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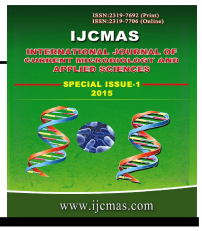

Original Research Article

Correlation between Tracheal Aspirate Culture and Bronchoalveolar Lavage Culture for the Diagnosis of Ventilator Associated Pneumonia

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Keywords

Tracheal aspirate, Bronchoalveolar lavage, Correlation, Ventilator associated pneumonia

A B S T R A C T

Ventilator associated pneumonia (VAP) develops in approximately 20% of mechanically ventilated patients. The diagnosis of VAP is challenging because the clinical and radiological findings lack sensitivity and specificity. Prior institution of antibiotic therapy and upper airway colonization further complicates the microbial analysis. So, this prospective study was done with an aim to find correlation between tracheal aspirate (TA) culture and bronchoalveolar lavage (BAL) culture for the diagnosis of VAP. Thirty adult patients of either sex requiring mechanical ventilation for more than 48 hours, showing leukocytosis or leucopenia, infiltrate on chest radiograph and temperature >38^0 C were included in the study. Analysis showed26 out of 30 patients showed growth in the tracheal aspirate compared to 27 out of 30 in BAL group. 22 out of 26 patients had colony count ≥10^5 CFU/ml in TA group compared to 25 out of 27 patients in BAL group. Cohen's kappa [κ=0.918, 95% CI (0.442-1.000)] showed a very good agreement between TA and BAL culture. Pearson's correlation coefficient between two groups was (r=0.9, p<0.001).Correlation between clinical pulmonary infection score (CPIS) and

Introduction

Ventilator associated pneumonia (VAP) develops in approximately 20% of mechanically ventilated patients. Patients suffering from VAP exhibit high mortality rate (Craven *et al.*, 1986), stay longer in the Intensive care unit (ICU) and consume more resources (Safdar *et al.*, 2005).

The diagnosis of VAP is challenging because the clinical and radiological findings are neither sensitive nor specific. Prior institution of antibiotic therapy and upper airway colonization further results in misinterpretation of culture results. Over the years continuous attempt has been made to

identify the optimal method of respiratory sample collection for microbial culture. The main problems in the interpretation of results are the antibiotic treatment before sampling and upper airway colonization, both resulting in possible misinterpretation of culture samples.

Bronchoalveolar Lavage (BAL) had traditionally been the ideal method of sample collection for the diagnosis of VAP. But, due to its inherent cost, risks and requirement of special training there has been a reappraisal of noninvasive cultures of quantitative endotracheal aspirate (QEA) in the management of VAP (Baigelman *et al.*, 1986).

So, this prospective study was done with an aim to find correlation between Tracheal Aspirate (TA) culture and Bronchoalveolar lavage (BAL) culture for the diagnosis of VAP.

Material and Methods

After obtaining approval from the faculty ethical committee the study was conducted on 30 mechanically ventilated adult patients (18–60 years) of either sex admitted to ICU. Inclusion criteria were intubated and mechanically ventilated patients with high grade fever (≥38°C), Leukocytosis (≥12000/cu mm), Infiltrate on chest radiograph (new infiltrate or worsened previous infiltrate). Patients suffering from AIDS, organ transplant patients and those in whom bronchoscopy was not recommended were excluded from the study.

All the patients suspected of having VAP were observed daily for leukocyte count, temperature and appearance of the tracheal secretion till the end of the natural course of the disease. Antibiotic therapy was prescribed by the attending physician according to the ICU protocol.

Collection of specimen: Patients were sedated with injection midazolam 0.05mg/kg intravenously. FiO_2 was increased to 100%. Vital parameters (heart rate blood pressure and oxygen saturation) were monitored on the multichannel monitor. Full aseptic and antiseptic precautions were taken while collecting the specimen.

Tracheal Aspirate (TA): Endotracheal tube was disconnected from the ventilator only for 10–15 seconds at a time. Procedure was stopped if patient Spo_2 decreased ≤ 92%. A measured length of size 14F, suction catheter was introduced in the tube for tracheal aspirate. A second catheter of smaller diameter was introduced through the first catheter to avoid contamination. The suction tube was inserted up to the tip of endotracheal tube and sample fluid obtained. If no fluid is aspirated in the first attempt, 5ml of 0.9% normal saline was injected and rapidly aspirated. The collected sample was transferred to a culture bottle and labeled.

