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### RESEARCH ARTICLE

#### MICROBIOLOGICAL PROFILE OF BRONCHOALVEOLAR LAVAGE IN PATIENTS WITH NOSOCOMIAL PNEUMONIA IN NEONATAL INTENSIVE CARE UNIT

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#### Abstract

**Introduction:** Intensive Care Units (ICU) are a major threat to nosocomial pneumonias with children being the most common victims of pneumonia. It is defined as manifestation of infection after 48 hours of hospital admission which can be also attributed to any procedures done to the patient.

**Aim:** To find out the bacteriological profile in pulmonary involvement in the ICU setup and to determine the sensitivity patterns of these bacteria to the antibiotics by doing Bronchoalveolar Lavage (BAL).

**Materials and methods:** Present study was a retrospective study conducted on children aged upto 1 month, who were admitted and ventilated for more than 48 hours and developed ventilator associated pneumonia (VAP) as per CDC criteria with the data collected between a one year period from June 2020 to June 2021 and was conducted at a pediatric tertiary care centre of GMC Srinagar, India. The study included 34 BAL samples received in the laboratory from these patients.

**Results and discussion:** The most common bacteria found out from the 34 BAL specimens was *Acinetobacter baumannii* which accounted to 16 samples (47%) of the entire sample size. It was followed by *Klebsiella pneumonia* from 8 samples accounting to 23%. *Pseudomonas aeruginosa* was the third commonest with 6 samples accounting to 18%. *Escherichia coli* was isolated in 4 of the samples. Colistin was the only antibiotic which was seen uniformly sensitive (100%) among all the organisms isolated which was followed by tigecycline which was sensitive in 78% of isolated organism.

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#### Introduction:-

Bacterial pneumonias are very common in children. Annually, close to 156 million children present with pneumonia within 5 years of birth worldwide. It is estimated that two million cases result in death, of which 95% occur in developing countries. Neonates are at the greatest risk of death from pneumonias as many of the normal lung defenses are not yet fully developed, leading to an increased susceptibility to infection.[1] Additionally, mortality rates are considerably higher among low birth weight neonates compared with normal birth weight neonates. [2, 3,

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4] Ventilator associated pneumonia (VAP) is defined as pneumonia in mechanically ventilated patients, that develops at 48 hours or later after the patient has been placed on ventilator. It is the second most common hospital acquired infection among pediatric/neonatal intensive care unit patients. VAP is further classified as early onset or late onset pneumonia. Early-onset pneumonia occurs within the first 4 days of initiation of mechanical ventilation.[5,6] Overall, VAP occurs in 3 to 10% of ventilated pediatric patients.[7, 8] Etiologic diagnosis is achieved in 30-60% of cases only and by means of an airway sample culture, which is not an easy task in children.[9] Gram-negative bacteria, such as *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*, are the predominant causes of hospital acquired pneumonia(HAP) in the ICUs. Early-onset neonatal pneumonia often develops in utero or within the first week of life and is predominantly caused by Gram-negative bacteria. Gram-negative bacilli are responsible for 30% of nosocomial pneumonias in neonates. In contrast, Gram-positive bacteria are responsible for the largest proportion of HAP later in the neonatal period and many, including methicillin-resistant *S. aureus* (MRSA), coagulase-negative staphylococci (predominantly *Staphylococcus epidermidis*), and vancomycin-resistant enterococci, are multidrug resistant. [10, 11]

Etiological studies of childhood pneumonia are complicated by difficulties in obtaining an accurate microbiological diagnosis, due to the reluctance of physicians to perform invasive procedures such as lung aspiration and bronchoalveolar lavage (BAL) in children, difficulties obtaining adequate sputum samples, and the low yield of pathogens identified from blood cultures.[12] Even in collaborative patients, sample quality is typically insufficient and reflects upper respiratory tract flora only. In respiratory conditions with unfavorable progression, this can be addressed by resorting to fibrobronchoscopy with bronchoalveolar lavage (BAL) for sample collection purposes. This is an invasive technique, which means it requires a specialized cross-disciplinary team, and it is not exempt from complications, so usefulness in children has been called into question. Here the aim of the study was to find out the most common microorganism infecting patients having pneumonia in the neonatal ICU setup and their sensitivity patterns to the antibiotics.

