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Original Research Article

CLINICAL UTILITY OF CONVENTIONAL TRANSBRONCHIAL NEEDLE ASPIRATION (C-TBNA) IN THE EVALUATION OF MEDIASTINAL LYMPHADENOPATHY: AN OBSERVATIONAL CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Mediastinal lymphadenopathy poses a significant diagnostic challenge due to overlapping clinical features of infectious, inflammatory, and malignant diseases. While endobronchial ultrasound (EBUS) is highly detailed, conventional transbronchial needle aspiration (c-TBNA) remains a vital, minimally invasive, and cost-effective approach for resource-limited clinical settings. **Objectives:** This study aimed to evaluate the diagnostic yield, sample adequacy, and safety of landmark-guided c-TBNA in patients presenting with mediastinal or hilar lymph node enlargement. **Materials and Methods:** A cross-sectional observational study was conducted from December 2020 to June 2022 at a tertiary respiratory care facility in Hyderabad, India. Fifty patients with computed tomography (CT)-confirmed mediastinal lymphadenopathy who were sputum-negative for acid-fast bacilli (AFB) and cartridge-based nucleic acid amplification test (CBNAAT) were enrolled. Flexible bronchoscopy-guided c-TBNA was performed to sample lymph node stations at Levels 2, 4, and 7 without rapid on-site evaluation (ROSE). **Results:** The mean age of the cohort was 47.76 years, consisting of 56% males and 44% females. The primary clinical symptoms were cough (100%) and fever (98%). The most frequently involved stations on CT were Level 4 (96%) and Level 7 (82%). Sample adequacy was achieved in 92% of cases, providing a definitive diagnostic yield of 88%. Diagnoses included malignancy (38%), tuberculosis (24%), non-specific inflammation (20%), metastatic disease (2%), sarcoidosis (2%), and lymphoma (2%). A statistically significant correlation was observed between age 50 years and older and malignant pathology ($p < 0.000001$).[1] No significant procedure-related complications occurred. **Conclusion:** Conventional landmark-guided TBNA provides strong diagnostic accuracy and high sample adequacy rates. It serves as an excellent, highly economical diagnostic tool in low-resource medical environments.

INTRODUCTION

The mediastinum is a central anatomical zone bounded by the sternum, vertebral column, and pleural cavities, housing essential thoracic organs, major blood vessels, and a complex network of lymph node stations.[3] Pathological enlargement of these nodes—typically defined as a short-axis diameter exceeding 1 cm on cross-sectional computed tomography (CT) scans—can result from a wide array of benign or malignant diseases.[5] In developing countries such as India, infectious granulomatous diseases like tuberculosis frequently mimic or coexist with lung malignancies, creating an urgent clinical need for reliable, timely tissue diagnosis.[1]

Historically, identifying mediastinal pathologies required highly invasive surgical procedures like

mediastinoscopy or video-assisted thoracoscopic surgery (VATS).[10] While accurate, these interventions carry risks of morbidity, higher financial burdens, and require general anesthesia.[10] The advent of flexible bronchoscopy altered this landscape.[2] First introduced via rigid bronchoscopy by Dr. Eduardo Schieppati in 1949 and adapted for flexible scopes by Dr. Ko-Pen Wang in 1977, conventional transbronchial needle aspiration (c-TBNA) allows operators to safely sample paratracheal, subcarinal, and hilar regions using endobronchial landmarks.[8]

Despite the newer development of real-time endobronchial ultrasound-guided needle aspiration (EBUS-TBNA), c-TBNA remains significantly underutilized, frequently performed by fewer than 30% of practicing pulmonologists.[7] EBUS infrastructure requires specialized equipment and carries high operational costs.[12] In low- and middle-income regions, landmark-guided needle passage based on detailed pre-procedural CT planning offers a viable, highly accessible alternative.[1] This study evaluated the diagnostic value, specimen adequacy, and safety of c-TBNA at a specialized tertiary care chest hospital in Telangana, India.

MATERIALS AND METHODS

This prospective cross-sectional observational study was conducted in the Department of Pulmonary Medicine at the Government General and Chest Hospital, affiliated with Osmania Medical College, Hyderabad, Telangana spanned over an 18-month period from December 2020 to June 2022.

The study protocol was approved by the Institutional Ethics Committee of Osmania Medical College Written, informed consent was obtained from all participants prior to their bronchoscopic procedures.

