IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 21, Issue 6 Ser.9 (June. 2022), PP 06-10
www.iosrjournals.org

Diagnostic Efficacy of Bronchoalveolar Lavage In Pulmonary Lesions

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Abstract:
Background:*Fibreoptic bronchoscopy (FOB) is a very useful and safe procedure for diagnosis of various respiratory diseases. It is a universally accepted procedure both in the diagnosis and therapy of different pulmonary disorders. It can be performed under local anaesthesia in various clinic/hospital settings providing maximal visualization of tracheobronchial tree. Bronchoalveolar lavage (BAL) i.e., saline wash of bronchial tree was introduced way back in 1970. It remained as an investigative technique and research tool but did not reach the status of the diagnostic toll in India until 1994.BAL can be used to diagnose various infectious and non-infectious diseases of the lung and it remains the only effective treatment for alveolar proteinosis.*
Materials and Methods:*In this cross-sectional study, all inpatients and outpatients >18 years of age presenting with lung pathologies such as mass, fibrosis, collapse, consolidation and cavities (on CT scan of thorax) were recruited into the study. A total of 216 patients were enrolled for the study. Fibreoptic video bronchoscope, model: Olympus BF-1T150 Fibreoptic bronchoscope, Manufacturer: Olympus, Tokyo, Japan was used for the study.*
Result:*Tuberculosis was diagnosed in a total of 68 patients (31.5%), out of which 13 patients had a secondary bacterial infection. Pyogenic pneumonia was diagnosed in 44 (20.4%) cases, the commonest organism isolated was Streptococcus pneumoniae (16 cases). Fungal pneumonia was diagnosed in 14 (6.5%) cases and bronchogenic carcinoma was diagnosed in 8 (3.7%) cases. BAL was not able to make a definite diagnosis in any of the suspected ILD cases. The overall diagnostic efficacy of the study was 62%.*
Conclusion: *BAL, when performed by an expert with strict adherence to guidelines for performing and processing of the specimen, can help in arriving at a diagnosis and also help to rule various infections, tumours and occupational lung diseases in suspected cases of ILD.*
Key Word: *Bronchoalveolar Lavage, Fibreoptic Bronchoscopy*

Date of Submission: 14-06-2022 Date of Acceptance: 29-06-2022

I. Introduction

Fibreoptic bronchoscopy (FOB) is a very useful and safe procedure for diagnosis of various respiratory diseases. It is a universally accepted procedure both in the diagnosis and therapy of different pulmonary disorders. It can be performed under local anaesthesia in various clinic/hospital settings providing maximal visualization of tracheobronchial tree[1], and if performed carefully, can be a thoroughly safe procedure.[2] Gustav Killian[3] reported his experience with the first bronchoscopy in 1898. Bronchoalveolar lavage (BAL) i.e., saline wash of bronchial tree was introduced in 1970. Various workers stressed upon the utility of BAL in the diagnosis and monitoring of lung diseases.[4]However, it remained as an investigative technique and research tool but did not reach the status of diagnostic tool in India until 1994.[5]It is now considered a safe and useful method for sampling cellular and humoral materials from the lower respiratory tract. BAL allows the recovery of both cellular and noncellular components from the epithelial surface of lower respiratory tract and differs from bronchial washings, which refers to the aspiration of either secretions or small amount of instilled saline from the lower airway.[6]For clinical use of BAL, one of the major obstacles in the past has been the lack of standardization on procedures such as performing lavage and processing the BAL cells and fluid. In a report of the European Task Group on BAL, 1989, the technical aspects have been sufficiently addressed.[7]BAL technique involves introduction of sterile saline into the lungs through fibreoptic bronchoscope to obtain secretions, cells and proteins from the lower respiratory tract. This has been in use for many years in treating cystic fibrosis and severe asthma to remove mucus plugging in patients not responding to other treatment.[8]It remains the only effective treatment for alveolar proteinosis.[9]As a diagnostic tool, BAL can be used to diagnose infectious diseases (Pneumocystis carinii, Legionella Pneumophilia, Mycobacterium tuberculosis, Haemophilus influenza, Mycoplasmapneumoniae, Histoplasma capsulatum, Toxoplasma gondii, Strongyloidesstercoralis, Respiratory syncytial virus) and non-infectious diseases (Alveolar proteinosis, Histiocytosis X, pulmonary malignancies, pulmonary haemorrhages, eosinophilic lung diseases, asbestosis, hypersensitivity pneumonitis,

sarcoidosis).[4]FOB not only helps in assessing the disease area but also provides better bacteriological and histological yield thus helping to reach a definite diagnosis.[10]

