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ORIGINAL ARTICLE

Anterior Mediastinotomy: Is it Still a Reliable Diagnostic Method in the Era of Minimally Invasive Techniques? - A Retrospective Analysis of 73 Cases

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Abstract

Background: Rapid diagnosis of anterior mediastinal masses, which can arise from a wide range of diseases, is crucial for adopting appropriate treatment approaches.

Methods: The demographic, radiological, operative, and pathological data of 73 patients who underwent diagnostic procedures—computed tomography (CT)-guided transthoracic fine-needle aspiration biopsy (TTFNAB), anterior mediastinotomy (AM), or video-assisted thoracoscopic surgery (VATS)—for anterior mediastinal masses between 2013 and 2023 were retrospectively analyzed.

Results: The mean age of the patients was 45.29±18.51 years (range: 9–82), and 40 (54.8%) were male. The most common presenting symptom was chest pain (33%), while incidental detection occurred in 23.3% of cases. Initial biopsy procedures yielded a pathological diagnosis in 90.4% of cases, with lymphoma being the most common diagnosis (42.4%). Compared to surgical biopsies, TTFNAB had significantly lower diagnostic yield and shorter hospital stay but was performed in significantly older patients ($p=0.025$, $p<0.001$, $p<0.001$, respectively). Patients who underwent VATS had significantly smaller tumor sizes compared to other procedures (6.25cm, $p=0.004$). No significant differences were found among the groups in terms of complications, SUVmax values, sex distribution, or tumor laterality. AM and VATS demonstrated similar outcomes except for tumor size. The overall mean hospital stay was 2.59±2.03 days, and no procedure-related mortality was observed.

Conclusion: Surgical biopsies provide a higher diagnostic yield than needle biopsies for anterior mediastinal masses. Despite a decline in its use in recent years, AM remains a viable option alongside VATS, particularly for diagnosing larger anterior mediastinal masses, given their comparable diagnostic accuracy and morbidity rates.

Keywords: Anterior mediastinal mass, anterior mediastinotomy, lymphoma

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INTRODUCTION

Anterior mediastinal masses encompass a broad spectrum of pathologies, including thymic disorders, lymphomas, germ cell tumors, and mediastinal cysts. Based on the initial or final diagnosis, treatment may involve various multimodal approaches, such as direct surgical excision, definitive chemotherapy, chemoradiotherapy, neoadjuvant chemotherapy, and/or surgery following radiotherapy (1). In cases of anterior mediastinal masses that exhibit aggressive growth with invasion of adjacent structures or compression-related symptoms, rapid diagnosis plays a critical role in determining the appropriate therapeutic approach. Diagnostic procedures, such as less invasive techniques like ultrasound or computed tomography (CT)-guided transthoracic fine-needle aspiration biopsy (TTFNAB), anterior mediastinotomy (AM), and video-assisted thoracoscopic surgery (VATS), can be utilized based on the patient's age and clinical condition. The diagnostic accuracy of needle biopsies varies depending on the underlying pathology. For instance, pathologies like lymphoma, which may involve dense fibrosis, have a lower diagnostic yield with small biopsies, whereas thymic disorders tend to be more readily diagnosed with higher accuracy. Consequently, surgical biopsies are considered the gold standard for diagnosis in cases of anterior mediastinal masses (2,3).

This study aims to compare the diagnostic accuracy, complication rates, and length of hospital stay among patients who underwent TTFNAB, AM, and VATS for diagnostic purposes due to anterior mediastinal masses.

MATERIALS AND METHODS

The study was approved by the local ethics committee (Approval Date: 12.06.2024 Approval Number:2024-BÇEK/80) and was conducted in accordance with the Helsinki Declaration of Human Rights.

A total of 73 patients who presented to the Thoracic Surgery Clinic with anterior mediastinal masses between 2013 and 2023, and who underwent diagnostic procedures with fully accessible data, were included in this study. Patients who underwent direct surgical excision without a diagnosis were excluded.

The demographic data of the patients, presenting complaints, tumor size, Positron Emission Tomography/Computed Tomography (PET/CT) standard uptake value maximum (SUVmax) level, side of the surgical procedure, pathological diagnosis, diagnostic accuracy, complications, and length of hospital stay were retrospectively analysed. Patients were categorized into three groups based on the initial biopsy method: VATS, AM and TTFNAB and then these three groups were compared.

