority were from the neonatal ICU patients.Isolates from swabs ,blood collected from outpatient were only 17.45%.

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Table 4: Specimen from which organism isolated

Specimen	No.of patients	Percentage
Blood	92	33.45
Pus/Swabs	22	8.00
Tracheal aspirate	116	42.18
Pleural fluid	5	1.82
Urine	11	4.00
Central tip line	13	4.73
Sputum	5	1.82
Others	11	4.00

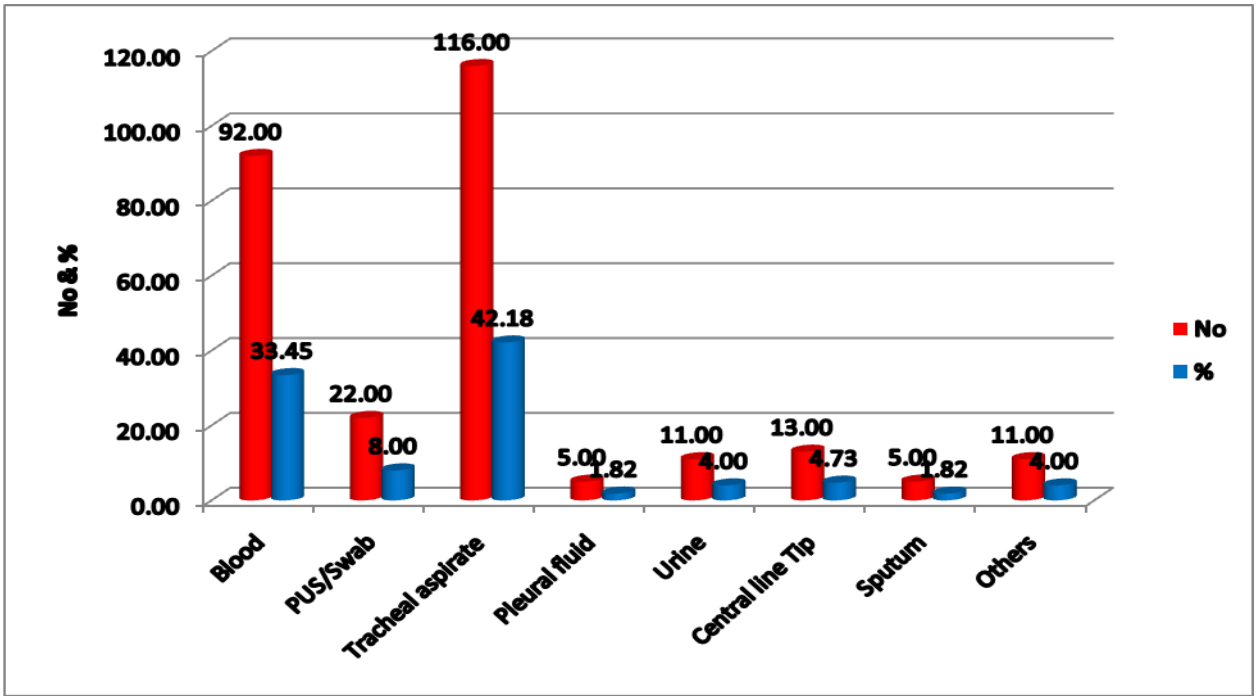

Fig. 4: Specimen from which organisms isolated

Tracheal aspirate isolates made up 42.18 percent of the total acinetobacter isolates in our study, whereas blood isolates made up 33.45%.The majority of children with positive tracheal aspirate results required at least 2 to 3 days of intubation and ventilation. Acinetobacter was also found in swabs from surgical sites, pleural fluid, urine, central line tips, and pus (8%, 1.82%, and 8%, respectively).

Table 5: Clinical features

Clinical feature	No.of patients	Percentage
Fever	112	40.73
Breathlessness	48	17.45
Lethargy	42	15.27
Seizures	7	2.55
Vomiting	8	2.91
Abdominal pain	4	1.45
Ear discharge	15	5.45
Soft tissue injury	10	3.64
Fracture	8	2.91
Others	21	7.64

