ORIGINAL ARTICLE

DEVELOPMENT OF BACTEREMIA IN VENTILATOR ASSOCIATED PNUEMONIA PATIENTS AT A TERTIARY CARE HOSPITAL, GUJARAT- A PROSPECTIVE STUDY

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ABSTRACT

Ventilator Associated Pneumonia (VAP) is second most common cause of nosocomial infection. It also increases length of stay in hospital & cost for the patient. The 'American Thoracic Society' guidelines for Hospital Acquired Pneumonia recognize that when bronchoscopy is not performed blood cultures may be of value both to isolate an etiologic agent & define severity.

Aim: The present study was carried out to measure the prevalence of bacteremia in pt. with VAP.

Methodology: In this prospective study 100 patients aged 0-12 years, admitted in ICU & put on ventilator at S.S.G.Hospital, Vadodara from 1st Sep. 2010 to 31st September 2011 were enrolled. The Endotracheal secretion culture & Blood culture were performed after 48hrs of ventilation. The samples were processed as per standard microbiological methods. In case of ET secretion culture, $>10^6$ cfu/ml was considered significant for the presence of bacteremia.

Result: Of total 100 patients, 85 were Endotracheal secretion culture positive. Blood culture was positive in 38 of these 85 patients. Out of these 38 patients 30 (79%) patients showed the same organism as was recovered from the Endotracheal secretion culture. VAP was developed in 85% of patients (85 of 100) & bacteremia was present in 44% of VAP patients but 30 out of 38 (79%) cases of bacteremia were of pulmonary origin.

Conclusion: The presence of Bacteremia in the patients with Hospital Acquired Pneumonia is considered to have important role for defining the aetiology.

Keywords: Bacteremia, ventilator associated pneumonia, nosocomial infection

INTRODUCTION

Ventilator Associated Pneumonia is defined as pneumonia occurring in a patient within 48 hours or more after intubation with an endotracheal tube or tracheostomy tube and which was not present before [1].

Ventilator Associated Pneumonia is the second most common Nosocomial infection after urinary tract infection in paediatric intensive care unit patients accounting for 20% of nosocomial infection in this population**.** The 'National Nosocomial Infection Surveillance' (NNIS) reported that this incidence differs from that in adult ICUs where urinary tract infections were most frequent (31%), followed by pneumonia (27%), and primary bloodstream infections (19%). The pneumonia rate was 6–21 fold higher for patients receiving ventilator support than for those not requiring mechanical ventilation and also intubations to independently increase the risk of nosocomial pneumonia sevenfold in adults[2].

Langer and co-workers divided Ventilator Associated Pneumonia into early onset Ventilator Associated Pneumonia which occurs within 5 days of mechanical ventilation and late onset Ventilator Associated Pneumonia, which develops five or more days after initiation of mechanical ventilation. The importance of segregating Ventilator Associated Pneumonia into early and late is that, the pathogenesis, microorganisms responsible and outcome in these two groups are different and so the therapeutic implications also differ. Early onset Ventilator Associated Pneumonia results from aspiration of endogenous community acquired organisms e.g. *S. pneumoniae*, *H. influenzae*, and other organisms (aerobic gram negative bacilli). Late onset Ventilator Associated Pneumonia is more severe and results usually from aspiration of gastric/oropharyngeal

secretions and caused by potentially drug resistant organisms like methicillin resistant staphylococcus aureus (MRSA) and Pseudomonas [3].

It also increases length of stay in hospital & cost for the patient. [3] The American Thoracic Society guidelines for Hospital Acquired Pneumonia recognize that when bronchoscopy is not performed blood cultures may be of value both to isolate an etiologic agent & define severity[4]. When a microorganism is isolated from a blood culture in a patient with pneumonia, that organism is the likely etiologic pathogen. Even in complex circumstances, such as nosocomial ventilator-associated pneumonia (VAP), if a non-pulmonary infection is absent, then a positive blood culture is considered presumptive evidence of an exact etiologic diagnosis.[4]

The present study was carried out to review various methods of diagnosis of VAP and also to measure the prevalence of bacteremia in patient with Ventilator Associated Pneumonia which plays role in defining etiology, improving patient management and outcome.

MATERIAL AND METHODS

However, so far, no universally accepted optimal techniques or gold standard has been documented for the diagnosis of VAP [2]. On the other hand, an incorrect diagnosis may lead to unnecessary treatment and subsequent complications related to therapy]. Early, accurate diagnosis is, therefore, fundamental in the management of patients with VAP [5].