II. Materials and methods

This cross-sectional study was carried out in the department of Respiratory Medicine, Regional institute of Medical Sciences, Imphal, Manipur from October 2014 to September 2016. A total of 216 patients (inpatients as well as outpatients) >18 years of age were enrolled for the study.

Study Design: Cross sectional study

Study Location: Department of Respiratory Medicine, Regional Institute of Medical Sciences, Imphal, Manipur.

Study duration: October 2014 to September 2016.

Sample size: 216. All patients undergoing bronchoscopy within the study period were included in the study

Study tool: Fibreoptic Video Bronchoscope. Model: Olympus BF-1T150 Fibreoptic bronchoscope. Manufacturer: Olympus, Tokyo, Japan.

Inclusion Criteria:

1. All inpatients and outpatients >18 years of age presenting with lung pathology such as mass, fibrosis, collapse, consolidation and cavities as shown by CT scan.

Exclusion Criteria:

1. Those who are not willing to undergo fibreoptic bronchoscopy or who do not give their consent for the procedure.
2. Patients with SpO_2<89% inspite of oxygen therapy.
3. Myocardial infarction in the past six weeks.
4. Cardiac arrythmias.
5. Haemodynamic instability.
6. Uncorrected bleeding diathesis.

Procedure methodology

After written informed consent was obtained, a detailed history regarding the duration of the disease, age of onset of the disease, symptoms like shortness of breath, cough with or without expectoration, fever, etc. of all the patients who participate in the study were recorded. A thorough general physical and clinical examinations were also performed. Complete blood hemogram, fasting and post prandial blood sugar, kidney function test, liver function test, serum electrolyte, coagulation profiles, routine urine examination, sputum for AFB and gram stain and culture, chest X-ray, CT scan thorax, ECG and spirometry (wherever appropriate) and other tests depending upon co-morbid illnesses were done.

Bronchoscopy was done for all patients using an Olympus BF TYPE 1T150 fibreoptic bronchoscope. Patients were instructed to stay nil orally for 12 hours prior to the procedure. the procedure was done with the patient in supine position as there are no studies comparing effects of upright, semi recumbent or supine position on BAL.[11] All patients were given supplemental oxygen inhalation and continuous SpO_2 monitoring was done with pulse oximetry. Premedication with anticholinergics was not done due to a lack of clinical benefit and a possible increased risk of haemodynamic changes. Intravenous midazolam (2mg-5mg, 2mg for patients over 70 years) were given to select patients who could not tolerate unsedated bronchoscopy. Topical anaesthesia (Lidocaine 2%) is sprayed locally at the pharynx and Lidocaine 2% jelly is instilled in the nostril and bronchoscope is introduced through the nostril. As the bronchoscope is manipulated through the airways, the spray-as-you-go technique was adopted to anaesthetise the vocal cords and the trachea. To reduce the risk of lidocaine toxicity, the lowest possible dose was used which was sufficient to prevent excessive coughing and produce patient comfort.[12] 100-300ml of normal saline was instilled into the affected lobe of the lung using 20ml aliquots. The lobe of lung selected for BAL is based on the CT scan results and in cases of bilateral diffuse lung pathology, BAL was taken from the most affected area or from the right middle lobe. The instilled saline is then retrieved by using a negative suction of no more than 100mmHg pressure. The minimal volume retrieved should be at least 5% of the instilled volume (optimal retrieved volume ≥30%). If the retrieved volume is <5%, the procedure has to be aborted.[11] The aspirated normal saline is then sent for the required investigation.

Figure 1: Olympus Fibreoptic bronchoscope Model BF TYPE 1T150 used for the study.

Statistical analysis

The result of the study is tabulated and the percentage of diseases diagnosed by BAL is calculated using SPSS 16.0. Thus, the overall diagnostic efficacy is calculated based on the diseases diagnosed.