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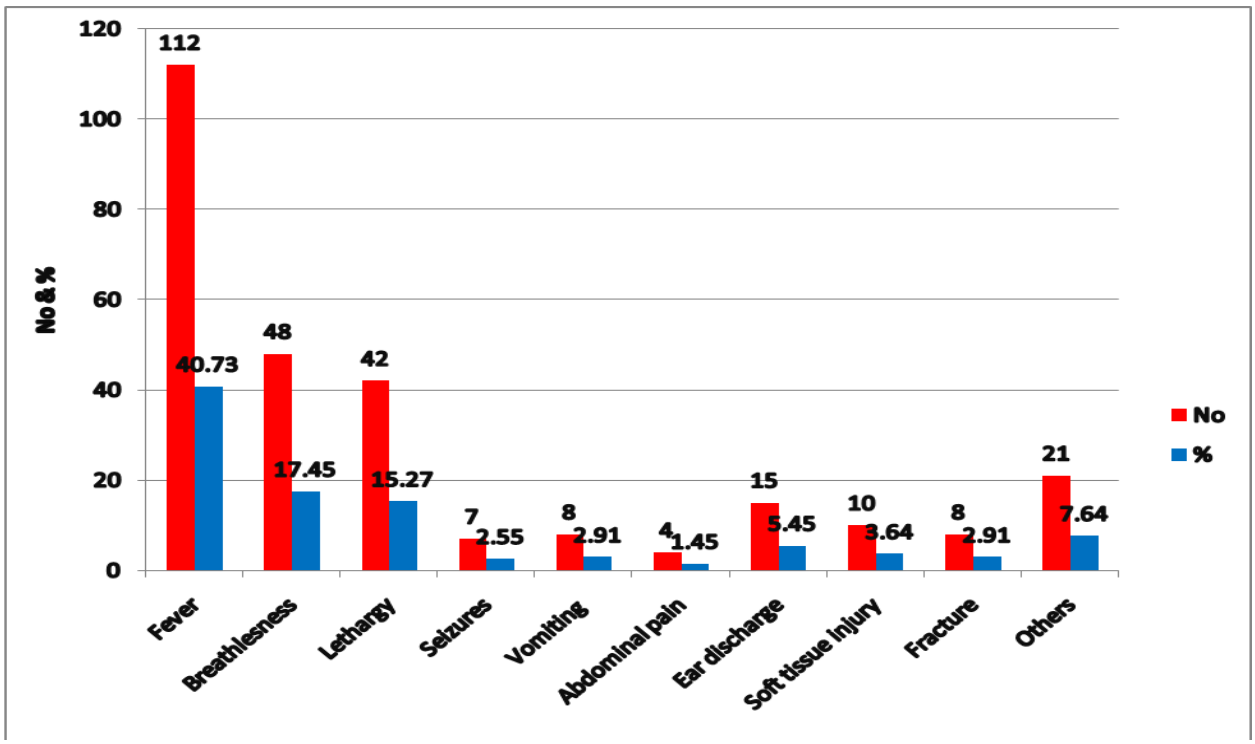

Fig. 5: Clinical features

Among the children who had blood isolates of acinetobacter, fever was the common presentation (40.73%).followed by breathlessness/respiratory distress(17.45 %)

