# To define usefulness of blood culture in microbiological diagnosis of ventilator-associated pneumonia (VAP)

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## Abstract

**Background and Objectives:** The rate of positive blood culture in ventilator- associated pneumonia (VAP) ranges from 8-20% and some studies report that bacteremia is not always related to pulmonary infection. The present study was undertaken to assess the usefulness of blood culture in microbiological diagnosis of VAP.

**Material and Methods:** The study was carried out in the Department of Microbiology, Dr. Ulhas Patil Medical College for a period (January 2013 to December 2014). 85 patients receiving mechanical ventilation hospitalized for more than 48 hrs, were evaluated for VAP.

Endotracheal aspirate (ETA) and blood culture performed after establishing a clinical diagnosis of VAP using mucus extractor and 2 set of blood culture bottles (Himedia Mumbai) was used respectively. A growth of organism more than $10^5$ cfu/ml was considered as microbiological VAP while less than $10^5$ cfu/ml was considered as not significant or commensal growth. Bacteremia was diagnosed when both 2 set of blood culture yields a microorganism or when only one set was positive but same microorganism was present in ETA in concentration more than $10^5$ cfu/ml.

**Result:** 39(45%) patients were ETA positive and remaining 46(55%) does not yield any significant growth of microorganisms while in blood culture only 12(14.11%) shows same isolate that were found in ETA culture while in 10(11.76%) blood culture microorganism were found which were not the same microorganism isolated from ETA culture and were considered as extra pulmonary source.

**Conclusion:** Blood culture have limited value in microbiological diagnosis of VAP. ETA shows 45% positive culture while blood culture yields only 25.88% positive culture. Blood culture may be useful in finding extrapulmonary source of infection associated with VAP.

**Key Words:** Blood Culture, Ventilator Associated Pneumonia, Bacteremia

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|---|---|
| Quick Response Code: | Website: www.innovativepublication.com |
| | DOI: 10.5958/2394-5478.2016.00027.3 |

## Introduction

Blood is cultured to detect and identify bacteria and other cultivable microorganism and our classical teaching is that when microorganism is isolated from blood culture in a patient that organism is likely the etiological pathogen[1,2].

The presence of bacteremia in patients with community-acquired pneumonia is considered to have a high predictive value for defining the etiology, however in patients with nosocomial ventilator-associated pneumonia the relationship of bacteremia to pneumonia etiology is less certain[3,4,5].

Overall rate of positive blood culture in VAP ranges from 8-20% and some studies reports that bacteremia in this patients is not always related to pulmonary infection and may have other additional source of infection[6,7,8].

Ventilator –associated pneumonia (VAP) is an important form of hospital acquired pneumonia and it refers to pneumonia developing in mechanically ventilated patients for more than 48hrs after tracheal intubation or tracheostomy[9,10].

So the present study was undertaken to assess the usefulness of blood culture in diagnosis of ventilator-associated pneumonia.

## Material and Methods

The study was conducted in Department of Microbiology, Dr. Ulhas Patil Medical College and Hospital, Jalgaon Maharashtra.

A total 85 patients admitted in ICU of medicine and surgery were evaluated for a period of 1 years (January 2013 to December 2014).

**Selection of patient**: Patients who were on mechanically ventilation for more than 48hrs and ventilator associated pneumonia was suspected when new and persistent pulmonary infiltrate appeared on chest radiograph and have atleast two of the following criteria:

1. Fever≥38˚c 2. Leucocytosis ≥ 10000mm$^3$ 3. Purulent tracheal secretion

**Collection of endotracheal aspirate(ETA):** Patients who fulfilled above criteria, ETA was collected using Romson's mucus extractor and was immediately transported to Department of microbiology for further processing. **Fig. 1**

**Microbiological processing:** The samples were than plated on Blood agar(BA),Chocolate agar(CA), Mac Conkey agar(MA) by using 4mm Nichrome wire loop (Himedia, Mumbai) all plates incubated overnight at 37˚c and candle jar(5%-10%)for chocolate agar.

For definitive diagnosis of VAP in this study quantitative culture threshold was considered as $10^5$ cfu/ml.[11,12,13,14]

**Collection of blood:** With all aseptic precautions blood was collected in blood culturing bottles (Himedia, Mumbai) and dilution of 1:10 was considered, two set of such blood culturing bottle was used from two different venepuncture[1,15] and immediately transported to department of microbiology and incubated at 37˚c. **Fig. 2**

**Microbiology processing:** After 24 hrs incubation first subculture was done, the culture plates were inspected for any growth, in absence of growth the bottle were again incubated, the second subculture was done on 4 day while the third subculture was done on 7 day and if no growth occurs bottles were discarded.

Subculture was done on culture plates similarly done for ETA.

**Bacteremia** was diagnosed on the basis of following:

- When both set of blood yields the same micro-organism
- When only one set is positive but the same bacteria is isolated in concentration in ETA culture[1,15].

## Results

A total 85 patients were evaluated in the period from January 2013 to December 2014. Quantitative culture results were significant ($10^5$ cfu/ml) for pathogenic organism causing VAP in 39(45%) patients. Forty six (55%) did not have VAP this 46 clinically suspected cases quantitative culture of ETA showed colony count $<10^5$ cfu/ml(Table 1).

