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Endobronchial Ultrasound Guided Transbronchial Needle aspiration and EBUS Transbronchial needle biopsy- A comparative cross- sectional study

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ABSTRACT

Background of the study: EBUS -TBNA (Endobronchial Ultrasound- Transbronchial Needle Aspiration) is a minimally invasive yet cost-effective procedure for the diagnosis of mediastinal, hilar lymphadenopathy and peri-bronchial lung parenchymal lesions of the lung. It is very helpful for both routine and advanced molecular diagnostic tests. Combined with Endobronchial Ultrasound Transbronchial Needle biopsy (EBUS TBNB), it helps in improving the diagnostic outcome of the same lesions.

Materials and methods: This retrospective study was conducted between February 2023 and February 2024. Eighty patients with mediastinal, hilar, para-bronchial and para-tracheal mass lesions on chest computed tomography (CT) scan and suspected neoplastic and non- neoplastic cases were included to know about the application and diagnostic value of EBUS-TBNA.

Results: The EBUS-TBNA exhibited a sensitivity, specificity, positive predictive value, negative predictive value of 85.7%, 100%, 100%, 96.2% respectively. Chi square test was statistically significant (P= <0.01) when taking into account the cytological and histological analysis of the EBUS -TBNA and EBUS TBNB samples.

Conclusion: EBUS TBNA is an extremely useful minimal invasive diagnostic modality with a high sensitivity and pecificity for mediastinal lymphadenopathy, peri-bronchial and parenchymal lung lesions.

Keywords: *Endobronchial ultrasound, lung cancer, mediastinal lymphadenopathy, cytology.*

1. INTRODUCTION

EBUS TBNA and EBUS Transbronchial Needle biopsy (EBUS TBNB) are popular and safe minimally invasive tests used to obtain samples from mediastinal lymph node, peri-bronchial andparenchymal lung lesions for cytopathological and histopathological examination. Apart from routine tests, these techniques also help to get samples for ancillary diagnostic tests for theranostics.[1]

In EBUS-TBNA technique, there is real time visualization of the target lesion using ultrasonography and simultaneously the needle is sent through the bronchoscope to obtain the fine needle aspiration or biopsy samples.[2] The sensitivity and specificity is predictedto be around 90% and 100% respectively. This technique also gives access to posterior mediastinal region.[3]

Techniques other than EBUS-FNA/Biopsy to acquire samples are mediastinoscopy- guided biopsy, transbronchial FNA/biopsy, video assisted thoracic surgical biopsy are used for both non-malignant lesions and malignant lesions. For instance, mediastinal lymphadenopathy due to lymphoma, granulomatous lymphadenitis and metastatic cancers can be diagnosed by EBUS FNA and biopsy. [4]

The biggest advantage of EBUS FNA/biopsy is that diagnosis, staging of the lesion in case of malignancy and obtaining sample for ancillary diagnostic methods can all be done in a single, minimally invasive procedure. This technique is a collaborative effort by pathologist, pulmonologist and interventional radiologist. Studies have shown that EBUS-FNA is better thanconventional transbronchial needle aspiration and transbronchial lung biopsies in diagnosing sarcoidosis.[5]

Bronchoalveolar lavage (BAL) is a useful diagnostic procedure to aid in the diagnosis of infections and neoplastic lesions. BAL was first used in diagnosing malignancy in 1980s.It can also be helpful in obtaining samples for culture and sensitivity in case of infections.[6]

Many studies recommend EBUS-FNA as the first choice for the diagnosis of mediastinal lymphadenopathy especially in cases of lung cancer.[2] and when compared withBronchoalveolar lavage, EBUS-FNA is more sensitive and specific.