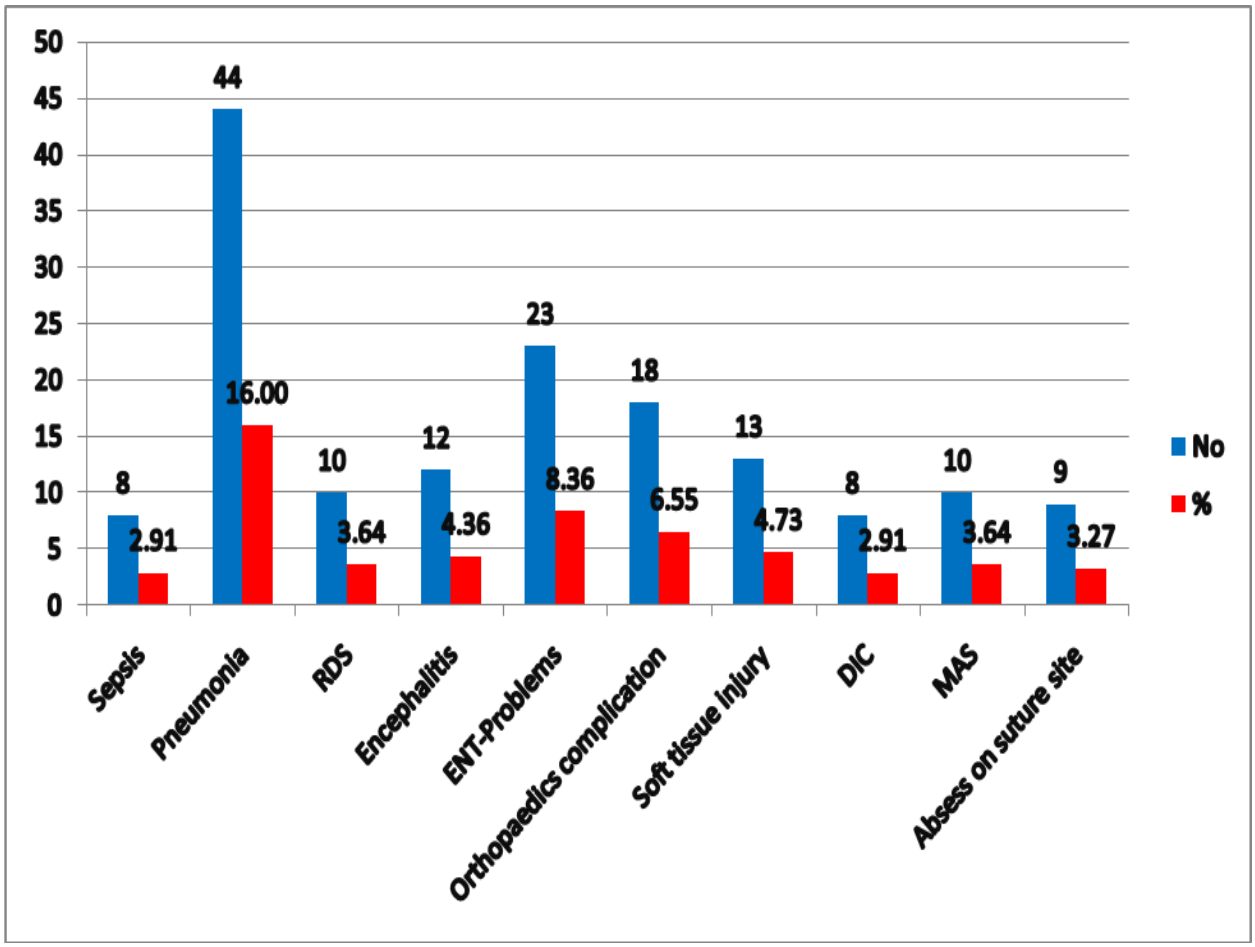

Fig. 6: Primary Diagnosis

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In our study Acinetobacter spp. accounted for the following percentages of total infections among patients in pediatric , pneumonia 16%; lower respiratory infections other than pneumonia, 3.6%; Ent problems like ASOM 8.36%,meningitis 4.36 %,orthopedic 6.55%,soft tissue injury 4.73%,bacteremia,DIC 2.91% , surgical site infections, 3.27%.

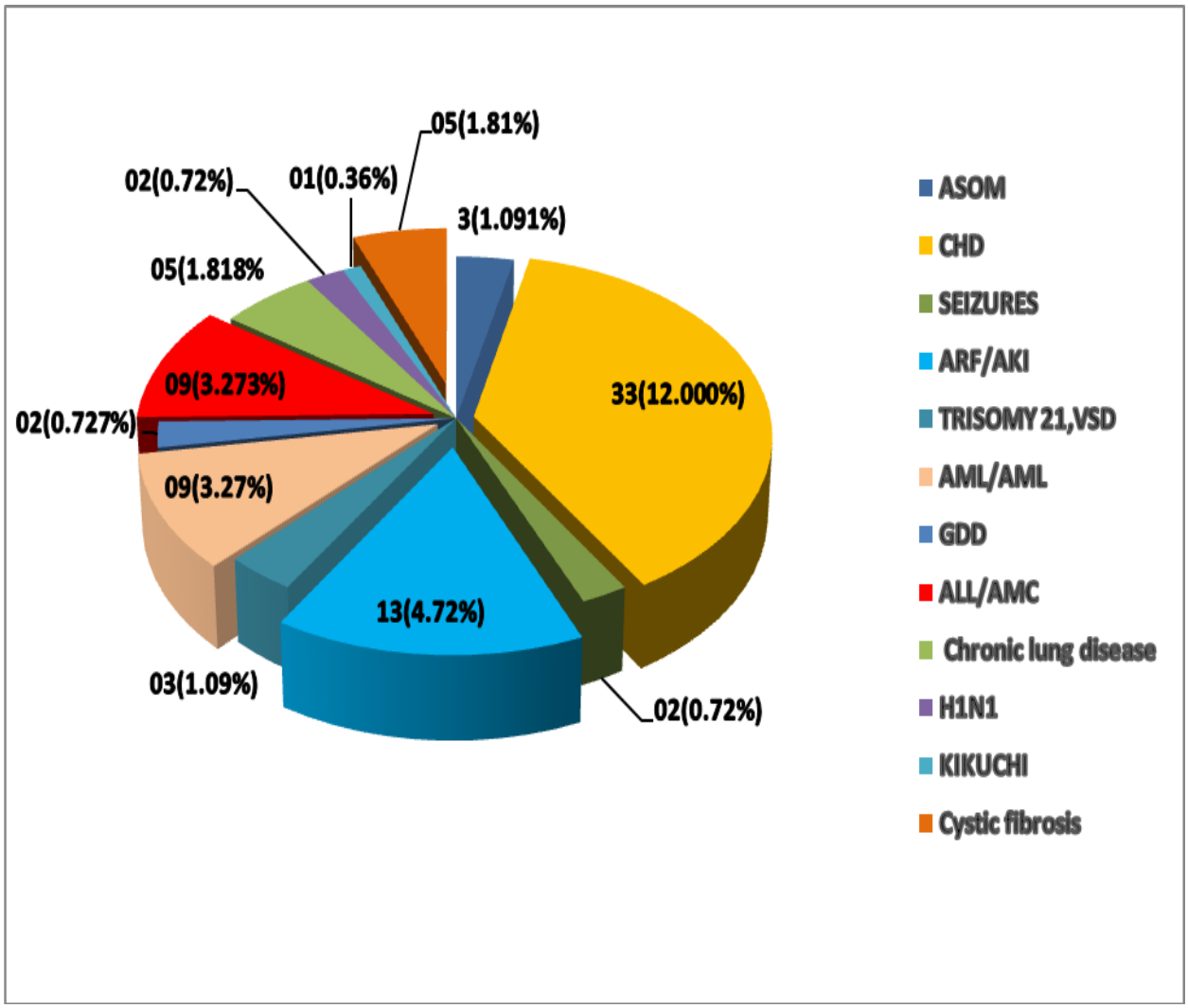

Fig. 7: Associated illness

Among the children admitted and found to have acinetobacter infection, Congential heart diseases accounted for 12% , acute kidney injury 4.72%,malignancies 3.27%

