



## ORGANISMS CAUSING VENTILATOR ASSOCIATED PNEUMONIA IN PAEDIATRIC PATIENTS OF HEAD TRAUMA- A PROSPECTIVE OBSERVATIONAL STUDY.

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### ABSTRACT

Ventilator associated pneumonia (VAP) is the infection of the pulmonary parenchyma with onset after 48–72 hours of endotracheal intubation. VAP increases hospital stay and extra cost of the patient. It also increases mortality. In Paediatrics and neonatology, the frequency of VAP is 3–19%, with a mortality rate ranging from 10 to 20% of patients. The aim of this study is to determine the commonest bacterial species in children who are mechanically ventilated for indication of head trauma in tertiary care teaching hospital having facility of NICU and PICU. The study was conducted in a tertiary care hospital. It was an observational study of 3 months. The patients, who had a new pulmonary infiltration, satisfied 2 or more conditions among the cases of body temperature 38.3oC or higher, purulent bronchial secretions, and a leukopenia or leukocytosis (<5,000 or >10,000 mm<sup>3</sup>), they were diagnosed with pneumonia. Specimens were collected from all patients with ET tip culture. Once the specimens were obtained, the sample was sent for gram stain, culture and sensitivity. Total of 50 patients were included in the study. 20 patients were below age of one year, 16 patients were in the age group of 1-10 years while 14 were above 10 years of age. *Acinetobacter baumannii*, *klebsiella pneumoniae* and *candida* species were found in patients. Mixed infection was also seen in 1/4th of the patients enrolled. Knowledge of risk factors for VAP may be useful in implementing simple and effective preventive measures. As mixed infection is on the rise, routine hygiene of respiratory tract and endotracheal tube with complete asepsis is required to reduce the VAP.

**KEYWORDS :** Ventilator associated pneumonia, *Acinetobacter baumannii*, *klebsiella pneumoniae*, mixed infections, ICU

### INTRODUCTION

Pneumonia is considered as one of the serious public health problem which results from an infectious process of the lower airways through aspiration or inhalation of pathogenic microorganisms.<sup>1</sup> According to the guidelines of the American Thoracic Society, hospital pneumonia is divided into ventilator-associated pneumonia (VAP), and the one that occurs in non hospitalized patients, but that have constant contact with health services. Ventilator-associated pneumonia (VAP) is defined as pneumonia that occurs 48–72 hours or thereafter following endotracheal intubation. It is characterized by the presence of a new or progressive infiltrate, signs of systemic infection (fever, altered white blood cell count), changes in sputum characteristics, and detection of a causative agent.<sup>2</sup> It is considered most common in mechanically ventilated patients and second most common nosocomial infection in the intensive care unit (ICU).<sup>3,4</sup> VAP is the infection of the pulmonary parenchyma with onset after 48–72 hours of endotracheal intubation. It is usually classified as early onset and late onset pneumonia. Early-onset VAP occurs during the first 4 days of mechanical ventilation and is caused by antibiotic sensitive bacteria whereas late-onset VAP occurs on 5 or more days of mechanical ventilation and is caused by multidrug resistant pathogen.<sup>5</sup> Mortality due to VAP is high, principally because of the association with multidrug-resistance (MDR) bacteria.<sup>6</sup> In Paediatrics and neonatology, the frequency of VAP is 3–19%, with a mortality rate ranging from 10 to 20% of patients.<sup>7</sup> VAP increases hospital stay and extra cost of the patient. It also increases mortality which is more due to late onset pneumonia caused by *Acinetobacter* or other gram negative bacilli. The aim of this study is to determine the commonest bacterial species in children who are mechanically ventilated for indication of head trauma in tertiary care teaching hospital having facility of NICU and PICU.

### MATERIAL AND METHOD

The study was conducted in a tertiary care hospital. It was an observational study of 3 months. Patient who were mechanical

ventilated for 48 hours or more in the age group from new born to 16 years with head trauma and those who have given consent were included in the study. Patients who were put on mechanical ventilation of less than 48 hours and patients who have given negative consent were excluded from the study. Endotracheal tube used is of smith medicals protex company. Mechanical ventilation used is of maquet with variant of servo i and servo s. Pneumonia was diagnosed by chest radiograph and clinical and laboratory findings. If the patients, who had a new pulmonary infiltration, satisfied 2 or more conditions among the cases of body temperature 38.3oC or higher, purulent bronchial secretions, and a leukopenia or leukocytosis (<5,000 or >10,000 mm<sup>3</sup>), they were diagnosed with pneumonia.<sup>8</sup> Age and gender of the patient, a history of antibiotic therapy before hospitalization, a history of hospitalization in other hospitals, concurrent diseases, causative pathogens, antibiotic resistances, and mortality were retrospectively examined.