Bronchoalveolar lavage (BAL): After the TA procedure, the bronchoscope was introduced (BF30; Olympus®) for the BAL procedure. The device was introduced without aspiration through the trachea up to the site suggested by chest radiograph. The affected segment was selected and the bronchoscope was placed in front of it. After that, 5 units (20 ml each) of 0.9% saline solution was instilled and aspirated. Results of the cytological evaluation and Gram stain analysis were obtained within the first 24 hours, and quantitative culture results were obtained within the following 48 to 72 hours. Diagnosis of VAP was confirmed through clinical signs, accompanied by the quantitative analysis of the BAL culture (with a cutoff of 10^5 CFU/mL), and evolution of the radiological findings.

Statistical analysis was performed with the help of SPSS for windows (Version 19, SPSS Inc., USA) and Graph Pad Prism 6.00 (Graph Pad Software, San Diego, CA). Qualitative Endotracheal aspirate culture and Bronchoalveolar lavage culture were compared using Chi square test. For measuring the correlation between two groups with normal variation, Pearson correlation coefficient (r) was calculated. Cohen's kappa coefficient was used to identify the agreement between TA and BAL culture for bacteriology.

Result and Discussion

There were no differences among the groups with regard to age, sex, duration of mechanical ventilation, Hb%, TLC, PO_2/FiO_2, temperature and chest X-ray (Table 1). Mean duration of mechanical ventilation was 5.3 ± 1.3 days. The underlying disorder was Sepsis (40%), Aspiration pneumonitis (20%), Diabetes (10%), Meningitis/ Encephalitis (7%), COPD (7%), Snake bite (7%), Organophosphorus poisoning (7%) and ARDS (2%). All the patients were on empirical antibiotics before inclusion in the study. 8 out of 30 patients required vasopressor. Eighteen out of 30 patients improved and shifted toward while 12 patients died due to the complications of VAP.

Tracheal aspirate culture showed growth in 26 out of the 30 patient suspected of having VAP. The result of quantitative culture showed 22 out of 26 patients having their

colony count $\geq 10^5$ CFU/ml suggesting lung

infection. On the other hand, Broncho alveolar lavage culture was positive in 27 out of 30 patient suspected of having lung infection. Quantitative culture showed 2 out of 27 patients having their colony count $<10^5$ CFU/ml. Diagnosis of VAP was ruled out in these patients (Table 2, Fig. 1). There was no significant difference between qualitative endotracheal aspirate culture and Bronchoalveolar lavage culture (p=1.0).

Most common microorganism isolated were *Acinetobacter* spp., *Pseudomonas aeruginosa* and *Klebsiella* spp. in both the cultures. Significant correlation (r=0.9, p<0.001) and agreement [κ=0.918 (0.442–1.000)] was observed among the organism from tracheal aspirate and the BAL culture (Table 3 & 4). Tracheal aspirate showed a Sensitivity and specificity of 86% & 63% respectively. Diagnosis of VAP was made if the BAL culture showed colony count $\geq 10^5$ CFU/ml. Correlation between clinical pulmonary infection score (CPIS) and quantitative bacteriology (Table 3) was r=0.79 for BAL (p<0.001) and r=0.69 for TA (p<0.001).

In our study quantitative culture of tracheal aspirate correlated very well with BAL culture (r=0.9, p<0.001) while qualitative culture showed no significant difference (p=1.0). There was a good agreement in bacteriology between the two cultures (κ= 0.918; 0.442–1.000). TA was found to have good sensitivity (86%) but low Specificity (63%) for the diagnosis of VAP.

The diagnosis of hospital-acquired pneumonia is difficult because clinical, biological, and radiological signs alone are neither sensitive nor specific (Meduri *et al.*, 1992) for nosocomial pneumonia. This led to the emphasis on microbiological analysis, both for diagnosis and prognosis but prior antibiotic therapy and colonization of upper airway pose a major challenge in the collection of culture sample.

Blot *et al.* (2000) described that invasive diagnostic techniques can improve clinical management, reduce the use of antibiotics and possibly improve the prognosis of mechanically ventilated patients with suspected nosocomial pneumonia. Researchers have used various invasive procedures such as BAL and protected brush specimen (PBS). We have chosen BAL since it has good sensitivity and specificity and is considered as the 'gold standard'.

Tracheal aspirate culture (TA), conversely is a cheap and easy method, which requires little expertise and gadgets. Qualitative culture of TA usually identifies the same organism as of invasive methods, but it also contains other nonpathogenic organism. Most common organism isolated in our study were similar in both TA culture and BAL culture which was comparable to previous researches (Wu *et al.,* 2002; Carvalho *et al.,* 2008; Baraibar *et al.,* 1997) except for the low incidence of MRSA which might be due to the fact that majority patients in our ICU were post-operative septicemic patients.

Clinical Pulmonary Infection Score (CPIS) also showed good correlation with TA(r=0.69) and BAL(r=0.79). Wu *et al.* (2002) and El-Ebiary *et al.* (1993) observed that the TA with a cutoff point of 10^5 CFU/mL can detect pneumonia with a good sensitivity and specificity. Furthermore, Sanchez-Nieto and colleagues (1998) found a 71% agreement between QEA, PBS, and AL culture techniques. In general, the reported sensitivity and specificity by various authors is reported to be 38–100%, and 14–100 % respectively.