Table 8: Ventilated children vs. Non ventilated

	No. of patients	Percentage
Ventilated	117	42.55
Not ventilated	158	57.45
Total	275	100

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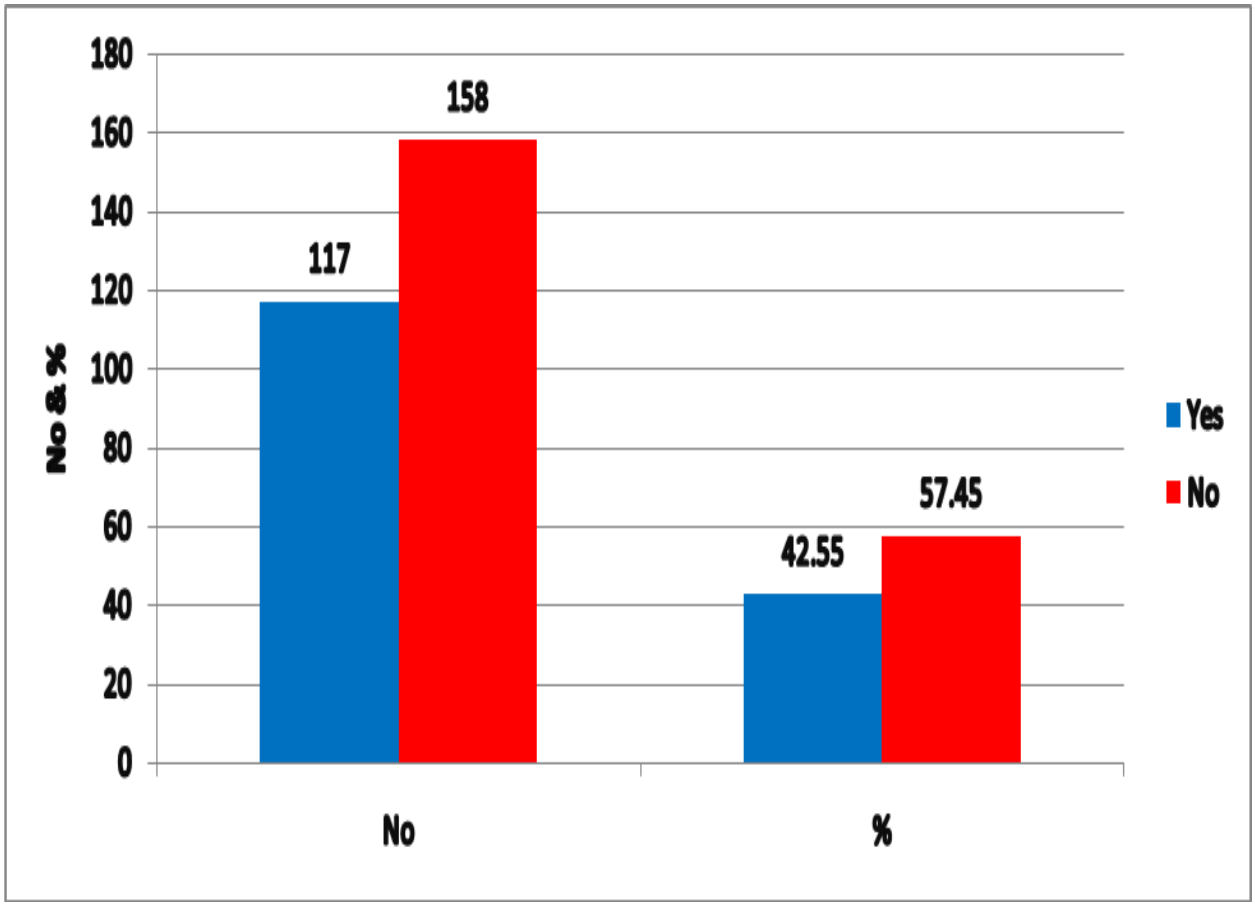

Fig. 8: Ventilated vs Not ventilated.