Specimens were collected from all patients with ET tip culture. Once the specimens were obtained, the sample was sent for gram stain, culture and sensitivity.

### RESULTS

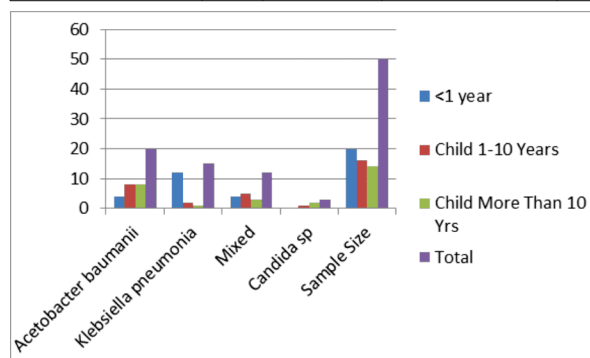
Total of 50 patients were included in the study. 20 patients were below age of one year, 16 patients were in the age group of 1-10 years while 14 were above 10 years of age. *Acinetobacter baumannii*, *klebsiella pneumoniae* and *candida* species were found in patients. Mixed infection was also seen in 1/4<sup>th</sup> of the patients enrolled.

*Acinetobacter baumannii* and *klebsiella pneumoniae* were commonest. *Acinetobacter baumannii* was found in 20 patients, *klebsiella pneumoniae* was seen in 15 patients, mixed infection was seen in 12 patients while *candida* species were seen in 3 patients. (Table-1).

In age less than 1 year, *klebsiella* was commonest. *Candida* species was also seen in children age more than 10 years.

**Table-1. Organisms found in patients with VAP**

	<1 year	Child 1-10 Years	Child More Than 10 Yrs	Total
Acinetobacter baumannii	4	8	8	20
Klebsiella pneumonia	12	2	1	15
Mixed	4	5	3	12
Candida sp	0	1	2	3
Sample Size	20	16	14	50



## DISCUSSION

VAP in patients of head trauma is generally caused by bacteria, whereas fungi and viruses are rarely involved<sup>2,3</sup>. Generally, early-onset VAP is caused by pathogens more susceptible to antibiotics, including *Streptococcus pneumoniae*, *Haemophilus influenzae*, and methicillin-susceptible *Staphylococcus aureus*. On the other hand, late-onset VAP is usually caused by antibiotic-resistant bacteria, such as *Pseudomonas aeruginosa*, *Acinetobacter* spp., methicillin-resistant *Staphylococcus aureus* (MRSA), and extended-spectrum  $\beta$ -lactamase producing Enterobacteriaceae, such as *Klebsiella pneumoniae*, *Escherichia coli*, *Enterobacter* spp., among others<sup>5,9,10</sup>. However, some studies have reported that both susceptible and antibiotic-resistant microorganisms can have similar frequencies in early and late-onset VAP<sup>11, 12</sup>. In many cases, VAP can be caused by more than one pathogen (polymicrobial infection)<sup>13</sup>.

The aetiology of VAP varies in different countries and even between ICUs of the same city, in patients groups like the ARDS patients, immunocompromised, or settings of the same hospital<sup>14</sup>. However, among Gram-negative bacteria, a high frequency is generally reported for *P. aeruginosa*, *Acinetobacter* spp., and Enterobacteriaceae members. Among Gram-positive isolates, *Staphylococcus aureus* and *Streptococcus* spp. are considered as important pathogens.<sup>2,9,13,15</sup>

In our study *Acinetobacter baumannii*, *klebsiella pneumonia* and *candida* species were found in patients. Mixed infection was also seen in 1/4th of the patients enrolled. *Acinetobacter baumannii* and *klebsiella pneumonia* were commonest.

