

Optimization of Lung and Mediastinal Tumor Diagnosis Using Fluoroscopic-Guided Transthoracic Puncture-Biopsy

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Abstract

Introduction: Pathological confirmation of a newly identified tumor is mandatory to create an adequate treatment plan. Patients may have multiple health comorbidities, making them unsuitable for traditional invasive diagnostic procedures. The percutaneous transthoracic biopsy is a minimally invasive alternative method that can provide tissue samples to identify, diagnose, and classify lung or mediastinal tumors.

Materials and methods: Data from patients who underwent fluoroscopic-guided transthoracic needle biopsy (FGTNB) in a tertiary cancer center in the Republic of Moldova from 2019 to 2021 were collected retrospectively.

Results: We identified 54 patients with lung and 12 with mediastinal tumors. In the lung tumor group, the median age was 57 years; in the mediastinal tumor group, the median was 27.5 years. Most lung tumors were situated in the superior lobes (79.6%) and were found to be less than 5 cm in diameter (70.4%). Most mediastinal tumors were anteriorly located (66.7%) and were found to be more than 10 cm in diameter (58.3%). The sensitivity of transthoracic percutaneous biopsy was 79.6% in lung tumors and 83.3% in mediastinal tumors. The patients we biopsied were identified with either malignancy, infectious pathology, or pulmonary fibrosis. Transthoracic needle biopsy of the lung showed a low rate of pneumothorax (5.6%) and a low rate of bleeding (3.7%). Mediastinal tumor biopsy had a rate of pneumothorax of 16.7%, significantly higher than lung biopsy.

Conclusion: Transthoracic needle biopsy performed under fluoroscopic guidance is a safe and efficient alternative diagnostic procedure for comorbid patients with lung or mediastinal tumors.

Keywords: *needle – transthoracic biopsy, lung tumors, mediastinal tumors, diagnosis*

1. Introduction

Lung cancer is the most common cancer in the world and the leading cause of cancer death worldwide. Central lung cancer with airway obstruction is generally sampled bronchoscopically. Computed tomography (CT)-guided or Fluoroscopic-Guided Transthoracic Needle Biopsy is reserved for lesions difficult to visualize sonographically due to bony or paravertebral localization of the intervention. Lung biopsy is a reliable procedure performed to inform treatment strategy for patients with abnormal findings of the lung. Cytology of biopsy specimens has long been a major diagnostic modality for initial evaluation of patients with lung cancer (1,2).

However, invasive diagnostic procedures can be challenging or impossible in patients with multiple underlying health conditions.

The prevailing lung biopsy techniques that are used today encompass the Percutaneous Transthoracic Lung Biopsy, Open Lung Biopsy, Video-Assisted Thoracic Surgery, Transbronchial Biopsy, and Cryo-biopsy (3). Mediastinal cancers, typically diagnosed in younger patients, often have diverse origins and prognostic factors, so a specific pathologic diagnosis is mandatory due to the array of possible differential diagnoses. Surgeons commonly employ thoracoscopy (including video-assisted thoracoscopic surgery) and mediastinoscopy to obtain tissue samples for histopathologic analysis. Various diagnostic possibilities also exist for transbronchial or transesophageal endoscopic techniques, with or without ultrasonic guidance.

Fluoroscopic-guided transthoracic needle biopsy (FGTNB) is a minimally invasive technique with a high degree of diagnostic accuracy, which offers the possibility of obtaining sufficient material for cytological and histological research. This method is particularly beneficial for patients with unresectable tumors, concurrent diseases that pose a significant risk for radical surgery, or those who refuse surgery, where the traditional histopathological diagnosis is unachievable (4).

When obtaining a biopsy in mediastinal tumors proves challenging or repeated biopsies yield negative results, there may be a calculated need to resort to parasternal mediastinotomy. When biopsy results for lung tumors remain inconclusive, a comprehensive discussion with the multidisciplinary team may warrant the per-

formance of thoracotomy or median sternotomy. A separate study conducted in the Department of Thoracic and Abdominal Surgery in 2013 reported a false-negative rate for detection of malignancy by percutaneous biopsy of only 5%.

This study is focused on presenting the outcomes of FGTNB in diagnosing both lung and mediastinal tumors.

2. Material and Method

We enrolled patients with lung or mediastinal tumors admitted to the Department of Thoracic and Abdominal Surgery of the Oncological Institute of Chişinău, Republic of Moldova, from 2019-2021. The criteria for inclusion were the ineligibility for general anesthesia and the technical accessibility of the tumor. The superior-anterior part of the mediastinum or segment 3 of the upper lobe were considered as the most accessible locations. The exclusion criteria for the procedure were a performance status of 3 or 4, coagulation disorders, and an estimated life expectancy of less than two months. Tumours with endobronchial extension were primarily referred for bronchoscopy. FGTNB was performed in these patients only if the bronchoscopy was unavailable or unfeasible. We conducted a retrospective review of data from the patients' clinical records.