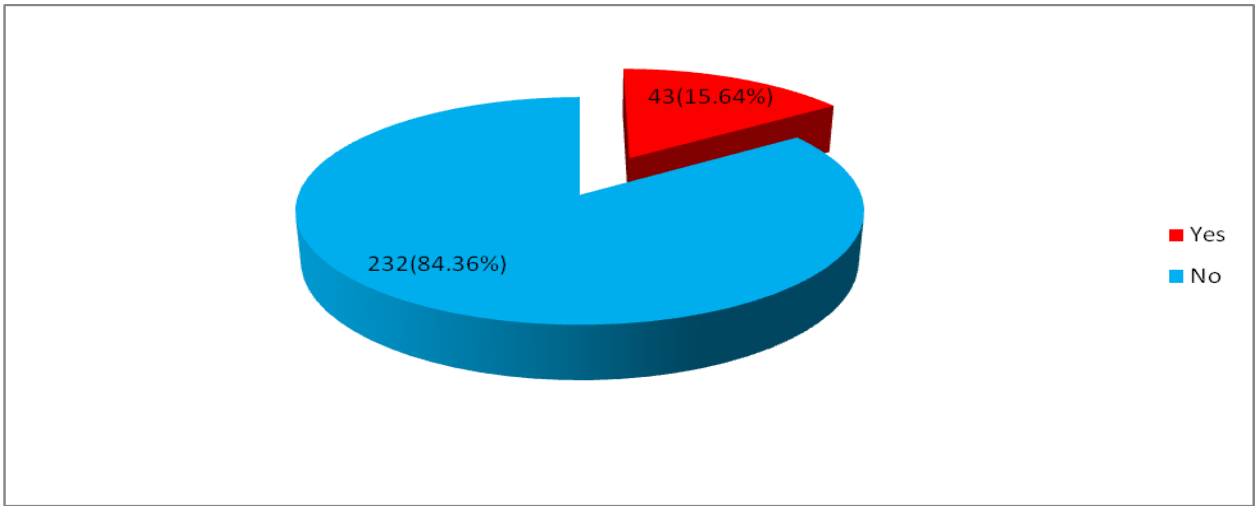

Fig. 9: Mortality status

Mortality of 15.64 % was seen , a total of 43 patients , among them most of them are neonates who are preterm and associated compliacations during postnatal period.

Table 10: Acinetobacter sps isolated

Species	No.of patients	Percentage
A.Baumanni cmplx	178	64.73
A.haemolyticus	3	1.09
A.Lwoffi	6	2.18
A.junii	7	2.55
Others	81	29.45

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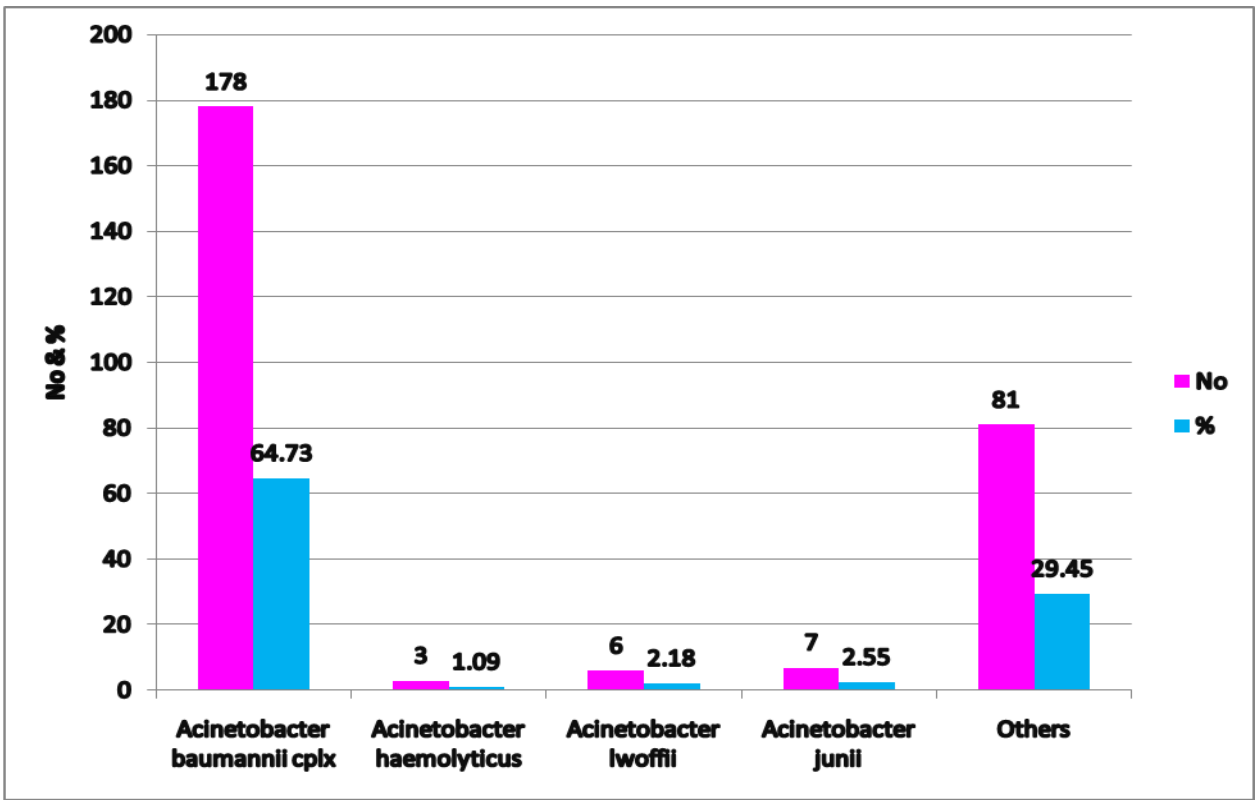