So, our study supports the observation of previous authors that, tracheal aspirate with a diagnostic threshold of $\geq 10^5$ has good sensitivity (86%) for the diagnosis of VAP but lower specificity (63%). Multiple reasons like duration of mechanical ventilation, bacterial load, and prior antibiotic therapy could probably explain this observation.

As with most of the studies, this study also has some limitations such as prior antibiotic therapy, which could have influenced the sensitivity and specificity of the cultures. Moreover, retrieval volume was not compared, if small volume of fluid is retrieved, then the bacterial count can be falsely high due to less volume of diluents and vice versa (Dreyfuss *et al.,* 1993).

Significant correlation and agreement exists between Tracheal aspirate and BAL culture. Sensitivity and specificity of TA culture for the diagnosis of VAP was 86% and 63% at a cut-off value of 10^5 CFU/ml.

Fig.1 Quantitative growth in Tracheal aspirate and Bronchoalveolar lavage culture

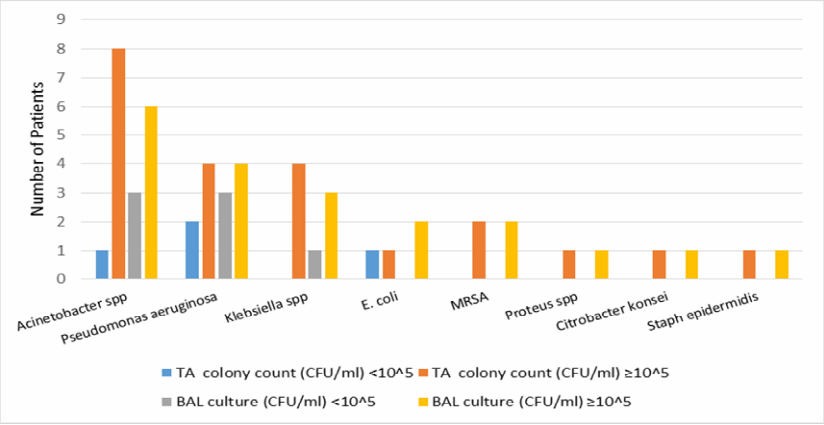

Table.1 Demographic parameters

Clinical characteristics	**Mean±S.D**
Age (Years)	35±14.877
Male/Female ratio	15/15
Duration of mechanical ventilation (days)	5.3±1.4
Mortality	12/30
Total Leukocyte Counts (TLC)	15961 ± 4582.57
Temperature (Fahrenheit)	100.96±1.089
Underlying disorders	
Sepsis	12(40%)
ARDS	6(20%)
Meningitis/encephalitis	5(17%)
Trauma	4(13%)
Snake bite	2(7%)
Diabetes	2(7%)
COPD	3(7%)
Aspiration pneumonitis	2(7%)
Organophosphorus poisoning	1(2%)

Table.2 Quantitative bacterial isolates in tracheal aspirate and bronchoalveolar lavage culture

Microorganism	**TA colony count (CFU/ml)**		**Total**	**BAL culture (CFU/ml)**		**Total**
	$<10^5$ (n)	$\geq 10^5$ (n)		$<10^5$ (n)	$\geq 10^5$ (n)	
Acinetobacter spp	1	8	9	3	6	9
Pseudomonas aeruginosa	2	4	6	3	4	7
Klebsiella spp	0	4	4	1	3	4
E. coli	1	1	2	0	2	2
MRSA	0	2	2	0	2	2
Proteus spp	0	1	1	0	1	1
Citrobacter konsei	0	1	1	0	1	1
Staph. epidermidis	0	1	1	0	1	1
No growth	-	-	4	-	-	3
Total no of patients	4	22	30	2	25	30

CFU=colony forming Units, TA= Tracheal aspirate, BAL=Bronchoalveolar lavage, n=number of patients

Table.3 Correlation between TA culture, BAL culture and CPIS score

Group		Tracheal Aspirate (TA)	BAL	CPIS score
Tracheal Aspirate(TA)	Pearson Correlation (r)	1	0.97	0.69
	Sig. (2-tailed)	-	<0.001	<0.001
	N	30	30	30
BAL	Pearson Correlation(r)	0.97	1	0.79
	Sig. (2-tailed)	<0.001	-	<0.001
	N	30	30	30

N= number of patients

Table.4 Agreement between TA and BAL culture

	Value	SE	95% Confidence interval
Measure of Agreement Kappa	0.918	0.106	0.442 - 1.000
Number of Cases	30		

SE= Standard error

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