A transthoracic needle biopsy guided by chest radiography was performed in these patients. The Bard Biopsy-Gun system was used to biopsy the lesions with Tru-cut needles with a diameter of 16–18G. The needle gauge was selected according to the characteristics of the lesion: tumors larger than 4 cm or with signs of parietal invasion were biopsied with larger gauge needles.

Histopathological identification of the biopsied tissue was obtained in the Cytopathology Department using the Romanowsky-Giemsa coloration method.

3. Results

A total of 66 patients met the inclusion criteria. Severe concomitant pathologies were present in 31 cases (47.0%), advanced local tumors with distant metastases in 23 patients (34.8%), and mediastinal compression syndrome in 12 patients (18.2%). Fifty-four

patients had lung tumors, and 12 patients had mediastinal tumors.

Most patients with lung tumors were older than 50 (85.2%). On the contrary, two-thirds of the patients with mediastinal tumors were under 30 (66.7%). Most lung tumors (70.4%) were less than 5 cm, and more than half of the mediastinal tumors were more than 10 cm in diameter (58.3%). Detailed information on both patient groups can be found in Table 1.

All patients were initially investigated by radiography or radioscopy. Prior to the admission in the Oncology Institute, where CT investigation was not available, a thoracic CT was performed in other clinics for 59.3% (n=32) of patients with suspected lung cancer and 83.3% (n=10) of those with mediastinal pathology.

The imaging diagnosis in patients with lung and mediastinal tumors can be found in Table 2.

Table 1. Patients' characteristics

	Lung (N=54)	Mediastinum (N=12)
	Number	Number
Sex		
Male	44	11
Female	10	1
Age		
Median	57	27.5
Range	min 21- max 72	min 18- max 65
Investigation		
Radiography	54	12
CT	32	10
Tumor size		
median	5.5 cm	15.1 cm
< 5 cm	38	1
6-10 cm	13	4
11-15 cm	3	6
16-20 cm	0	1

Table 2. Radiological description of patients with lung and mediastinal tumors

Radiological conclusion	Number
Lung tumors (N=54)	
Primary tumor only	27
Primary tumor and metastasis to the same lung	13
Primary tumor with metastases in the same lung and pleurisy	8
Primary tumor and metastases in the contralateral lung	4
Metastatic pleurisy	1
Malignant pleural mesothelioma	1
Mediastinal tumors (N=12)	
Mediastinal tumor	10
Mediastinal tumor and lymphadenopathy	2

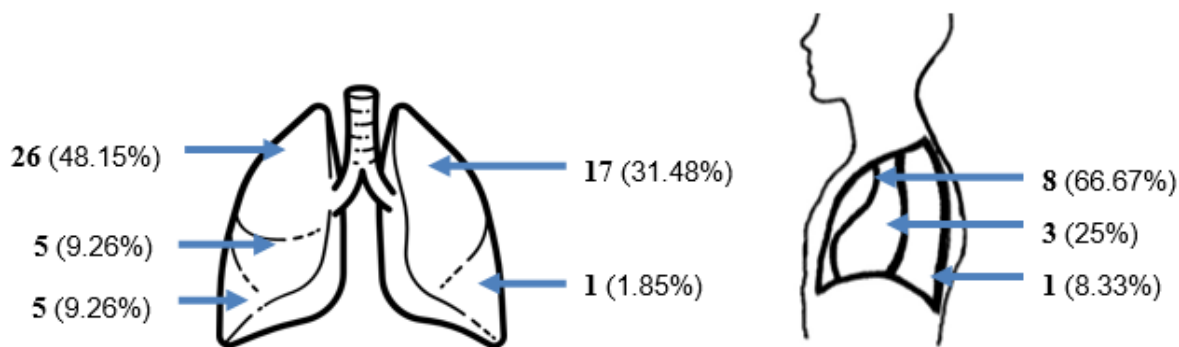


Figure 1. Number of cases corresponding to anatomical location of lung and mediastinal tumors (relative percentage in brackets)

Lung tumors were more frequently located in the superior lobes (79.6%), and most of the mediastinal tumors (66.7%) were in the anterior compartment (see Figure 1).

The transthoracic needle biopsy provided sufficient pathologic material for diagnosing 43 patients (79.6%) with lung tumors. Out of these,

32 cases were identified as lung cancer, the rest were found to be either tuberculosis or pulmonary fibrosis. In the case of mediastinal tumors, the transthoracic biopsy provided a conclusive diagnosis for 10 patients (83.3%) (see Table 3).

