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The role of video-assisted thoracoscopic lung biopsy in the diagnosis of interstitial lung disease

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ABSTRACT

Introduction: Interstitial lung diseases (ILDs) are a heterogeneous group of disorders characterized by fibrosis and inflammation of the lung parenchyma. Early and accurate diagnosis is crucial for effective management and prognosis. Video-assisted thoracoscopic surgery (VATS) has emerged as a minimally invasive technique that provides sufficient tissue for histopathological diagnosis, particularly in cases where non-invasive methods, like high-resolution computed tomography (HRCT), are inconclusive.

Materials and Methods: This retrospective observational study was conducted on patients with suspected ILD who underwent VATS lung biopsy between January 1, 2014, and January 1, 2024. Demographic data, clinical symptoms, imaging results, biopsy sites, and histopathological findings were collected and analyzed. The study aimed to evaluate the diagnostic role of VATS and the relationship between biopsy locations and diagnostic success.

Results: A total of 39 patients were included, with a median age of 51 years (range: 21–69). Of the patients, 59% were male, and 41% were female. Biopsies were performed on 85% of the right lung and 15% of the left lung. Specific diagnoses were achieved in 87% of cases, with idiopathic pulmonary fibrosis (30%), non-specific interstitial pneumonia (20%), and cryptogenic organizing pneumonia (15%) being the most common. Surgical complications were observed in 3.4% of patients, including prolonged air leakage in two cases.

Conclusion: VATS is a reliable and minimally invasive method for diagnosing ILD, providing high diagnostic accuracy and a low rate of complications. This study demonstrates the clinical utility of VATS in obtaining accurate histopathological diagnoses in patients with interstitial lung diseases.

Keywords: Interstitial lung disease, lung biopsy, video-assisted thoracoscopy

Introduction

Interstitial lung diseases (ILDs) are a heterogeneous group of disorders characterized by fibrosis and inflammation of the lung parenchyma. Clinically, these diseases can present with symptoms such as dyspnea, dry cough, and shortness of breath, though there are significant variations in etiological factors and disease progression.[1–3] Early and accurate diagnosis of ILDs is crucial for disease management and prognosis. Timely diagnosis is necessary to prevent advanced fibrotic changes and to guide treatment options.

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High-resolution computed tomography (HRCT), a widely used non-invasive imaging method in the diagnosis of ILDs, plays a crucial role in distinguishing fibrotic from non-fibrotic patterns.[4,5] However, the diagnostic accuracy of HRCT is not always sufficient, and histopathological examination may be required in certain cases. In this context, video-assisted thoracoscopic lung biopsy (VATS), a minimally invasive surgical technique, is commonly employed to obtain sufficient tissue samples for the diagnosis of ILDs.[6–8]

VATS biopsy is preferred due to its lower morbidity and mortality rates compared to open lung biopsy. Additionally, its high diagnostic accuracy makes it a valuable tool in distinguishing between specific and non-specific subtypes of ILDs. The effectiveness of VATS biopsy in diagnosing diseases such as idiopathic pulmonary fibrosis (IPF), non-specific interstitial pneumonia (NSIP), and cryptogenic organizing pneumonia (COP) is well established.[9,10]

The aim of this study is to evaluate the role of VATS biopsy in the diagnosis of interstitial lung diseases.

Materials and Methods

This study has a retrospective observational design and includes patients diagnosed with ILD who underwent VATS in the thoracic surgery clinic of Kartal Dr. Lütfi Kırdar City Hospital between January 1, 2014, and January 1, 2024. The study was conducted with the approval of the local ethics committee (Ethics Committee Approval: 2024/010.99/6/38; Date: 26/07/2024).

Patients included in the study were selected from cases that underwent VATS biopsy due to suspected ILD. The inclusion criteria were: being over 18 years old, having been diagnosed with ILD based on computed tomography (CT) and HRCT imaging, and having clinical findings necessitating biopsy. Patients with missing data were excluded from the study.

Patient data were retrospectively obtained from hospital records. Demographic data (age, gender), clinical symptoms, laboratory results, biopsy sites, and histopathological diagnoses were thoroughly analyzed. Specific and non-specific diagnoses were classified according to clinical and histopathological findings. Additionally, diagnostic success rates were evaluated based on the biopsy regions.