Participants were Patients aged 18 to 89 years with radiographically documented mediastinal or hilar lymphadenopathy on chest X-rays or contrast-enhanced CT (CECT) scans, who consented to participate and had negative sputum smears for AFB and CBNAAT.

Patients presenting with acute coronary syndromes, unstable arrhythmias, severe uncorrected bleeding disorders, deep metabolic or organ decompensation, or severe respiratory failure that precluded routine flexible bronchoscopy were excluded.

Pre-procedural assessment included a complete history, physical examination, basic coagulation parameters, and an electrocardiogram. Lymph node size and localization were mapped using pre-bronchoscopy chest CT scans classified under the Wang staging grid and the International Association for the Study of Lung Cancer (IASLC) map.

Flexible bronchoscopy was performed under conscious sedation and local anesthesia using 2% topical lignocaine spray. To procure samples, operators utilized dedicated 21-gauge or 22-gauge Wang needle systems. During passage through the scope's working channel, the needle bevel remained fully retracted within its protective catheter to prevent internal scope damage. Once positioned beyond the scope tip at the targeted anatomical site, the needle was deployed and driven through the intercartilaginous space at an angle greater than 45 degrees using the jabbing or pushing method.

Continuous suction was applied via a 20 to 50 mL syringe, and the needle was agitated to-and-fro within the node to capture cellular material.[1] Suction was released prior to needle withdrawal from the bronchial wall. Collected specimens were expelled onto glass slides; half were fixed in 95% alcohol for standard staining (Papanicolaou and H&E), and the rest were air-dried. Core tissue samples were preserved in formalin for cell block histopathology or saline for microbiological cultures.

Statistical Analysis

Data fields were tabulated into descriptive statistical matrices. Categorical correlations—specifically between patient age groups (under 50 years vs. 50 years and older) and the final benign or malignant diagnosis—were analyzed using the Chi-square test or Fisher's exact test via standard statistical tools. The threshold for statistical significance was set at $p < 0.05$.

RESULTS

The study analyzed 50 patients. The highest age density occurred in the 30–39 age group (22%), followed by the 60–69 age group (20%), with an overall sample mean age of 47.76 years. Gender distribution showed 28 males (56%) and 22 females (44%).

Persistent cough was present in 100% of the study population, and subjective fever was noted in 98%. Other frequent symptoms included weight loss (76%), loss of appetite (74%), dysphagia (38%), and hemoptysis (28%). Comorbidities were minimal: 8% had isolated diabetes mellitus, 4% had isolated hypertension, and 8% had both conditions.

Initial screening chest X-rays revealed mediastinal widening in 30 patients (60%) and pleural effusion in one patient (2%), while 19 patients (38%) had normal radiographic lines. Cross-sectional CECT imaging demonstrated a high density of lymph node enlargement across multiple anatomical levels: Level 4 paratracheal nodes were present in 48 patients (96%), Level 7 subcarinal nodes in 41 patients (82%), and Level 2 upper paratracheal nodes in 25 patients (50%). Calcifications within the enlarged nodes were identified on CT in 13 patients (26%).[1] Direct bronchoscopic inspection revealed a normal tracheobronchial tree in 32 cases (64%), while carinal widening was observed in 18%, bronchial narrowing in 10%, and a combination of both in 8%.

Landmark-guided needle punctures targeted single or multi-station layouts, most frequently involving Level 2, 4, and 7 nodes simultaneously (42%) or Level 4 and 7 combined (28%). Specimen processing

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confirmed that 46 out of the 50 aspirations (92%) yielded adequate cellular material. Landmark-guided c-TBNA established a definitive, conclusive diagnosis in 44 of the 50 total patients, demonstrating an overall diagnostic yield of 88%. The remaining six cases (12%) were inconclusive due to inadequate or non-diagnostic tracking elements.