Table 3. Morphological diagnosis of lung and mediastinal tumors, respectively

	Number
Lung tumors (N=54)	
Adenocarcinoma	13
Squamous cell carcinoma	11
Tuberculosis	7
Large cell carcinoma	5
Foci of pulmonary fibrosis	4
Small cell carcinoma	3
Inconclusive	11
Mediastinal tumors (N=12)	
Non-Hodgkin's lymphoma	5
Mediastinal lymphoma	3
Hodgkin's lymphoma	2
Inconclusive	2

Lung cancer was identified in 32 (59.3%) of the 54 patients initially diagnosed with lung tumors. The transthoracic biopsy failed to establish a definitive diagnosis in 13 patients. These cases were subjected to further evaluation by the multidisciplinary board. Despite the associated risks, it was determined that a diagnostic thoracotomy was necessary in 6 of these

cases. In 7 instances, the circumstances were deemed inoperable. Complications seen after percutaneous transthoracic needle biopsy in lung tumors were reported in 5 cases (9,3%). Among these, pneumothorax was described in 3 patients (5,6%), who all required subsequent pleural cavity drainage. Hemoptysis occurred in 2 patients (3,7%), which was subsequently

stopped by administering hemostatic agents. In patients with mediastinal tumors, pneumothorax was reported in 2 cases (16,7%) following the percutaneous biopsy.

4. Discussion

A significant advantage of this method is the possibility of performing the procedure under only local anesthesia, which is essential for patients suffering from various comorbidities that generally don't allow undergoing general anesthesia. The good results and low rate of adverse events seen in transthoracic percutaneous puncture in our patients are evident.

In our study, for patients considered unfit for more invasive diagnostic procedures, FGTNB established a conclusive diagnosis in 79.6% of lung tumors and 83.3% of mediastinal tumors, with a rate of manageable adverse effects of 9,3% and 16.7% for lung and mediastinal tumors, respectively. Patients with tumors in the superior lung or the anterior area of the mediastinum were more suitable for the procedure, as the approach was more straightforward, and the risk of adverse events was lower.

A cohort study of 100 patients comparing the accuracy, safety, and effective dose (ED) of FGTNB with CT-guided needle lung biopsy (CTNLB) procedures demonstrated that the adequacy rate of was 95%. The overall sensitivity of FGTNB for detecting malignancy was 87%. Overall accuracy was also 87%. The specificity and positive predictive value were 89% and 99%, respectively, but with a pneumothorax complication rate of 25%. FGTNB is faster, taking only 15 minutes (fluoroscopy-guided CT biopsy of lung lesions ranged from 15 to 41 minutes, with a mean of 23.8 min). FGTNB has proven to be a real-time imaging modality and is associated with low radiation dose to the patient and operator. With the use of a multiplanar fluoroscopic unit, it is usually possible to document the correct placement of the needle tip within the lesion, including small lesions (5).

Abbreviations:

CT – Computed Tomography

FGTPB – Fluoroscopic Guided Transthoracic Puncture Biopsy

CTNLB – CT Guided Needle Lung Biopsy

However, another cohort study of 235 patients using CTNLB demonstrated that the overall diagnostic accuracy was 95.4%, with 95.52% sensitivity, 100% specificity. Complications occurred in 51 patients, and the overall complication rate was 21.7%. The most frequent complication was minor pneumothorax with a rate of 19.1%. (6)

Other studies have demonstrated that the effectiveness of this method is 86% with radiological guidance and 95% when using CT guidance. When using CT as a guiding method, sufficient pathological material was obtained for cytological examination in 89% of patients and for histological diagnosis in 93% of patients. (7,8).

Over the last few years, improvements in imaging, needles, and procedural techniques have all reduced complication rates. Some rare complications include air embolism and tumor seeding, seen in less than 1% of cases. Factors associated with increased rate of complications include the patient's age, comorbidities, tumor size and location, and the number of punctures performed (9,10).

The limitations of our study were performing the puncture only with the use of radiology, which did not allow us to compare the effectiveness of using CT guidance. We also only compared a relatively small number of patients, and these results generally only apply to patients with severe comorbidities who had contraindications for other, more traditional diagnostic interventions.

5. Conclusions

For patients with lung or mediastinal tumors where obtaining a surgical tissue biopsy is not feasible, and the CT-guided biopsy is not available, the fluoroscopic guided transthoracic biopsy may provide the necessary material for pathologic diagnosis with a satisfactory success rate and relatively low risk of manageable adverse events.

Statements:

Author's contributions: MV, SD, and PC conceived the discussed topic; MV, CP, SD, MA, and MEC drafted the initial paper; MV, MA, MEC, and CC made the final revisions to the final paper.

Consent for publication: As the corresponding author, I confirm that the manuscript has been read by and approved for submission by all authors.

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