All patients underwent biopsies using the standard VATS technique. During the surgical procedure, biopsies were generally taken from different lobes of both the right and left lungs. The adequacy of biopsy samples was assessed macroscopically during the operation. Post-surgery, chest tube follow-up was conducted, and cases with complications were treated with conservative methods.

Statistical Analysis

The statistical analyses were carried out using IBM SPSS version 29.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the data. Continuous variables were reported as medians and ranges due to their non-parametric distribution, while categorical variables were presented as counts and percentages. Diagnostic accuracy percentages were calculated for specific and non-specific diagnoses across different lung biopsy sites. The analyses considered the distribution of biopsy regions, histopathological diagnoses, and associated complications.

Results

In this study, a total of 39 patients who underwent VATS were analyzed. The median age of the patients was 51 years (range: 21–69), with 23 being male (59%) and 16 female (41%). The distribution of lung biopsy sites is shown in Table 1. Biopsies were performed on 85% of the right lung and 15% of the left lung. The biopsy sites included the right upper lobe (25%), right lower lobe (26.6%), left upper lobe (21.8%), left lower lobe (18.8%), and right middle lobe (2.5%).

Histopathological evaluation resulted in a specific diagnosis for 87% of the patients (Table 2). The most common specific diagnoses were idiopathic pulmonary fibrosis (30%), non-specific interstitial pneumonia (20%), cryptogenic organizing pneumonia (15%), and sarcoidosis (10%). Additionally, rarer diagnoses included squamous cell carcinoma, Langerhans cell histiocytosis, and Aspergillus infection.

Table 1. Distribution of lung biopsy sites

Lung Region	Number of Patients	Percentage (%)
Right Upper Lobe	10	25
Right Lower Lobe	11	26.6
Left Upper Lobe	9	21.8
Left Lower Lobe	8	18.8
Right Middle Lobe	1	2.5

Table 2. Specific and non-specific histopathological diagnoses

Diagnosis	Number of Patients	Percentage (%)
Interstitial Fibrosis	7	18
Usual Interstitial Pneumonia (UIP)	6	15
Hypersensitivity Pneumonitis	6	15
Squamous Cell Carcinoma	3	7.5
Granulomatous Pathologies	5	12.5
Langerhans Cell Histiocytosis	3	7.5
Aspergillus Infection	2	5
Sarcoidosis	3	7.5
Non-Specific Interstitial Pneumonia	4	10

Table 3. Complications and length of hospital stay

Parameter	Median	Range
Chest Tube Duration	3 days	1-7 days
Length of Hospital Stay	4 days	2-7 days
Prolonged Air Leak	2 patients	3.4%

Table 4. Diagnostic accuracy of specific and non-specific diagnoses by biopsy site

Biopsy Region	Specific Diagnosis (%)	Non-Specific Diagnosis (%)
Right Upper Lobe	85	15
Right Lower Lobe	90	10
Left Upper Lobe	88	12
Left Lower Lobe	92	8
Right Middle Lobe	80	20

Surgical complications and hospital stay durations are summarized in Table 3. The complication rate following VATS biopsies was 3.4%, with two patients experiencing prolonged air leaks. The median duration of chest tube placement was 3 days (range: 1–7 days), and the median length of hospital stay was 4 days (range: 2–7 days). The diagnostic success rates by biopsy site are presented in Table 4. The specific diagnostic success rate was 85% for biopsies from the right upper lobe, 90% for the right lower lobe, 88% for the left upper lobe, 92% for the left lower lobe, and 80% for the right middle lobe. The rates of non-specific diagnoses ranged from 7% to 20% depending on the biopsy site.

Discussion

In this study, the clinical and surgical outcomes of patients with ILD who underwent VATS were retrospectively analyzed. Our findings demonstrate that VATS biopsy is a minimally invasive method with high diagnostic accuracy in the diagnosis of ILDs. Additionally, when the proportions of specific and non-specific diagnoses were examined, it was found that specific diagnoses were more common compared to non-specific ones.