Fig. 10: Acinetobacter sps isolated

Among the isolates, Acinetobater baumanni were most common isolates 64.73%.less common isolates were a haemolyticus 29.45 % were other species of acinetobacter for which proper identification was not possible.

Table 11: Sensitivity of different antibiotics in -Acinetobacter baumannii cplx

Antibiotics	R		S	
	No	%	No	%
Trimethoprim/Sulphamethoxazol	133	48.54	34.00	12.41
Ciprofloxacin	149	54.38	27.00	9.85
Ofloxacin	41	14.96	12.00	4.38
Levofloxacin	81	29.56	57.00	20.80
Gentamicin	120	43.80	35.00	12.77
Amikacin	135	49.27	39.00	14.23
Netilmicin	56	20.44	26.00	9.49
Tobramycin	121	44.16	49.00	17.88
Cefotaxime/Ceftriaxone	65	23.72	4.00	1.46
Ceftazidime	149	54.38	24.00	8.76
Cefoperazone	67	24.45	8.00	2.92
Cefepime	150	54.74	20.00	7.30
Piperacillin	81	29.92	26.00	9.36
Piperacillin+Tazobactum	143	52.19	27.00	9.85
Cefoperazone+Sulbactum	82	29.93	66.00	24.09
Imipenem	150	54.74	26.00	9.49
Meropenem	147	53.65	29.00	10.58
Aztreonam	73	26.64	3.00	1.09
Polymyxin B	0	0.00	44.00	16.06
Colistin	1	0.36	119.00	43.43
Tigecycline	12	4.38	57.00	20.80

In our study, antibiotic resistance was studied separately for A. baumannii complex and other Non A. Baumannii species .It was noted that A. baumannii isolates are resistant to all pencillins, fluroquinolones, cephalosporins and carbepenems. All isolates are sensitive to PolymyxinB , colistin.tigecycline.

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Table 12: Sensitivity of different antibiotics other than Acinetobacter baumannii

	R		S	
Antibiotics	No	%	No	%
Trimethoprim/Sulphamethoxazole	6	2.19	9.00	3.28
Ciprofloxacin	6	2.19	8.00	2.92
Ofloxacin	5	1.82	1.00	0.36
Levofloxacin	3	1.09	11.00	4.01
Gentamicin	10	3.65	8.00	2.92
Amikacin	9	3.28	7.00	2.55
Netilmicin	8	2.92	8.00	2.92
Tobramycin	7	2.55	9.00	3.28
Cefotaxime/Ceftriaxone	9	3.28	4.00	1.46
Ceftazidime	10	3.65	5.00	1.82
Cefoperazone	9	3.28	5.00	1.82
Cefepime	9	3.28	7.00	2.55
Piperacillin	1	0.36	0.00	0.00
Piperacillin+Tazobactum	7	2.55	8.00	2.92
Cefoperazone+Sulbactum	3	1.09	9.00	3.28
Imipenem	1	0.36	8.00	2.92
Meropenem	2	0.73	7.00	2.55
Aztreonam	3	1.09	4.00	1.46
Polymyxin B	0	0.00	1.00	0.36
Tigecycline	2	0.73	9.00	3.28

No resistance to colistin, polymixin b. tigecycline of Non Baumannii strains of Acinetobacter were seen. Almost sensitive to all pencillins, cephalosporins, carbepenens.