### Materials And Methods:-

Present study was a retrospective study conducted on children aged upto 1 month who were admitted and ventilated for more than 48 hours and developed VAP as per CDC criteria with the data collected between a one year period from June 2020 to June 2021

This study was conducted at a Pediatric tertiary care centre of GMC Srinagar, India. The study included 34 BAL samples received in the laboratory from these patients. BAL samples were received in the microbiology lab of the hospital in a sterile container for cultivation and identification of the microorganism using agars like blood agar, chocolate agar and MacConkey's agar and their sensitivity to the antibiotic spectrum by Kirby Baeur method against colistin, tigecycline, meropenem, imipenem, gentamycin, amikacin, tobramycin, aztreonam, ciprofloxacin, amoxicillin clavulanic acid, piperacillin tazobactam. For culture, a colony count of  $10^4$  CFU/ml of BAL was taken as cut off between organisms causing VAP and colonization. [13]

### Statistical Analysis

All basic statistical calculations like percentage calculation, development of graphs was done using spread sheets.

### Results:-

In this study patients were between 6 to 30 days of age. Out of the total 34 patients studied 20 (58%) were male and 14(42%) were female. Microbiological growth was seen in all of the BAL samples

The most common bacteria found out from the 34 BAL specimens were *Acinetobacter baumannii* which accounted to 16 samples (47%) of the study. The second in line was *Klebsiella pneumonia* isolated from 8 samples accounting to 23%. *Pseudomonas aeruginosa* was the third commonest with 6 samples accounting to 18%. *Escherichia coli* was isolated in 4 of the samples i.e. 12%. (Fig 1)

Comparing the antibiotic spectrum, the entire 16(100%) samples of *Acinetobacter baumannii* showed sensitivity for Colistin, 10 (62.5%) samples for Tigecycline. None of the strains of *Acinetobacter baumannii* showed sensitivity to other tested drugs ie meropenem, imipenem, gentamycin, amikacin, tobramycin, aztreonam, ciprofloxacin, amoxicillin clavulanic acid, piperacillin tazobactam. Similarly all strains of *klebsiella pneumonia* were sensitive to colistin and 50% showed sensitivity to tigecycline. All other antibiotics tested were resistant. Among the

*pseudomonas* strains isolated colistin, tobramycin, meropenem and aztreonam were 100% sensitive and all strains of *escherschia coli* were sensitive to colistin and tigecycline only.