The definitive pathologic etiologies derived from the adequate sample grid were distributed as follows:

- Malignancy (Primary Lung Cancer): 19 cases (38%)
- Tuberculosis: 12 cases (24%)
- Non-Specific Chronic Inflammation: 10 cases (20%)
- Inconclusive Outcomes: 6 cases (12%)
- Lymphoma: 1 case (2%)
- Sarcoidosis: 1 case (2%)
- Metastatic Carcinoma: 1 case (2%)

An evaluation of disease distribution based on age revealed a distinct clinical trend.[1] Benign diseases predominated entirely in patients under 50 years of age (n = 25), with zero malignant cases documented in this subgroup. Conversely, among the 25 patients aged 50 years and older, 20 cases (80%) were diagnosed as malignant processes. This clinical divide was statistically significant, indicating an increased risk of neoplastic disease in older individuals presenting with mediastinal node enlargement ($p < 0.000001$). There were no occurrences of severe procedural hemorrhage, pneumothorax, or major airway accidents during the study.

Table 1: Patient Demographic and Clinical Symptom Profiles

Parameter	Patient Count (N = 50	Percentage (%)
Age Distribution (Years)		
Under 30	9	18%
30–39	11	22%
40–49	5	10%
50–59	8	16%
60–69	10	20%
70 and Above	7	14%
Gender Profile		
Male	28	56%
Female	22	44%
Clinical Presentation		
Cough	50	100%
Fever	49	98%
Weight Loss	38	76%
Loss of Appetite	37	74%
Dysphagia	19	38%
Hemoptysis	14	28%

Table 2: Final Pathological Classification and Diagnostic Yield of CT-Guided Transthoracic Needle Biopsy (n = 50)

Final Pathological Classification	Diagnostic Yield (n = 50)	Percentage (%)	Sample Adequacy Status
Malignancy (Primary Lung Cancer)	19	38	Adequate
Tuberculosis	12	24	Adequate
Non-Specific Chronic Inflammation	10	20	Adequate
Inconclusive Outcomes	6	12	Inadequate / Non-diagnostic
Lymphoma	1	2	Adequate
Sarcoidosis	1	2	Adequate
Metastatic Carcinoma	1	2	Adequate
Total	**50**	**100**	

DISCUSSION

Evaluating mediastinal lymphadenopathy requires careful differentiation between infectious, granulomatous inflammatory, and malignant processes.[1] In highly endemic geographical regions such as India, distinguishing aggressive bronchogenic carcinomas from conditions like hyperplastic nodal tuberculosis is essential.[1] This study indicates that conventional transbronchial needle aspiration (c-TBNA) remains a highly precise, safe, and effective interventional tool, achieving a 92% specimen adequacy rate and an 88% true positive diagnostic yield.[11]

The sample demographics reflect distinct regional disease variations.[1] The cohort mean age of 47.76 years is significantly younger than the mean ages noted in Western studies, such as those by regional literature groups reporting lines above 60 years.[15] This younger age distribution is driven by the high prevalence of endemic tuberculosis, which frequently impacts younger adult demographics in developing environments.[1] However, age-stratified analyses revealed a highly significant clinical pivot point ($p < 0.000001$); malignant conditions were entirely restricted to patients aged 50 and above, whereas benign processes predominated in the younger cohorts.[14]

The high frequency of involvement at Level 4 (96%) and Level 7 (82%) on CECT confirms that these central locations are highly accessible targets for standard needle aspiration due to their proximity to the trachea and primary carinal borders.[13] By correlating cross-sectional CT films with internal

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landmark navigation, operators achieved diagnostic yields comparable to modern ultrasound-guided networks, even without rapid on-site cytological feedback.[1] Conventional landmark-guided TBNA avoids the high capital equipment costs and specialized technical requirements of EBUS infrastructure, making it a valuable, practical diagnostic choice for healthcare facilities with limited resources.[12]

Limitations

A key limitation of this study is its single-center design within a tertiary care hospital, which may over represent complex or advanced cases compared to general community settings. The sample size (N = 50) also limits detailed statistical cross-tabulations for less frequent conditions like sarcoidosis or lymphoma. Finally, the absence of real-time ultrasound control or ROSE support may increase the operator skill and number of needle passes required to achieve adequate tissue yields.

CONCLUSION

Conventional transbronchial needle aspiration (c-TBNA) is an accurate, safe, and cost-effective technique for diagnosing mediastinal lymphadenopathy. It achieved a 92% sample adequacy rate and an 88% overall diagnostic yield using landmark-guided methods without real-time ultrasound or immediate cytopathology feedback. Given its high diagnostic utility and low operational cost, c-TBNA remains an invaluable interventional tool for respiratory disease management, particularly in resource-limited clinical settings.

Conflict of Interest: Nil

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