The EBUS-TBNA and EBUS-TBNB procedures fall under the umbrella of minimally invasive methods, EBUS- TBNA and EBUS TBNB are now able to provide more accurate diagnoses and aid in the treatment of a broad range of diseases, including malignancies and benign disorders. These techniques have emerged as critical components of modern clinical practice since they are useful in diagnosing transbronchial lesions, hilar and airway regional lymph nodes, and bronchial lymph nodes. EBUS-based techniques, for instance, allow for more accurate needle placements and fewer complications because they provide real time ultrasound guidance in contrast to conventional approaches. [7]

As the prevalence of lung diseases like lung cancer which accounts for the majority of cancer related deaths globally continues to increase EBUS TBNB and EBUS methods are expected to be more relevant than ever. Notably, EBUS allows, in the same setting, both initiation of a diagnostic exam and the evaluation of such diseases making it invaluable for pneumologists, oncologist and other thoracic surgeon specialist. Furthermore, the concept of Precision Medicine is becoming more prevalent, and the merging of EBUS with other direct molecular and genetic testing modalities supports this trend and adds new value to this cause. [8]

During EBUS-TBNA, the target lesions are visualized in real-time. This is made possible through the use of an ultrasound transducer that is affixed on the flexible bronchoscope. This allows the clinician to carry out fine needle aspiration (FNA) using cytopathological methods and obtain FNA samples. For EBUS-TBNB, however, tissue cores are obtained for histopathological assessment which offers more diagnostic information, especially for instances in which cytology is not enough. These techniques are good substitutes for more invasive techniques such as mediastinoscopy since they allow access to the posterior periphery of the sputum which would normally not be obtainable with conventional means. [9]

However, factors do exist that prove difficult in the practice of EBUS-TBNA and EBUS-TBNB in spite of its many benefits. Availability of specific training and equipment restricts the provision to limited resource areas. Also, the success rate of the procedure is directly proportional to the presence of trained pulmonologists, cytopathologists, and interventional radiologists. The use of EBUS-based techniques is further enhanced by overcoming these barriers through training programs, infrastructural development, and teamwork. [10]

This study aims to assess the role EBUS-TBNA and EBUS-TBNB in mediastinal, hilar and para-bronchial and para-tracheal lesions in a cohort of patients. In doing so, we strive to evaluate the specific advantages and shortcomings of these techniques and how they would complement the clinical decision-making process and resource allocation, by comparing these techniques with BAL findings. The results of this study have the ability to further cement EBUS as an integral tool in the pulmonary diagnostic toolbox thus improving patient care.

Objective: The aim of the present study is to determine the usefulness of EBUS- FNA andEBUS- biopsy along with Bronchoalveolar Lavage (BAL) findings in cases of mediastinallesions, hilar lymphadenopathy and peri-bronchial lung parenchymatous lesions.

2. MATERIALS AND METHODS

This retrospective study was conducted between February 2023 and February 2024. Eighty patients with mediastinal, hilar, para-bronchial and para-tracheal mass lesions (both neoplastic and non-neoplastic lesions) on chest computed tomography (CT) scan were included to know about the application and diagnostic value of EBUS- TBNA. In a single session, each patient underwent the following three diagnostic modalities are EBUS-TBNA, EBUS- TBNA, and BAL.