Statistical Analysis

All statistical analyses were performed using SPSS 24.0 software. Descriptive statistics were presented as frequency (n), percentage (%), and mean ± standard deviation (mean ± SD) for age. Normality tests were conducted for mass size (cm), SUVmax value, and length of hospital stay, confirming normal distribution. Groups were classified according to the type of diagnostic procedure performed. For continuous numerical variables with normal distribution in three groups, a One-Way ANOVA was applied, whereas for comparisons between two groups, an independent samples t-test was used. The distribution of categorical variables among groups was assessed using Pearson's chi-square test or Fisher's exact test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 73 patients were included in the study, with a mean age of 45.29 ± 18.51 years (range: 9–82). Of these, 40 patients (54.8%) were male. In 23.3% of the cases, the anterior mediastinal mass was detected incidentally. The presenting symptoms of the patients are summarized in Table 1.

The average mass size was 7.83 ± 3.86 cm, and the mean PET/CT SUVmax value was 13.28 ± 7.41. The majority of biopsy procedures (65.8%) were performed on the left side. A diagnosis was achieved in 66 patients (90.4%) after the initial biopsy procedures, and the pathological results are presented in Table 2. Figure 1 and figure 2 presents PET/CT images of an anterior mediastinal mass diagnosed via VATS and AM, respectively.

Complications occurred in 11 patients (15.1%) following the biopsy procedures. In patients who underwent VATS, the procedure was routinely completed with the placement of a chest drain. During anterior mediastinotomy (AM), pneumothorax was observed in 4 patients (3 of whom required a drain), and in 1 patient following

Table 1. Presenting Complaints at Hospital Admission		
Symptom	**Number (n)**	**Percentage (%)**
Chest pain	24	33.0
Dyspnea	18	24.7
Asymptomatic	17	23.3
Cough	15	20.6
Hoarseness	6	8.2
Hemoptysis	2	2.8
Neck swelling	1	1.4
Fever	1	1.4
Sweating	1	1.4
Weight loss	1	1,4
Hypertension	1	1.4

TTFNAB (who also required a drain). In addition to pneumothorax, other complications observed included prolonged air leak in 2 patients, bleeding, pleural effusion, chylothorax, and atelectasis requiring bronchoscopy in 1 patient each. The mean hospital stay for all patients was 2.59 ± 2.03 days, and no procedure-related mortality was reported.

Table 2. Pathological Diagnoses in Anterior Mediastinal Mass Biopsies		
Diagnosis	**Number (n)**	**Percentage (%)**
Non-diagnostic procedure	7	9.6
Hodgkin's lymphoma	16	21.9
Non-Hodgkin's lymphoma	15	20.5
Thymic lesions	11	15.1
Non-small cell lung cancer	10	13.7
Granulomatous lymphadenitis	6	8.2
Small Cell Lung Cancer	2	2.7
Breast cancer metastasis	2	2.7
Synovial sarcoma	1	1.4
Plummer's disease	1	1.4
Sclerosing mediastinitis	1	1.4
Radiation-induced fibrosis	1	1.4

