Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 09, 2023

Original Research

Comparison of Bronchoalveolar Lavage, Mini Bronchoalveolar Lavage and ET aspirate in diagnosis and management of pneumonia in Intensive Care Unit

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Received: 28 October, 2023 Accepted:19 November, 2023

ABSTRACT

Introduction- One of the main causes of morbidity and death for patients hospitalized to the intensive care unit is pneumonia. In these patients, bronchoalveolar lavage (BAL) is frequently utilized to aid in the diagnosis and characterization of pneumonia. Compared to BAL, mini-BAL and ETA are less intrusive, expensive, and time-consuming diagnostic tools. The present study was conducted to compare microbiological examination of aspirate, taken by fiberoptic bronchoscope, mini-bal and et-aspirate from patients with diagnosis of pneumonia in intensive care unit.

Material & methods- The prospective study was conducted at department of pulmonary and critical care medicine, Shatabdi hospital, KGMU Lucknow for a period of 7 months among 59 intubated patients with diagnosis of pneumonia admitted in ICU. Aspiration was done through BAL, mini BAL and ETA. Data were stored in the microsoft excel software (2010) and analysed through SPSS 22nd version.

Results- The mean age of patients was 57.0±13.2 years. Out of 59 patients 57.6% were male and 42.3% were females. Of BAL samples, bacteria were isolated in 14 (23.7%) and fungi were isolated in 21 (35.5 %). Of mini-BAL samples, bacteria were isolated in 15 (25.4%) and fungi were isolated in 17 (28.8%) and in ETA sample bacteria were isolated in 11 (18.6%) and fungi were isolated in 11 (18.6%). Strong correlations for bacterial and fungal detection between BAL and mini-BAL ($r = 0.830$ and $r = 0.820$, respectively).

Conclusion- The isolation rates of fungus and bacteria in BAL and mini-BAL samples were shown to be strongly correlated. The data clearly favors the use of mini-BAL sample as a less intrusive, more affordable, and easier option to traditional BAL sampling in these patients but it is not a definitive method of approach.

Keywords – BAL, ETA, intensive care unit, mini-BAL, pneumonia, treatment

INTRODUCTION

A frequent respiratory condition that includes lung tissue consolidation, inflammation, and infection of the alveoli called pneumonia.[1] Patients in intensive care units (ICUs) frequently contract pneumonia, which carries a high risk of death for the afflicted individuals. A mix of imaging, clinical, and laboratory criteria are used to diagnose pneumonia.[2-5] Early detection and antibiotic treatment can save lives. But there's no gold standard when it comes to diagnosing pneumonia. The Centres for Disease Control and Prevention (CDC) have defined semi-quantitative or nonquantitative cultures of sputum acquired by deep coughing, induction, aspiration, or lavage as one of the criteria for pneumonia.[6] The process utilised to collect airway samples is crucial due to the possibility of upper airway contamination, which complicates the identification of the causal organism and increases the risk of using the wrong kind of antibiotic. In order to avoid upper airway contamination, flexible fiberoptic bronchoscopy (FOB) should be used. The efficacy of diagnostic modalities, such as protected-specimen brushing and flexible bronchoscopy with bronchoalveolar lavage (BAL), has been shown in multiple studies [7-11]. These modalities are traditionally used to

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 09, 2023

help guide the early and appropriate therapy in critically ill patients presenting with pneumonia. While bronchoscopy itself carries a significant risk in patients presenting with thrombocytopenia and hypoxemia, bronchoscopic methods offer good diagnostic yields; nevertheless, these sample techniques are expensive and typically require highly trained operators to perform. Furthermore, a number of factors, including bleeding, specimen contamination, hypoxemia, airway spasm, and arrhythmia, can make these invasive procedures problematic [12-14]. The aforementioned discoveries have led to the evaluation of novel and less invasive diagnostic techniques in recent years, especially in the diagnosis of ventilator-associated pneumonia (VAP) [15-18]. These techniques include mini-BAL and endotracheal aspiration (ETA). Mini-BAL was initially applied successfully in 1989 to diagnose hospital-acquired pneumonia [19]. However, there is not enough information available to compare the diagnostic utility of ETA and mini-BAL to BAL and other bronchoscopic techniques in patients with pneumonia who are in ICU. Because of this, there is growing curiosity about the viability and diagnostic potential of these minimally invasive techniques, especially the mini-BAL. Hence the present study was conducted to compare microbiological examination of aspirate, taken by fiberoptic bronchoscope, mini-bal and et-aspirate from patients with diagnosis of pneumonia in intensive care unit.

MATERIAL & METHODS

The prospective study was conducted at department of pulmonary and critical care medicine, Shatabdi hospital, KGMU Lucknow for a period of 7 months among all intubated patients with diagnosis of pneumonia on clinical-radiological basis at Pulmonary and critical care medicine ICU. Ethical permission was taken from the institutional ethical committee before the commencement of study. Written informed consent was taken from patients or their relatives after explaining them the complete procedure.