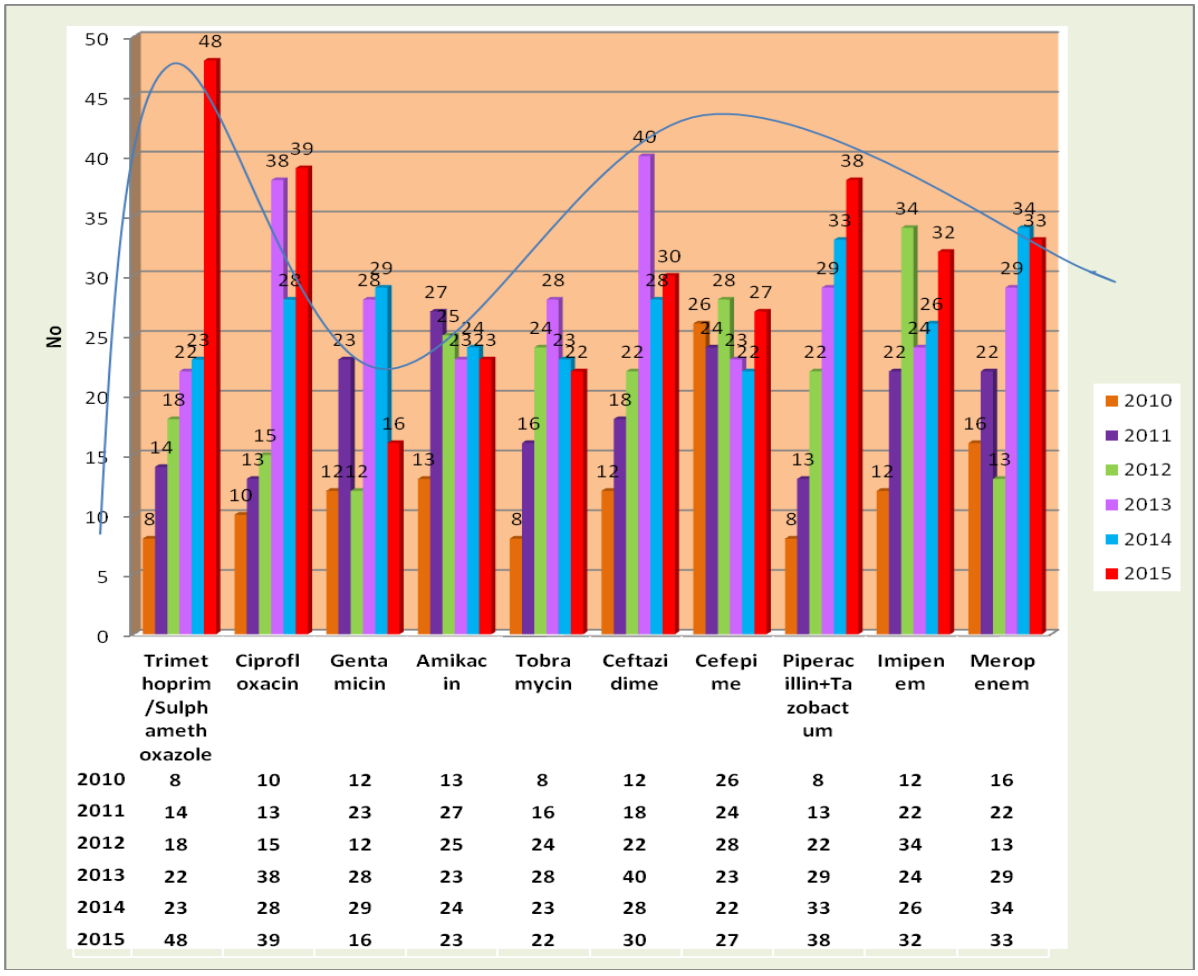

Fig. 12: Trend of Antibiotic resistance in 5 years

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Over a period of 5 years it is observed that there is increase in the resistance to septran, ciprofloxacin, gentamicin, amikacin, to bramycin, ceftazidime, cefipime, piptaz.

IV. FINDINGS

There were 275 kids who tested positive for Acinetobacter species, both baumanii and non-baumanii, during the study period. Neonatal infants younger than one month old made up the majority of them, at 38.71%, followed by children aged 10 to 18 years, at 19.27%.64.23% of the children were male. Newborns and premature neonates make up the majority of the ICU's neonatal and paediatric isolates, which were discovered. Preterm delivery, meconium aspiration syndrome, peri and post natal insult in newborns, prolonged use of broad spectrum antibiotics, surgeries, central venous catheters, and mechanical ventilation in the paediatric age group were the factors that were found to be significantly associated with Acinetobacter infection.

In the study population, the most common diagnoses at admission were meningitis (4.36%), bloodstream infection (2.9%), ASOM (6.36%), and pneumonia (16%).Twelve kids had undergone significant procedures for congenital heart problems, malrotation, ileal perforation, fractured limbs, traumatic brain damage, and laprotomy. Congenital heart disease was observed in 12% of cases, while haematological cancers such AML and ALL were seen in 6.4%. acute renal damage, 4.72 percent.

275 patients had Acinetobacter species isolated. 33.45% of the organisms from blood and 42.12% of the organisms isolated from endotracheal lavage.

In our investigation, the majority of Acinetobacter isolates (178/275) belonged to the A. baumanii species, followed by A. haemolyticus (1.09%), A. lwoffi (2.18%), and A. junii (2.55%). The remaining 29.45% of isolates belonged to other Acinetobacter species, for which species identification was not feasible.

All of the isolated organisms were tested for antibiotic sensitivity.All isolates were divided into two categories based on their in vitro antibiotic sensitivity, A. baumanii and A. non baumanii species.

The strains of A. baumannii that were tested were shown to be quite resistant to a number of the antimicrobial medications (Table 11). Antimicrobial susceptibility testing in vitro revealed polymixin B to be 100% sensitive and colistin to be 99% sensitive. Only 10.9% of strains were carbe-penem sensitive. Gentamicin, ciprofloxacin, and piperacillin-sulbactam each demonstrated 7-8% susceptibility. Cephalosporins of the third and fourth generations shown resistance.