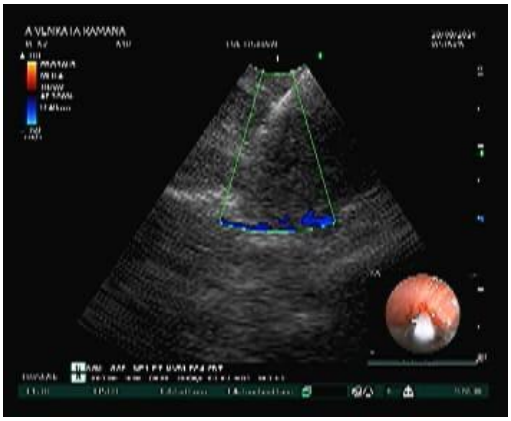

Fig 1: EBUS guided FNAC procedure

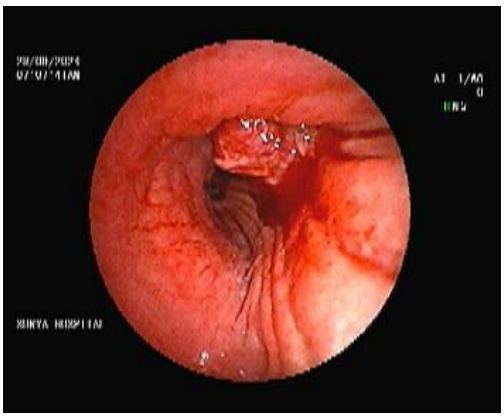

Fig 2: Endoscopy showing an ulcero proliferative growth in the bronchus

3. RESULTS

A total of 80 cases were included in the present study. The age range of the patients was between 35 years to 85 years. Maximum number of cases belonged to the age group between 55- 65 years. There was predominance of male population (68.5%) in the present study. Among 80 cases, the cytological examination of the samples (EBUS- TBNA) showed 17 malignant cases (6- Adenocarcinoma, 4 are Squamous cell carcinoma and 7 are lymphoma) while the rest of the cases were benign (63). (Table-1)

Table: 1- Findings from transbronchial needle aspiration guided by endobronchial ultrasonography (EBUS -TBNA)

EBUS-TBNA	Frequency	Percent
Adenocarcinoma	6	7.5
Granulomatous lesion	10	12.5
Lymphoma	7	8.75
Reactive lymphadenitis	51	63.75
Sarcoidosis	2	2.5
Squamous cell carcinoma	4	5.0
Total	80	100.0

Among the total 80 cases, the cytological examination BAL fluid showed one case of squamous cell carcinoma and two benign lesions. The rest were inconclusive. (Table-2)

Table :2 - Findings from Broncho alveolar lavage fluid

BAL	Frequency	Percent
Granulomatous lesion	1	1.3
Inconclusive	77	96.3
Sarcoidosis	1	1.3
Squamous cell carcinoma	1	1.3
Total	80	100.0

EBUS TBNB was done only for 32 of the 80 cases. Among 32 cases, the histological analysis showed 7 malignant cases (1- Adenocarcinoma, 3 Squamous cell carcinoma and 3 -lymphomas) while the remaining 25 cases were benign. (Table-3).

Table: 3 - Findings from EBUS TBNB

EBB	Frequency	Percent
Adenocarcinoma	1	3.1
Granulomatous lesion	2	6.3
Lymphoma	3	9.4
Reactive lymphadenitis	22	68.8
Sarcoidosis	1	3.1
Squamous cell carcinoma	3	9.4

The EBUS-TBNA exhibited a sensitivity, specificity, positive predictive value, negative predictive value of 85.7%, 100%, 100%, 96.2% respectively. Chi square test was statistically significant (P= <0.01) when taking into account the cytological and histological analysis of the EBUS -TBNA and EBUS TBNB samples.

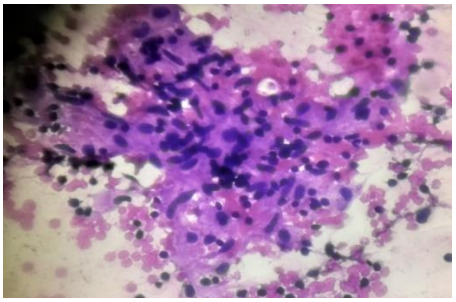

Fig 3: shows granuloma composed of numerous epithelioid cells, lymphocytes along with RBCs in the background- Granulomatous lymphadenitis. (H& E 40x)

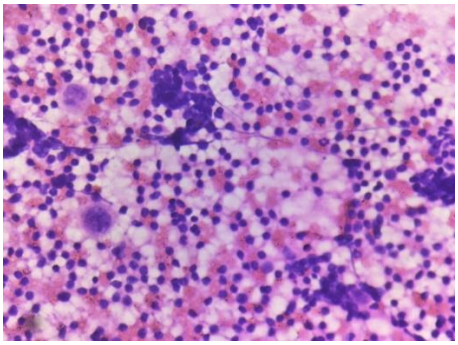

Fig 4: Shows lymphoid population native to lymph node showing predominately monomorphic population with few large cells favouring lymphoproliferative disease. (H&E 10x)