For sample size calculation following assumptions are made.

$$n = Z^2 \frac{P(1-p)}{d^2}$$

Where,

P=Prevalence =16%,

Odds ratio=2.5, α=0.05, Power=80%

Confidence interval=95%

= 59

Therefore total 59 patients were enrolled in this study. Following were the inclusion and exclusion criteria-

Inclusion criteria-

1. All intubated patients with diagnosis of pneumonia in our ICU were included in the study.
2. The mini-BAL catheter is usually directed into the right lung; however, in one third of the patients it may be inserted into the left lung. It was difficult to perform chest X-ray after the procedure. For these reasons, patients with bilateral pneumonia were included in the study.
3. Age more than 13 years.
4. Patient giving written informed consent will be taken.
5.

Exclusion criteria-

1. Deranged coagulopathy, extreme ventilatory and oxygenation demands and tracheal obstruction.
2. Age less than 13 years.
3. Not giving consent to take part in study.
4.

ETA sample collection : ETA collection was performed using a sterile suction catheter of size 12 French (Fr) introduced through the endotracheal tuber (ET) until resistance was encountered (level of the carina in the trachea), retracted approximately 2 cm and sample collected in a sterile container by suction. The samples were aspirated into a sterile polypropylene collector tube.

Mini-BAL sample collection : Non-bronchoscopic BAL is collected by double catheter technique. For this method, we need two different size suction catheters, where smaller one could pass easily through the larger one, e.g. 16 Fr

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 09, 2023

and 8 Fr catheters. Advancing a catheter through the endotracheal tube blindly until resistance is met, infusing sterile saline through the catheter (typically three 20 mL aliquots) and then aspirating using the syringe or wall mount suction via mucus trap (the catheter is estimated to be located in the distal endobronchial airway).

BAL sample collection : the bronchoscope is advanced distally into the bronchopulmonary segment of interest until it occludes the bronchus, thereby "wedging" the scope. Sequential aliquots of normal saline totaling at least 100 ml (and no more than 300 ml) should be instilled and at least 30% returned for optimal sampling . A minimum 5 ml (and ideally 10–20 ml) is needed for cellular analysis.
After sample collection of patients within 24th hour of intubation were examined for bacterial c/s, fungal c/s, KOH mount , AFB. Later on final outcome would be assessed and efficacy of BAL , mini BAL and et aspirate were compared. Statistical analysis: Data were stored in the microsoft excel software (2010) and spss 22nd version. Descriptive analysis was performed using number (n) and percent (%) for qualitative data and median and IQR for quantitative data. Statistical analysis were assembled to chi-squared test was used to study association between qualitative variables and comparison between groups was performed using mann-whitney test for quantitative variables. Statistical difference was considered in all cases at $p < 0.05$.

RESULTS

The mean age of patients was 57.0±13.2 years. Out of 59 patients 57.6% were male and 42.3% were females. Co morbidities seen were diabetes mellitus (28.8%), cardiac disease (10.1%), renal disease (8.4%) and liver disease 1 (1.6%). The average APACHE II score was 24.2±8.2 as shown in table 1.

Table 1:Demographic, clinical data of patients

Variable	Frequency (%)/ Mean ± SD
Age (years)	57.0±13.2
Male	34 (57.6)
Female	25 (42.3)
Diabetes mellitus	17 (28.8)
Cardiac disease	6 (10.1)
Renal disease	5 (8.4)
Liver disease	1 (1.6)
APACHE II	24.2±8.2

Of BAL samples, bacteria were isolated in 14 (23.7%) and fungi were isolated in 21 (35.5 %). Of mini-BAL samples, bacteria were isolated in 15 (25.4%) and fungi were isolated in 17 (28.8%) and in ETA sample bacteria were isolated in 11 (18.6%) and fungi were isolated in 11 (18.6%) as shown in table 2.

Table 2: Bacteriological and mycological results of BAL , mini-BAL and ET aspirate samples

Results	BAL	Mini BAL	ETA
Bacteriological results			
Acinetobacter baumannii	5 (8.4)	3 (3.3)	2 (1.6)
Streptococcus pneumonia	1 (1.6)	2 (3.3)	1 (1.6)
MSSA	1 (1.6)	2 (3.3)	1 (1.6)
Cupriavidus pauculus	1 (1.6)	0	0
Enterococcus faecium	1 (1.6)	1 (1.6)	1 (1.6)
Pseudomonas aeruginosa	1 (1.6)	1 (1.6)	0
Staphyloccus aureus	1 (1.6)	1 (1.6)	1 (1.6)
E . coli	1 (1.6)	1 (1.6)	0
Klebsiella spp.	1 (1.6)	1 (1.6)	1 (1.6)
Haemophillus influenzae	0	1 (1.6)	1 (1.6)
Proteus mirabilis	0	0	1 (1.6)
Enterobacter spp	0	0	0
Serratia spp	0	1 (1.6)	1 (1.6)
Moraxella catarrhalis	0	0	0
Ciratobacter freundii	0	1 (1.6)	1 (1.6)
No agent	40 (67.7)	42 (71.1)	47 (79.6)