In case of blood culture, 22(25.88%) case of bacteremia is seen, of which only 12(14.11%) blood culture came positive which were same organism isolated in ETA culture of patients. While remaining 10(11.76%) cases the isolates were not the same organism isolated in ETA and considered as extrapulmonary source(Table 2).

**Table 1: Microbial Investigations**

| Investigation | Performed | Positive | Negative | Percentage of positivity |
|---|---|---|---|---|
| ETA | 85 | 39 | 46 | 45.00% |
| Blood culture | 85 | 22 | 63 | 25.88% |

ETA- Endotracheal aspirate

**Table 2: Comparison of Blood culture positivity with ETA culture**

| Patients | ETA culture | Blood culture |
|---|---|---|
| 1 | Klebsiella pneumonia<br>Streptococcus pneumoniae<br>**Pseudomonas aeruginosa** | **Pseudomonas aeruginosa** |
| 2 | **Pseudomonas aeruginosa** | **Pseudomonas aeruginosa** |
| 3 | Staphylococcus aureus<br>**Escherichia coli**<br>Acinetobacter spp | **Escherichia coli** |
| 4 | Staphylococcus aureus<br>Pseudomonas aeruginosa | Klebsiella spp |
| 5 | Escherichia coli | Staphylococcus aureus |
| 6 | Escherichia coli<br>**Klebsiella pneumonia** | **Klebsiella pneumonia** |
| 7 | Klebsiella pneumonia | Pseudomonas aeruginosa |
| 8 | Staphylococcus epidermidis<br>**Acinetobacter spp** | **Acinetobacter spp** |
| 9 | Escherichia coli | Pseudomonas aeruginosa |
| 10 | Pseudomonas aeruginosa<br>Staphylococcus epidermidis<br>Staphylococcus aureus | Escherichia coli |
| 11 | **Pseudomonas aeruginosa** | **Pseudomonas aeruginosa** |
| 12 | Staphylococcus aureus | Escherichia coli |
| 13 | **Pseudomonas aeruginosa**<br>Staphylococcus aureus | **Pseudomonas aeruginosa** |
| 14 | Pseudomonas aeruginosa<br>Klebsiella pneumonia | Staphylococcus epidermidis |

| | | |
|---|---|---|
| 15 | **Pseudomonas aeruginosa**<br>Acinetobacter spp | **Pseudomonas aeruginosa** |
| 16 | Staphylococcus aureus<br>Escherichia coli | Klebsiella pneumonia |
| 17 | **Pseudomonas aeruginosa**<br>Staphylococcus aureus | **Pseudomonas aeruginosa** |
| 18 | Pseudomonas aeruginosa<br>Staphylococcus aureus | Klebsiella spp |
| 19 | Pseudomonas aeruginosa<br>**Escherichia coli** | **Escherichia coli** |
| 20 | Klebsiella pneumonia | Staphylococcus aureus |
| 21 | Acinetobacter spp<br>Citrobacter spp<br>**Klebsiella pneumonia** | **Klebsiella pneumonia** |
| 22 | **Escherichia coli** | **Escherichia coli** |

Letters in bold: Same organism isolated in both ETA and Blood culture

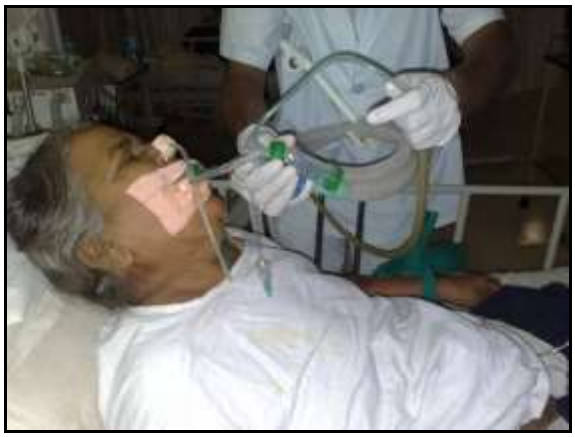

**Fig. 1: Collection of Endotracheal aspirate in mucus extractor from patient with ventilator associated pneumonia**

**Fig. 2: Blood culturing bottle (BHI- Brain Heart Infusion Bottle) for bottle culture**

## Discussion

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[5].

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 pathogen and also to define the severity of illness[6].

In a study on bacteremic nosocomial pneumonia Bryan and Reynolds [3] concluded that finding a positive blood culture defines a population at increased risk for complications. Nevertheless, several studies have questioned the value of blood cultures in defining the etiologic pathogen, especially in VAP, arguing that an additional extrapulmonary source of infection is usually present in these patients[5,7,11,15]. In recent study Luna et al pointed out that blood culture in patients with VAP is less significant and there may be extrapulmonary source[15]. So in present study ETA shows 45% and blood culture shows 12(14.11%) which is in concordance with studies carried out by other researchers[3,6,15].

## Conclusion

Blood culture has a low sensitivity for detecting the same pathogenic microorganism as ETA culture in patients with VAP. Blood culture in patients with VAP are clearly useful if there is suspicion of another probable infectious condition as some of these patients can have multiple sites of infection simultaneously, but blood culture have limited valve in microbiological diagnosis of VAP.

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**How to cite this article:** Kotgire SA. To define usefulness of blood culture in microbiological diagnosis of ventilator-associated pneumonia (VAP). Indian J Microbiol Res 2016;3(2):118-121.