Several criteria have been proposed for diagnosing VAP in clinical settings, including clinical manifestations, imaging techniques, methods to obtain and interpret bronchoalveolar specimens, and biomarkers (Elastin fibre, Procalcitonin, C-Reactive protein) of host response. Due to the lack of an acceptable gold standard, the accuracy of these methods in diagnosing VAP is controversial.[5]

Advantages and disadvantages of invasive and non-invasive techniques are summarized below [2]

Table 1: Advantages and disadvantages of invasive and non-invasive techniques [2]

Methods	Advantages	Disadvantages
Nonquantitative cultures	-Noninvasive -Inexpensive -Gram stain may be helpful for initial antibiotic treatment and interpretation of culture results	-False positive results that may lead overdiagnosis -Increased inappropriate antibiotic use that may lead increased mortality compared with quantitative microbiology
Quantitative endotracheal aspirate analysis	-Noninvasive -Gram stain may be helpful -No requirement for qualified personnel -Less expensive than bronchoscopy and non-bronchoscopic BAL 65% correlation with bronchoscopy with PSB or BAL, but less specific -Good negative predictive value	-Potential sampling errors -Threshold for diagnosis varies among studies; difficulty with sputum processing
Nonbronchoscopic (blind) BAL/PSB	-Easily done at bedside -Protected from orotracheal contamination -Less expensive than bronchoscopy -Safe in paediatric patients -Best concordance with bronchoscopic BAL	-Special skills required -Limited data for comparison -Lack of airway visualization
Bronchoscopic BAL/PSB	-Can observe sampling site Specificity >95% -Greater sensitivity for 10^3 CFU/mL for PSB and 10^4 CFU/mL for BAL -Cytocentrifugation may be helpful for early identification of cause. -May decrease antibiotic use and development of resistance -Useful in immunocompromized and non-responding patients	-Requirement for qualified personnel -Antibiotic use in last 24 hours may decrease sensitivity -False-negative results in early cases -Need quantitative bacteriology and meticulous and prompt processing of specimens -Much expensive Increased complication rate

BAL: Bronchoalveolar lavage; PSB: Protected specimen brush; CFU: Colony-forming unit.

Centres for Disease Control and Prevention criteria for diagnosing pneumonia[6] are summarized below:

- **Centers for Disease Control and Prevention (CDC)**

• **Radiology signs**

Two or more serial chest radiographs with at least 1 of the following:

- New or progressive and persistent infiltrate

- Consolidation
- Cavitations

• Clinical signs

At least 1 of the following:
- Fever (temperature > 38 C)
- Leukopeni a (< 4000 WBC) or leukocytosis (> 12000 WBC)
- Altered mental status, for adults 70 years or older, with no other recognized cause

In addition at least 2 of the following:-
- New onset of purulent sputum, or change in character of sputum
- Increased respiratory secretions, or increased suctioning requirements new-onset or worsening cough or dyspnea or tachypnea
- Rales or bronchial sounds
- Worsening gas exchange
- Increased oxygen requirements

• Microbiological criteria

At least one of the following:
- Positive growth in blood culture not related to another source of infection
- Positive quantitative culture from bronchoalveolar lavage (> 10^4) or protected specimen brushing (> 10^3)
- Five percent or more of cells with intracellular bacteria on direct microscopic examination of Gram-stained bronchoalveolar lavage fluid
- Histopathological evidence of pneumonia

In this prospective study 100 patients aged 0-12 years, admitted in ICU & put on ventilator at paediatric department, S.S.G.Hospital, Vadodara from Sep. 2010 to September 2011 were enrolled. The Endotracheal secretion culture & Blood culture were performed after 48 hrs of ventilation.

After proper hand washing and wearing sterile gloves before suctioning, the endotracheal secretions were collected from the endotracheal tube with the help of sterile mucous trap. The specimen collected was immediately transported to the laboratory within one hour of collection. Sample collected at night was stored at 4 degree centigrade overnight and send to the laboratory by 10 am next day morning.

Also all the specimens are collected after satisfaction of clinical criteria according to CDC GUIDELINES.

There was a limitation in the sampling procedures used to obtain microbiologic specimens from the small respiratory tract in our study, in that invasive techniques to distinguish infection from colonization are not practical or feasible and may be harmful in small infants. They can impair blood-gas exchange, delay treatment, and lead to sepsis.