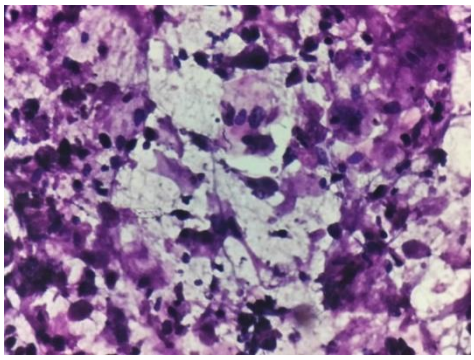

Fig 5: Dirty background in a case of squamous cell carcinoma (H&E 10x)

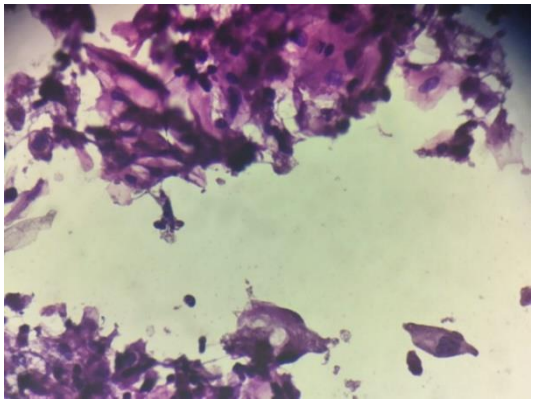

Fig 6: Atypical looking squames with nuclear pleomorphism, hyperchromatism. (H&E 10X)

4. DISCUSSION

Endobronchial ultrasound-guided Transbronchial Needle aspiration (EBUS-TBNA) is a minimally invasive procedure that enables tissue sampled from the mediastinal, hilar, para- bronchial, and paratracheal mass lesions to be examined cytologically and histologically. EBUS- TBNA has become a valuable diagnostic tool with a high diagnostic yield in malignant diseases. It has been shown that EBUS-TBNA can be helpful in the diagnosis of non-malignant mediastinal lymphadenopathy, such as tuberculosis & sarcoidosis. It is a secure method that offers quick and precise diagnosis.[11] Many previous studies have shown that EBUS TBNA has very high sensitivity and specificity in diagnosing mediastinal lymph node metastasis and is considered to be superior even to computed tomography (CT).[2]

The current study examined the benefits and drawbacks of BAL, EBUS TBNA cytological examination of mediastinal, hilar, para-bronchial, and paratracheal mass lesions at our center using in comparison with histopathological examination of EBUS TBNB samples.

In the present study, sensitivity, specificity, positive predictive value and negative predictive value were calculated for EBUS- TBNA by keeping EBUS-TBNB as gold standard for mediastinal lesions, hilar lymphadenopathy and peri-bronchial lung parenchymatous lesions. The values of sensitivity, specificity, positive predictive value and negative predictive were 85.7%, 100%, 100%, 96.2%. Similarly, in the study by Sandoh et al, in which EBUS -FNA was done on mediastinal lymph nodes, the sensitivity, specificity, and positive predictive value of the cytological examination for malignant cases were 94.1%, 100% and 100%, respectively.[2]

Most of the previously published studies demonstrated that the sensitivity was more than 80% and the specificity was almost 100%.[5]

As per findings in the present study, Broncho alveolar lavage was less useful in the diagnosis of peri-bronchial, peri- hilar masses, hilar lymphadenopathy and parenchymal lung lesions in comparison with EBUS TBNA and EBUS TBNB.

The cytological examination of EBUS TBNA samples should be done meticulously by starting with the specimen adequacy. Then the slide be examined for granulomas followed by malignancy. If there is a malignancy, then categorization of the malignancy into small cell lung carcinoma (SCLC)and non-small cell lung carcinoma (NSCLC)should be attempted.[12]

An intra-operative cytological assessment of EBUS-FNA samples is called rapid on-site evaluation. According to reports, it can assist provide a preliminary diagnostic[13], reduce the number of needle passes[14], and increase the suitability of molecular testing.[15, 16] Our hospital now uses this quick on-site assessment, and we've found it to be quite helpful in shortening the time it takes to get a definitive diagnosis.[17] Previous studies have demonstrated that the presence of a cytologist during the cytological specimen collection and ROSE (Rapid on site evaluation) performance enhanced the identification of the targeted lesions in a variety of organs.[18,19] And the yields of the EBUS-TBNA with ROSE were higher than the conventional TBNA without ROSE.[20]