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 09, 2023

Mycological results			
Candida spp.	15 (25.4)	13 (22)	9 (15.2)
Aspergillus spp.	2 (3.3)	1 (1.6)	1 (1.6)
Yeast	4 (6.7)	3 (5.0)	1 (1.6)
No agent	38 (64.4)	42 (71.1)	48 (81.3)

Strong correlations for bacterial and fungal detection between BAL and mini-BAL (r = 0.830 and r = 0.820, respectively). In view of detecting bacterial agents, ETA correlated weakly both with BAL and mini-BAL (r = 0.467 and r = 0.420, respectively) whereas there were no correlations to detect fungal agents. Mycobacterial and viral agents were not isolated in any of the samples as shown in table 3. Mortality was seen in 24 subjects (40,6%). There was no mortality difference between subjects in whom respiratory pathogens were isolated compared to subjects in whom no respiratory pathogens were isolated. There were no complications associated with any of the sampling methods.

Table 3: Correlation of methods

Variable	Variable	Correlation coefficient
BAL bacteriology	Mini BAL bacteriology	0.830
BAL bacteriology	ETA bacteriology	0.467
Mini BAL bacteriology	ETA bacteriology	0.420
BAL mycology	Mini BAL mycology	0.820
BAL mycology	ETA mycology	0.085
Mini BAL mycology	ETA mycology	-0.156

DISCUSSION

Pneumonia is a major issue, whether it is acquired in the community or is related to medical care. Antibiotics are the primary therapeutic choice. Research indicates that a timely initiation of adequate antibiotic treatment reduces mortality.[20] Selecting the right antibiotic is challenging since it can be challenging to identify the causing organisms. Due of this challenge, wide spectrum antibiotics are typically employed, at least initially, until assessments by microbiologists are completed. Endotracheal suction samples from patients in intensive care may contain contamination from the upper airways, leading to inaccurate results.[21] For this reason, physicians must get trustworthy, uncontaminated lower respiratory tract samples. To identify the specific diagnostic method for pneumonia, microbiological analysis of the specimens taken during broncoscopy is thought to be the best course of action.[22,23] Nevertheless, bronchoscopy is an intrusive, costly, skill-intensive technique that takes longer to complete and disturbs the respiratory mechanics, hemodynamics, and oxygenation of patients receiving intensive care.[24-27] As a result, a simpler method is required. Protected mini BAL is less expensive, requires less training, takes less time, and has less of an impact on hemodynamics or oxygenation. It is also simpler to perform.[28] The present study was done to compare to compare microbiological examination of aspirate, taken by fiberoptic bronchoscope, mini-bal and et-aspirate from patients with diagnosis of pneumonia in intensive care unit. A previous study [29] that included 104 patients with pneumonia revealed a 38% BAL microbe isolation ate. A study conducted on 199 patients who had fever, pulmonary infiltrates, haematological malignancy, and chest imaging revealed that 59% of the patients had bacterial and/or fungal organism isms isolated by BAL [8]. In a related investigation, 49% of BAL samples from 93 neutropenic patients had respiratory bacteria [9]. In a different study, 57 patients had a microorganism isolation rate for BAL of 63% [30]. These investigations bolster the usefulness of BAL in characterising pneumonia pathogens in patients with compromised immune systems. Our study found that 59.2% of bacterial and/or fungal pathogens were isolated by BAL, which is consistent with other research. Mini-BAL was utilised by Rouby et al [19] in 1989 to diagnose nosocomial pneumonia. They came to the conclusion that mini-BAL is a highly effective, affordable, reproducible, and conveniently applied alternative diagnostic tool to bronchoscopic techniques of respiratory sampling. In a similar vein, mini-BAL was employed by Kollef et al. [17] to assess patients with VAP. In 46.2% of the cases, they were able to isolate at least one respiratory pathogen. In 82 patients with possible VAP, a different study evaluated the diagnostic performance features of ETA and miniBAL. It found that mini-BAL was considerably more specific than ETA for the microbiological diagnosis of pneumonia [31]. There were no side effects that the patients could link to the mini-BAL operation. Our study found that 54.2% of bacterial and/or fungal pathogens were isolated by mini-BAL, and 37.2% by ETA which is consistent with other research. We found a strong correlation between the isolation rates of bacterial and fungal organisms in the two methods. On the other hand, our data demonstrate a weak correlation between BAL and ETA for bacterial and/or

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 09, 2023

fungal isolation. According to our research, there is no discernible difference in the survival rates of patients with and without respiratory pathogen isolation. Due to the extremely unique characteristics of this group, which includes respiratory failure and the requirement for treatment in intensive care unit, the number of individuals in our study is limited.

CONCLUSION

To conclude, we found a strong association between the BAL and mini-BAL techniques for the isolation of bacterial and fungal pathogens. According to our research, mini-BAL can be a substitute for BAL in the early diagnostic evaluation of pneumonia among patients admitted in Intensive care unit but not a definitive approach. A prospective validation of this findings ought to be conducted at other centers with higher case counts.

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ISSN: 0975-3583,0976-2833 VOL14, ISSUE 09, 2023

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