III. Result

Out of the total 216 patients, 134 (62%) were males and 82 (38%) were females. 126 (58.3%) patients were above the age of 60 years and the rest were ≤60 years of age. Radiologically, all patients had a combination of two to three radiologically distinct findings. Consolidation [116 (53.7%)], was the most frequent findings encountered among the patients. The radiological findings are tabulated in table 1.

The average return volume (retrieved volume of normal saline after instillation) was 60.7%. the appearance of the BAL fluid was either clear, haemorrhagic or hazy with various colours (colourless, brownish, straw, reddish, brownish, yellowish and creamy). Coagulum was present in 162 (75%) BAL samples. The protein and sugar content were below assay range in 30 (13.9%) and 78 (36.1%) of patients. The average total cell count was 811.46 x 10^6/dl (1-1000 x 10^6/dl). Gram staining (Table 2) was positive for gram +ve cocci in 51 (23.6%), gram +ve bacilli in 2 (0.9%), gram -ve bacilli in 12 (5.6%). None of the samples was positive for gram -ve cocci organism (table). Culture for pyogenic organism (Table 3) was positive in 30 (13.9%) cases and culture for fungal organisms was positive in 14 (6.5%) cases (table4). Streptococcus pneumoniae was the most common organism isolated [16 (7.4%)]table. BAL fluid was positive for malignancy in 8 (3.7%) cases; 5 (2.3%) was squamous cell carcinoma and 1 (0.5%) case was adenocarcinoma. Ziehl-Neelsen (ZN) staining for acid fast bacilli (AFB) was positive in 20 (9.3%) cases and culture for AFB by using BACTEC method was positive in 68 (31.5%) cases (table5). Overall, BAL was able to make a final diagnosis in 134 (62.0%) cases; Pulmonary Koch's in 56 (25.9%) cases (13 cases had secondary infections with pyogenic organism), Pulmonary non-tubercular mycobacterium infection in 12 (5.6%) cases, Pyogenic pneumonia in 44 (20.4%) cases, Fungal infection in 14 (6.5%) cases (4 cases had secondary infections with pyogenic organisms) and Bronchogenic carcinoma in 8 (3.7%) cases (4 cases had secondary infections with pyogenic organisms).

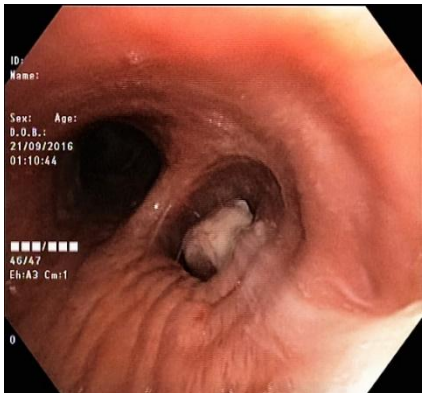

Figure 2: Endobronchial fungating mass in the right main bronchus obliterating the bronchus. BAL and biopsy were taken which proved the mass to be Squamous cell carcinoma.

Findings	Frequency	Percentage (N=216)
Consolidation	117	54.2%
Collapse	42	19.4%
Fibrosis	94	43.5%
Mass	66	30.6%
Cavity	30	13.9%
Others*	70	32.4%
*Mediastinal lymphadenopathy, pleural effusions, pleural thickening and fibrosis, emphysema, ground glass opacities, bronchiectasis (cystic and tractional), empyema thoracis, subpleural bulla, SVCO and Bronchial cyst.		

Table 1: Radiological findings on CT scan

Findings	Frequency	Percentage (N=216)
Gram +ve cocci	51	23.6%
Gram –ve cocci	0	0
Gram +ve bacilli	2	0.9%
Gram –ve bacilli	12	5.6%
Total	**65**	**30.1%**
Others: Budding yeast cells, psuedohyphae		

Table 2: Gram staining study of BAL fluid

Organism	Frequency	Percentage (N=216)
Streptococcus pneumoniae	16	7.4%
Klebsiella pneumoniae	5	2.3%
Staphylococcus aureus	6	2.8%
Pseudomonas aeuroginosa	2	0.9%
Klebsiella oxytoca	1	0.5%
Total	**30**	**13.9%**

Table 3: Culture for pyogenic organism. Streptococcus pneumoniae was the most common organism isolated.