Based on the findings of this study, we want to emphasize that EBUS-TBNA and EBUS-TBNB have a crucial role in the diagnostic workflow of EBUS for mediastinal and hilar lesions. Both sensitivity and specificity rates of more than 85% and over 100% respectively are achieved setting these techniques as gold standard procedures for sampling of the mediastinal lymph nodes and peri bronchial lesions. The comparison conducted with BAL findings provides further evidence and elucidates the greater diagnostic yield provided by EBUS based techniques, and the effectiveness of EBUS in malignant nail and granulomatous diseases.

EBUS-TBNA's greatest advantage also radiologically assists in the lesion targeting process guaranteeing accurate needle insertion and minimizing the chances of adverse events such as a vascular injury and a pneumothorax. EBUS TBNB On the

other hand, served a select group of patients but augmented the results of EBUS-TBNA diagnoses with its histopathological data.[21, 22] During the study the overwhelming majority of malignant lesions were diagnosed. That comprised: adenocarcinomas, lymphomas and squamous cell carcinomas, this diagnosis throughout the literature has been previously proven to have a high sensitivity and specificity rate when staging or diagnosing lung cancer.

Multimodal approach has been greatly assisted by the ability of EBUS-TBNA and EBUS-TBNB to be performed simultaneously, with the use of both being necessary to obtain tissue cores for sites which require complex architectural structures to be analyzed, or immunohistochemical type studies including differentiating between the subtypes of a lymphoma or finding a specific granulomatous.

The study evaluates the use of bronchoalveolar lavage, or BAL, in comparison with other techniques such as EBUS. While diagnosing infections and lung inflammation BAL is particularly useful, EBUS tests showed robust performance for mediastinal and hilar lesions making BAL much less effective. In fact, due to the huge number of bals which were inconclusive, there arises a scope for better sampling techniques, other than EBUS-TBNA and EBUS-TBNB, especially in this clinical setting. Still however, when used with EBUS, BAL is helpful in a more comprehensive assessment of lung infections.

Another great help was EBUS-ROSE, which marked a huge leap in EBUS workflow solutions as it greatly reduced the redundancy of EBUS for procedures requiring high levels of accuracy. Moreover, REOSE solves the dilemma of having to assess a specimen before leaving the procedure without knowing what is a sufficient amount of a sample. This in turn minimizes the resampling needed hence the number of invasive procedures decreases. But what was even more important was in this study, effective use of ROSE solved the problem of high diagnostic yield associated with EBUS-TBNA and EBUS-TBNB. Which only adds to reason why these procedures need to be more widely adopted.

The results of this research further delineate the collective characteristics of EBUS-based diagnosis procedures. The effectiveness of these procedures relies on fluency and efficiency in the interaction of the pulmonologists, cytopathologists and interventional radiologists. The involvement of a qualified cytopathologist during the procedure guarantees suitable preparation and preservation of the specimens while the input from the radiologists increases the precision of the lesion targeting. Such collaborative efforts in a number of disciplines are necessary for optimal use of EBUS for diagnosis.

Despite the results of this study seem promising there are numerous shortcomings that have to be confronted. The nature of the study and the scope being within one single institution may limit the scope of generalization of these findings. Further the small size of the samples particularly with EBUS-TBNB cases reflects the need for more extensive multicenter trials in order to corroborate these findings. Future research work should also aim on combining innovative imaging ways along with molecular diagnostics to EBUS.

5. CONCLUSION

In conclusion, our research demonstrates using clinical history to compare BAL fluid analysis, EBUS-FNA with biopsy. EBUS TBNA and biopsy exhibit excellent sensitivity, specificity, positive predictive value, and statistical significance in comparison with BAL fluid analysis. Thus, EBUS-FNA has the potential to become even more efficient to satisfy oncologists' needs for enabling a speedy beginning of appropriate therapy in mediastinal, hilar, para- bronchial and para-tracheal mass lesions.

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