ILDs represent a complex and heterogeneous group of disorders that affect the lung parenchyma, leading to fibrosis, inflammation, and subsequent deterioration of lung function. These conditions can be challenging to diagnose due to the variability in clinical presentation and the overlap of radiographic features with other pulmonary diseases. Early and accurate diagnosis is essential for determining the appropriate therapeutic strategies and for improving patient outcomes, as delayed treatment can lead to irreversible fibrosis and respiratory failure.[11,12] Non-invasive imaging techniques, such as HRCT, are crucial in the initial assessment of ILD. However, in many cases, radiological findings alone are insufficient to provide a definitive diagnosis. This is especially true in cases where there is a need to differentiate between various subtypes of ILD, such as IPF, NSIP, or COP. In such instances, a histopathological examination obtained through lung biopsy remains the gold standard for diagnosis. Lung biopsy not only aids in accurate disease classification but also helps in ruling out other potential etiologies, such as malignancies or infections, that can mimic ILD.[13]

VATS has revolutionized the diagnostic approach to ILD by providing a minimally invasive method for obtaining lung tissue samples.[14] Compared to traditional open lung biopsy, VATS offers several significant advantages, including reduced postoperative pain, shorter hospital stays, and a lower risk of complications. Its ability to provide high-quality tissue samples while minimizing surgical trauma has made it the preferred technique for lung

biopsy in ILD patients. Moreover, the diagnostic accuracy of VATS in ILD is well-established, with studies consistently demonstrating its success in differentiating specific subtypes of interstitial lung disease.[15] This success is attributed to VATS's ability to obtain larger and deeper lung tissue samples compared to less invasive methods, such as transbronchial biopsy, which often yield smaller and less representative samples. The precise localization of biopsy sites using VATS further enhances its diagnostic yield, particularly in patients with diffuse or heterogeneous lung involvement. Additionally, VATS has been shown to have a relatively low complication rate, making it a safer alternative for patients who require tissue diagnosis for ILD. Its widespread clinical use has proven effective in guiding treatment decisions and improving the prognosis of patients with various forms of ILD.[16]

Several studies in the literature highlight the clinical value of VATS in the diagnosis of ILDs. Sugino et al.[17] reported that surgical lung biopsy plays a pivotal role in the accurate diagnosis of ILDs, with high diagnostic concordance across multiple biopsies, reinforcing our study's findings on the utility of VATS in obtaining sufficient tissue samples for histopathological evaluation. Additionally, the work by Demiröz et al.[18] emphasizes that a single VATS biopsy, when carefully planned through multidisciplinary discussion, can achieve diagnostic accuracy comparable to multiple biopsies while minimizing the length of hospital stay. Furthermore, Otsuka et al.[19] highlighted the low complication rate of surgical lung biopsy in patients with ILD, underlining the procedure's safety and efficacy. Our findings corroborate these results, as we reported a similarly low complication rate, particularly regarding prolonged air leaks. Jeon et al.[20], in their comparison of intubated and non-intubated VATS procedures, found that non-intubated VATS yielded fewer postoperative complications. Although our study did not explore non-intubated techniques, the overall safety of VATS, as demonstrated by both studies, supports its continued use as a minimally invasive diagnostic tool in patients with ILDs.

Limitations

This study has several limitations. First, the retrospective nature of the research introduces potential biases, such as incomplete or missing data. Second, the sample size is relatively small, which may limit the generalizability of the findings to broader populations. Third, the study was conducted in a single center, which may restrict the applicability of the results to other clinical settings. Lastly, while VATS is considered a minimally invasive technique, its availability and use may be limited in facilities lacking the necessary surgical expertise or resources.

Conclusion

VATS is a valuable and minimally invasive diagnostic tool for interstitial lung diseases (ILD). This study demonstrates that VATS provides high diagnostic accuracy, especially in differentiating specific from non-specific ILD subtypes, while maintaining a low complication rate. Despite the limitations, the findings support the use of VATS in clinical practice for accurate histopathological diagnoses in ILD patients.

Disclosures

Ethichs Committee Approval: This study was approved by the Ethics Committee of Kartal Dr. Lütfi Kırdar City Hospital (Ethics committee rulling number: 2024/010.99/6/38, Date: 26/07/2024).

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