Findings		Frequency	Percentage (N=216)
Fungal stain		4	1.9%
Fungal culture		14	6.5%
Fungal type	Aspergillus	13	6.0%
	Candida albicans	1	0.5%

Table 4: Fungal study

Findings		Frequency	Percentage (N=216)
Direct smear		20	9.3%
Culture		68	31.5%
AFB type	MTB complex	56	25.9%
	NTM	12	5.6%

Table 5: Study for Mycobacterium tuberculosis. 68 patients were diagnosed as Tuberculosis based on the culture positivity (BACTEC). Out of the total 68 patients, 20 patients stained positive on direct Ziehl-Neelsen (ZN) staining for AFB. 56 isolates out of the total 68 positive culture were Mycobacterium tuberculosis complex and the remaining 12 were non-tubercular mycobacterium.

IV. Discussion

Since its introduction in 1968 by Ikeda et al.[13]flexible fibreoptic bronchoscopy has become a very useful tool in patient care and medical research. Proper selection of instrument is necessary to ensure effective and safe procedure. Ability to collect BAL provides a role for flexible bronchoscope in research.[14] this study was aimed to assess the overall diagnostic efficacy of bronchoalveolar lavage in various pulmonary lesions. Comparison with other modalities of investigation was not done. Provisional diagnosis of all patients was made prior to the bronchoscopy based on history, clinical, radiological and laboratory evidence. Presence of malignant cells, pyogenic organisms, acid fast bacilli and fungal elements in BAL specimen was taken as positive for that particular disease, e.g., diagnosis of bronchogenic carcinoma was made on the basis of presence of malignant cells in the BAL specimen. Biopsy of visible endobronchial lesions or mass was also taken, the result of which is not a part of this study, although it helped in making a final diagnosis in whom BAL specimen was negative for malignant cells.

The overall diagnostic efficacy of this study was 62% which is higher than a similar study done by Khara et al[15] in which the overall diagnostic yield was 55.7%. This study was able to diagnose tuberculosis in 68 (31.5%) cases (table for AFB study) out of which 13 patients had a secondary infection with pyogenic organisms (8 patients had Gram +cocci, 3 patients had Gram -ve bacilli and 2 had Gram +ve bacilli). The

organisms were not identified as they did not grow on cultures. Bacterial pneumonia was diagnosed in 44 (20.4%) cases. Out of these 44 cases, culture was positive in 30 (13.9%) cases while the remaining cases were culture negative (table). These remaining organisms were positive on gram staining but did not grow on culture. This can be due to one of the following reasons; 1) All patients who underwent bronchoscopy, with clinical suspicion of infections, were either on empirical antibiotic therapy at the time of the procedure or have already taken a course of antibiotic. This may result in the death of the offending organism that could not grow on culture but stain positive on gram staining. 2) Similarly, death of the offending organism may occur during transport, handling and processing of the specimen. 3) The offending organism is an anaerobe and hence they do not grow on aerobic culture.

V. Conclusion

Bronchoalveolar lavage is a safe, efficacious and universally accepted procedure for the diagnosis and therapy of various pulmonary lesion. BAL helps in the diagnosis of obscure lung pathology which cannot be diagnosed by other means of investigations. It especially plays animportant role in the diagnosis of lower respiratory tract infections with minimal complications and discomfort to the patients. In suspected cases of ILD, BAL is useful to rule out infections, tumours and occupational lung diseases. BAL analysis, by itself, may not be diagnostic, but BAL cell pattern results may support a diagnosis and/or narrow down the differential diagnosis when considered in the context of medical history, physical examination, and radiologic findings.[16] It is also recommended that BAL should be used along with transbronchial lung biopsy, bronchial brushings and EBUS (endobronchial ultrasonography) whenever feasible to increase the overall yield.

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Monsang G, et. al. "Diagnostic Efficacy of Bronchoalveolar Lavage In Pulmonary Lesions." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 21(06), 2022, pp. 06-10.