The samples were processed as per standard microbiological methods. Both Specimens are taken prior to start next scheduled antibiotic dose. In case of Endotracheal secretion culture, >10^6 cfu/ml was considered significant for the diagnosis of VAP[6]. Organisms causing Ventilator Associated Pneumonia are isolated and recorded. Details of patients like name, age, sex, hospital ID no., probable diagnosis, cause of putting patient on Ventilator are recorded. Finally data of Endotracheal secretion culture and Blood culture are compared.

RESULTS

Total 100 patients were enrolled. Out of 100, endotracheal secretion culture was positive in 85 patients. Following organisms were isolated. (Table 2)

Table 2: List of Isolated Organism

Name of organism	No. of organism (n=85) (%)
Klebseilla spp.	39 (45.8)
Acinetobacter spp.	20 (23.5)
Escheresia coli	6 (7.0)
Pseudomonas spp.	8 (9.4)
Candida spp.	2 (2.3)
Proteii group	3 (3.5)
Gram positive cocci	7 (8.2)

Total Blood culture was positive in 38 patients, which includes both endotracheal secretion cultures positive and negative. The organisms isolated from the Blood culture are as follows.

Table 3: List of Organism Isolated from Blood Culture

Name of organism	Endotracheal culture positive (n =85)	Blood culture positive (n =38) (44%)
Klebseilla spp.	39	22
Acinetobacter spp.	20	9
Escheresia coli	6	5
Pseudomonas spp.	8	4
Candida spp.	2	00
Proteii group	3	1
Gram positive cocci	7	3

In this prospective study prevalence of Ventilator Associated Pneumonia was 85% (85 of 100). Blood culture was positive in 44% (38 of 85) of the patients. Out of 38, pulmonary origin Bacteremia (in which both endotracheal secretion culture and blood culture were positive for same organism) was present in 30 patients (79%). Bacteremia due to non pulmonary origin (in which both endotracheal secretion culture and blood culture was positive but for different organism) was present in 8 patients (21%).

DISCUSSION:

The presence of bacteremia in patients with community- acquired pneumonia is considered to have a high positive predictive value for defining the etiology. However, in patients with nosocomial pneumonia, the relationship of bacteremia to pneumonia etiology is less certain, particularly since some of these patients can have multiple sites of infection simultaneously. Overall, bacteremia has been reported in patients with nosocomial pneumonia at a rate between 10 % and 31% [4]

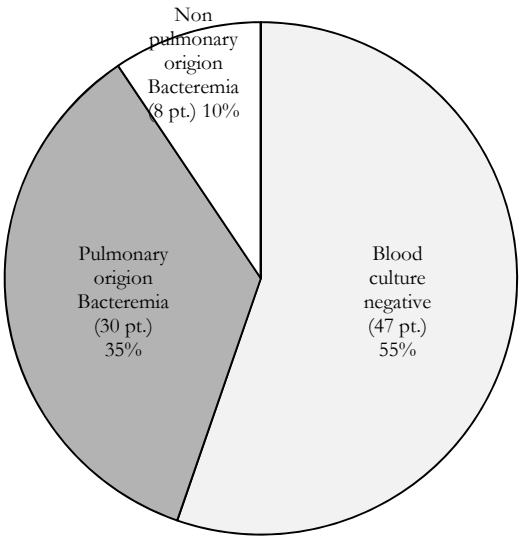

Fig 1: Distribution of samples according to origine

Overall, the sensitivity of blood cultures is less than 25%, and when positive, the organisms may originate from an extrapulmonary source in a large percentage, even if VAP is also present. Although an etiologic diagnosis is made from a respiratory tract culture, colonization of the trachea precedes development of pneumonia in almost all cases of VAP, and thus a positive culture cannot always distinguish a pathogen from a colonizing organism. However, a sterile culture from the lower respiratory tract of an intubated patient, in the absence of a recent change in antibiotic therapy, is strong evidence that pneumonia is not present, and an extrapulmonary site of infection should be considered. [7]

Blood Culture in the patients with Ventilator Associated Pneumonia is useful if there is suspicion of another probable infectious condition and also isolation of a microorganism in the blood that does not confirm that microorganism as pathogen causing Ventilator Associated Pneumonia. so The presence of Bacteremia in the patients with Hospital Acquired Pneumonia is considered to have important role for defining the aetiology.[8] So blood culture should be included as a routine investigation for the patients of VAP admitted in ICU.

Further study is needed to focus on practical issues to develop more reliable and less invasive diagnostic techniques and tools, and to search for safer and more cost-effective procedures in newborn infants[8]

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