Cephalosporin and gentamicin resistance was observed in non-baumanii strains more so than carbepenem resistance.

43/275 people died total, which was 15.64 percent. Preterm birth, related congenital heart abnormalities, and pneumonia were predictors of mortality linked to Acinetobacter infection.

According to the 5-year study on each antibiotic's resistance pattern, acinetobacter organisms are becoming dramatically more resistant to the antibiotics trimethoprim-sulphamethoxazole, ciprofloxacin, gentamicin, amikacin, tobramycin, imipenem, meropenem, and ceftazidime. The pattern of cefipime resistance showed no variation.

V. DISCUSSION

In recent years, Acinetobacter species have emerged as a significant offender in both the hospital and the community. Numerous antimicrobials are becoming less effective (61).

A. baumannii was discovered to be a significant species among the several acinetobacter species responsible for outbreaks and case reports. Although acinetobacter was found in both wards and the intensive care unit, it was more frequently found there because patients admitted there need invasive operations and are often taking numerous antibiotics.

One of the noteworthy aspects of the outbreaks and our analysis was the prevalence of infections among infants under one month old, primarily those in neonatal intensive care units, which is similar with many previous outbreaks that occurred in NICUs.This implies that preterm and newborn infants are more susceptible to acinetiobacter infections. Therefore, it is crucial to understand the true cause of previous outbreaks and to keep up a proper infection control surveillance.

The most frequent main diagnosis seen in our analysis was pnemonia (16%). Faruk Ekinci et al. (62) reported bacteremia 9 (25.7%), pneumonia 9 (25.7%), central catheter related infection 7 (20%), peritonitis, urinary tract infection, cerebrospinal fluid infection, and post-burn wound infection in their study on children hospitalised in Dr. Behçet Uz Children's Hospital between 2005 and 2011. Similar to other studies, pneumonia was the most frequent clinical manifestation in our study (63, 64).

Numerous risk factors were identified, some of which include the use of long-term invasive procedures and catheters (PICC lines), prolonged ventilation, and broad-spectrum antibiotic use. A continual source of infection is made possible by Acinetobacter's capacity to live for extended periods of time on inanimate surfaces close to the patient (65).

The longer the stay in the ICU, the more exposure there is, and as a result, this has been noted as a risk factor in other research.

Worldwide, the rise of XDR A. baumannii represents a therapeutic challenge. Studies have indicated that Acinetobacter has become less susceptible to antibiotics over time.

The generation of broad-spectrum -lactamases, aminoglycoside-modifying enzymes, changes in outer membrane porins, and modifications to penicillin-binding proteins (PBP) are some of A. baumannii's known antimicrobial resistance mechanisms.

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According to our study (61), polymyxin is the only therapeutic choice for MDR infections in environments with restricted resources.

A glycylcycline antibiotic called tigecycline has good in vitro efficacy against PRA, but it is quite expensive and hard to come by in underdeveloped nations (66).

The overall susceptibility to carbapenems was as high as 95.2% in a fairly recent (prospective, multicenter) American research of nosocomial blood stream infections caused by Acinetobacter species, including A. baumannii, which found barely 10% multi-drug resistance.

In contrast, colistin and polymixn were shown to be the most efficient drugs, being sensitive in >95% of instances, while carbapenems showed just 10% sensitivity in our investigation.

A 28.2% (24/85) mortality rate was what we reported. Mortality rates from earlier research ranged from 17% to 63% (68,69).Preterm babies had increased mortality rates, which may be related to their prolonged need for ventilator support, congenital heart problems, and ICU stays.

VI. CONCLUSION

Pneumonia, bacteremia, and meningitis are the most common symptoms of Acinetobacter infections in children. Acinetobacter infections that are multidrug resistant are still on the rise, mostly affecting neonatal and paediatric intensive care units. The majority of Acinetobacter infections that have been described up to this point are primarily nosocomial; there are just a few papers that mention community-acquired infections from India. Data must be derived from the adult literature because there are almost no studies with reliable methodology to guide therapy options in youngsters. In order to research the risk factors, interventions, and antibiogram of the organisms with a focus on both NICU and PICU, a sizable multicentric study is needed.

There has been an increase in antibiotic resistance across the board. In countries with limited resources, treatment costs increase due to resistance to widely used, affordable oral antibiotics. Acinetobacter strain identification using culture and routine local antibiogram will assist clinicians in understanding the pattern of sensitivity for improved treatment. The spread of infections and MDR/XDR strains can be stopped by maintaining effective infection control surveillance in the ICU and training both the personnel and the clinicians.

Additionally crucial methods are needed in India to advance knowledge of Acinetobacter.

- Acinetobacter infection statistics for India.
- The requirement for quick identification techniques and diagnostic kits
- Tracking research on various antibiotics and resistance.

Studies on the survival of Acinerobacter in the nosocomial environment, genetic research on the pathogenicity of Acinetolmcter.

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