*Acinetobacter baumannii* is a Gram-negative bacterium, strictly aerobic, non fermentative coccus-bacillus, non-motile, non-pigmented, and catalase-positive. It is ubiquitous in nature and has been recovered from soil, water, and animals and found as part of the normal skin, throat, and rectal flora of human. Although a frequent colonizer, *Acinetobacter baumannii* can be the cause of severe and sometimes lethal infections, frequently of nosocomial origin, principally VAP.

A survey in U.S. hospitals showed that the majority of the isolates (57.6%) were from the respiratory tract, and *Acinetobacter* species ranked fifth as the causative organism

of VAP (6.6%)<sup>16-18</sup>. A recent systematic review and meta-analysis showed that some invasive procedures frequently used in the ICU increase the risk of *Acinetobacter baumannii* bacteraemia: mechanical ventilation, central venous or urinary catheterization, and nasogastric tube use<sup>19,20</sup>.

*Klebsiella pneumoniae* is generally considered an opportunistic pathogen that affects mainly immuno-compromised individuals. It can be found normally in the intestine, oral cavity, and skin, as well as in hospital settings and medical devices<sup>21</sup>. *Klebsiella pneumoniae* is able to form biofilms in catheters and endotracheal tubes, which represent major sources of infection in patients with invasive devices.<sup>22</sup> Infections by *Klebsiella pneumoniae* that involves bio film formation tend to be persistent or chronic, since the biofilm protects the pathogen of the host immune response and also of the antibiotic action<sup>23</sup>. An additional risk factor for chronic infections caused by nosocomial strains includes resistance to multiple antibiotics, making difficult for the choice of suitable antibiotics for the treatment<sup>24</sup>.

Most studies on causative pathogens have been conducted in western countries, and few studies have been conducted in India. According to the SENTRY antimicrobial surveillance program operated in US, Europe and South America, *Pseudomonas aeruginosa* (27%) is the most common causative pathogen taken all regions together, and *S. aureus* (20%), and *Acinetobacter* species (14%) follow *P. aeruginosa* in that order<sup>25</sup>. Meanwhile, according to a study on the causative pathogens of nosocomial pneumonia in Asia, *Staphylococcus aureus* (27%) was the most common causative pathogen of nosocomial pneumonia, and *Acinetobacter* species (16%), *Pseudomonas aeruginosa* (14%), and *Klebsiella pneumoniae* (9%) followed *Staphylococcus aureus* in that order<sup>26</sup>.

However in the recent studies done in India, VAP is predominantly caused by gram negative organisms especially *Acinetobacter* species<sup>27,28</sup>. Our results are similar to study done by Ghosh et al.<sup>28</sup> where *Acinetobacter baumannii* (37.63%) and *Klebsiella pneumonia* (36.55%) were the commonest organisms. Similar results were shown in the study done by Patil et al.<sup>29</sup> where Gram-negative organisms *Klebsiella*, *Pseudomonas* and *Acinetobacter* were the most commonly isolated organisms with high mortality rates. Similarly in the study done by Pawar et al.<sup>30</sup> the most common pathogens isolated were *Pseudomonas aeruginosa*, *E. coli*, *Klebsiella pneumoniae*, *Staphylococcus* species, and *Acinetobacter* species with mortality rate of 16%.

Our study also found *candida* species in 3 patients. Infection caused by *candida* species is an increasingly important complication experienced by immunosuppressed and critically ill patients.<sup>31</sup> Although *Candida* species were isolated from bronchoscopic specimens in a study done by Rello and colleagues<sup>32</sup> its occurrence is not much reported in literature.

## CONCLUSION

This study was conducted to investigate the causative pathogens in the tertiary care hospital. Total of 50 patients took part in the study. As a result *Acinetobacter baumannii* was found in 20 patients, *klebsiella pneumonia* was seen in 15 patients, mixed infection was seen in 12 patients while *candida* species were seen in 3 patients. VAP is a fatal disease with a high mortality. An appropriate and judicious use of antibiotic is recommended to treat VAP, empirically. Knowledge of risk factors for VAP may be useful in implementing simple and effective preventive measures. As mixed infection is on the rise, routine hygiene of respiratory tract and endotracheal tube with complete asepsis is required to reduce the VAP. An action plan and a goal oriented strategy

to reduce VAP should be formulated as the organism which are resistant to most of the antibiotics are on the rise.

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