

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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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 $\geq 38^{\circ}\text{c}$
2. Leucocytosis $\geq 10000\text{mm}^3$
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 10⁵ 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.

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 (10⁵ 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 <10⁵ 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 Streptococcus pneumoniae Pseudomonas aeruginosa	Pseudomonas aeruginosa
2	Pseudomonas aeruginosa	Pseudomonas aeruginosa
3	Staphylococcus aureus Escherichia coli Acinetobacter spp	Escherichia coli
4	Staphylococcus aureus Pseudomonas aeruginosa	Klebsiella spp
5	Escherichia coli	Staphylococcus aureus
6	Escherichia coli Klebsiella pneumonia	Klebsiella pneumonia
7	Klebsiella pneumonia	Pseudomonas aeruginosa
8	Staphylococcus epidermidis Acinetobacter spp	Acinetobacter spp
9	Escherichia coli	Pseudomonas aeruginosa
10	Pseudomonas aeruginosa Staphylococcus epidermidis Staphylococcus aureus	Escherichia coli
11	Pseudomonas aeruginosa	Pseudomonas aeruginosa
12	Staphylococcus aureus	Escherichia coli
13	Pseudomonas aeruginosa Staphylococcus aureus	Pseudomonas aeruginosa
14	Pseudomonas aeruginosa Klebsiella pneumonia	Staphylococcus epidermidis

15	Pseudomonas aeruginosa Acinetobacter spp	Pseudomonas aeruginosa
16	Staphylococcus aureus Escherichia coli	Klebsiella pneumonia
17	Pseudomonas aeruginosa Staphylococcus aureus	Pseudomonas aeruginosa
18	Pseudomonas aeruginosa Staphylococcus aureus	Klebsiella spp
19	Pseudomonas aeruginosa Escherichia coli	Escherichia coli
20	Klebsiella pneumonia	Staphylococcus aureus
21	Acinetobacter spp Citrobacter spp 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 diagnosis⁵.

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 illness⁶.

In a study on bacteremic nosocomial pneumonia Bryan and Reynolds³ 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 source¹⁵. 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 value in microbiological diagnosis of VAP.

References

1. Basic laboratory procedures in clinical bacteriology 2 edition, WHO Geneva publication pages 20-25.
2. Meduri GU. Diagnosis of ventilator associated pneumonia. *Infect Dis. Clin. North Am* 1993;7:295-329.
3. Bryan CS, Reynolds KL. Bacteremic nosocomial pneumonia. *Am Rev Respir Dis* 1984;129:668-671.
4. Salata RA, Lederman MM, Shlaes DM .Diagnosis of nosocomial pneumonia in intubated, intensive care unit patients. *Am Rev Respir Dis* 1987;135:426-432.
5. Luna CM, Vujacich P, Niederman MS, et al. Impact of BAL data on the therapy and out come of ventilator-associated pneumonia. *Chest* 1997; 111:676-685.
6. American Thoracic Society. Hospital-acquired pneumonia in adults: Diagnosis, assessment, initial therapy, and prevention: A consensus statement. *Am J Respir Crit Care Med* 1996;153:1711-1725.
7. Blasi F, Cosentini R. Non invasive methods for the diagnosis of pneumonia. *Eur Respir Mon* 1997;3:157-174.
8. Rello J, Gallego M, Mariscal D, Sonora R, Valles J. The value of routine microbiologic investigation in the diagnosis of ventilator-associated pneumonia. *Am J Respir Crit Care Med* 1997;156:196-200.
9. Iregui M, Ward S, Sherman G, Fraser VJ, Kollef MH. Clinical importance of delays in the initiation of appropriate antibiotic treatment for ventilator-associated pneumonia. *Chest* 2002;122:262-8.
10. Kollef MH, Ward S. The influence of mini-BAL cultures on patient outcomes: Implications for the antibiotic management of ventilator-associated pneumonia. *Chest* 1998;113:412-20.
11. Arindam Dey, Indira Bairy Incidence of multidrug-resistant organisms causing ventilator-associated pneumonia in a tertiary care hospital: A nine months' prospective study.
12. el-Ebiary, M, Torres A, Gonzalez J, Bellacasa JP, Garcia C, Anta MT, *et al* .Quantitative cultures of endotracheal aspirates for the diagnosis of Ventilator Associated Pneumonia. *Am Rev Respir Dis* 1993;148:1552-7.
13. Jourdain B, Novara A, Joly GM, Dombret MC, Calvat S, Trouillet JL, *et al* . Role of quantitative cultures of endotracheal aspirates in the diagnosis of nosocomial pneumonia. *Am J Respir Crit Care Med* 1995;152:241-6.
14. Wu CL, Yang DI, Wang NY, Kuo HT, Chen PZ. Quantitative culture of endotracheal aspirates in the diagnosis of ventilator- associated pneumonia in patients with treatment failure. *Chest* 2002;122:662-8.
15. Luna CM, Videla A, Mattera J. Blood cultures have limited value in predicting severity of illness and as a diagnostic tool in ventilator-associated pneumonia. *Chest* 1999;116:1075-1084.

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