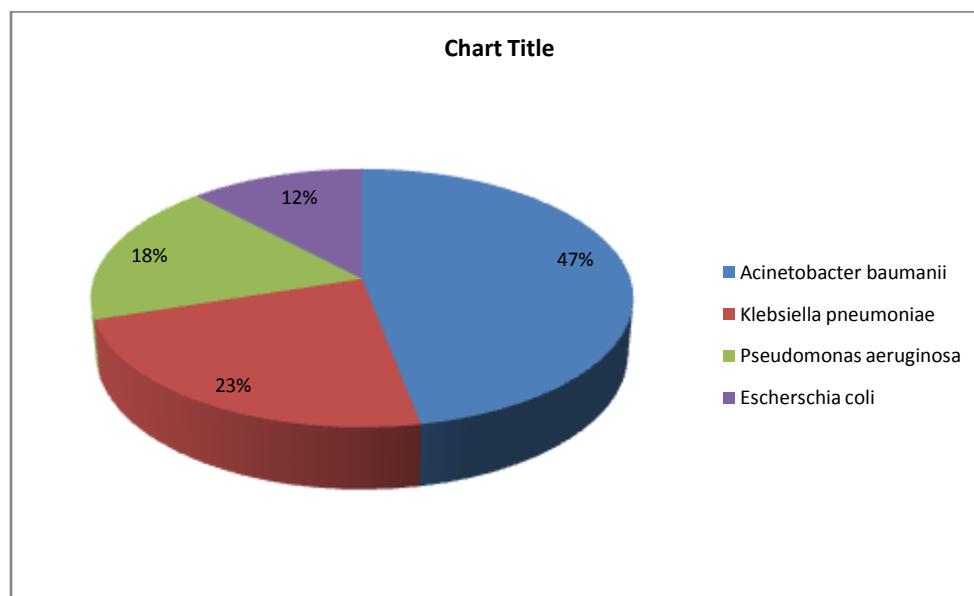
### Discussion:-

BAL is an invasive technique used in patients with already decreased respiratory function. However, it is considered not to entail any more severe risks apart from fibrobronchoscopy itself [14] and it is well-tolerated even in patients with respiratory insufficiency.[15]

The aim of the study was to find out the most common microorganism infecting patients having pneumonia in the neonatal ICU setup and their sensitivity patterns to the antibiotics by doing BAL culture/sensitivity testing of 34 samples. A study done by Johanson WG et al., on the bacteriologic diagnosis of nosocomial pneumonia following prolonged mechanical ventilation, he compared different specimens like tracheal aspirates, BAL, Protected-Specimen Brush (PSB) samples, and direct lung aspirates with cultures of lung homogenates with histological findings of intubated baboons and showed that BAL contributed the precise outlook of the bacterial burden of pulmonary infections. [16] Moreover, the American Thoracic Society and the infectious diseases society of America have issued evidence based guidelines that support the use of quantitative culture of bronchoscopically collected lower respiratory tract secretions for the aetiological diagnosis of VAP. [17] Such interventions facilitate early medical interventions by initiating appropriate antibiotic regimens or by indicating the need to search for an alternative cause when findings are negative

Most common organism isolated was *Acinetobacter baumannii* in 16 (47%) followed by *klebsiella pneumoniae* in 8 (23%) and *Pseudomonas aeruginosa* in 6 (18%) cases and *e coli* in 4 (12%). Our study results were in concordance with results obtained by Mahantesh et al where *Acinetobacter* was the predominant isolate in 62.1% cases followed by *Pseudomonas aeruginosa* in 31%. [18] The predominance of gram negative bacterial isolation, with the most common organism being *Acinetobacter* spp (54.5%), was observed in study conducted by Patra et al.[19] In the study done by Meenakshi Sharma et al *Acinetobacter* was reported in 37.5% cases and *Kliebsella* in 27.5% cases.[20] Colistin was the only antibiotic which was seen uniformly sensitive (100%) among all the organisms isolated which was followed by tigecycline which was sensitive in 78% of isolated organism other than *pseudomonas* wherein it shows intrinsic resistance and it was also seen that all of these strains isolated were multidrug resistant. Similar results were seen in a study done by Vijay et al. [21]

Further it was also seen that colistin and tigecycline were the two antibiotics which all the patients were receiving empirically however after receiving the culture report of 8 patients from whom *pseudomonas* was isolated tigecycline was replaced with antipseudomonal antibiotic



**Fig 1:-** Percentage yield of each organism from 34 BAL samples.

### Conclusion:-

In an ICU setup, nosocomial infections are a major threat especially VAP showing increasing levels of multidrug resistance pathogens. As per the study *Acinetobacter* was the most common organism isolated from ventilator associated pneumonia patients with a high percentage of resistant strains followed by *Klebsiella* and *Pseudomonas*. Hence, with the knowledge of the commonest organism isolated along with their resistance pattern to the antibiotics, each institution can phrase their own antimicrobial policy for treatment of nosocomial pneumonia especially Ventilator associated pneumonia depending on their local evidence

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