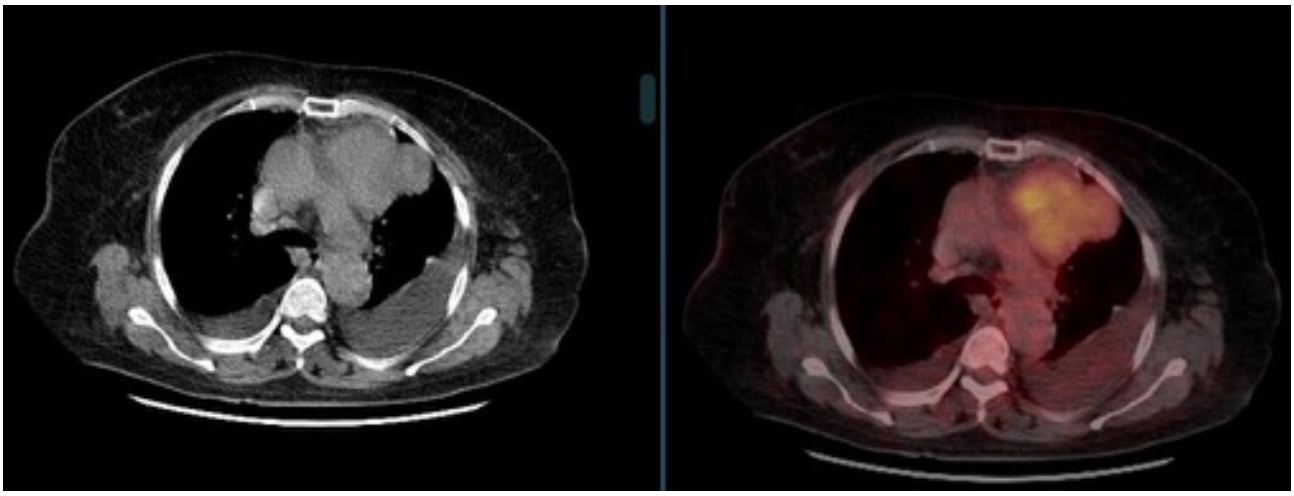

Figure 1: PET/CT images of an anterior mediastinal mass case diagnosed via VATS.

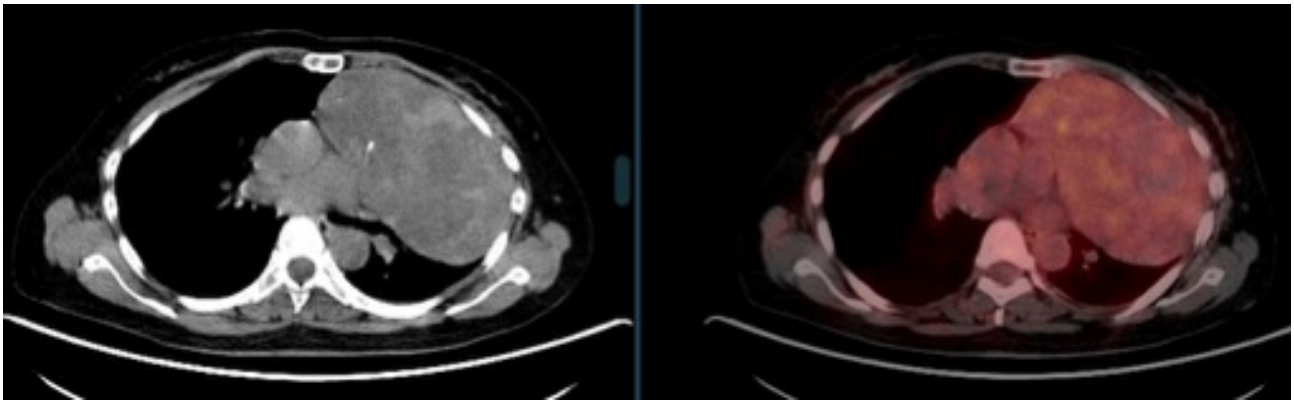

Figure 1: PET/CT images of an anterior mediastinal mass case diagnosed via anterior mediastinotomy.

Biopsy procedures were performed as follows: 30 patients (41.1%) underwent VATS, 29 patients (39.7%) underwent AM, and 14 patients (19.2%) underwent TTFNAB. Statistical analysis of patients based on the procedure type revealed that the mean age of the TTFNAB group (63.93 years) was significantly higher compared to the other diagnostic methods, while the length of hospital stay was significantly shorter ($p < 0.001$). The diagnostic accuracy of TTFNAB was significantly lower than that of surgical biopsy methods ($p = 0.025$). The mass size in the VATS group (6.25 cm) was significantly smaller compared to the other diagnostic procedures ($p = 0.004$). No significant differences were found between groups for gender, side of the procedure, or PET/CT SUVmax values. There was no significant difference in complication rates between the groups. No patient required conversion to open surgery.

When comparing surgical biopsy procedures, the average mass size in the AM group (9.52 cm) was significantly larger than in the VATS group ($p = 0.001$). No statistically significant differences were found between the VATS and AM groups in terms of age, gender, PET/CT SUVmax value, hospital stay, diagnostic accuracy, or complication rates (Table 3).

DISCUSSION

A significant proportion of mediastinal lesions are located in the anterior mediastinum and can arise from a wide range of pathologies. In a recent study analyzing resected mediastinal lesions, approximately 65% of lesions were found in the anterior mediastinum. Furthermore, lesions detected incidentally without symptoms

Table 3. Comparison of Biopsy Procedures

Parameter	Diagnostic Procedure			Statistical analysis
	VATS*	AM*	TTFNAB*	p
Age	41.60±15.05	40.10±18.86	63.93±12.65	<0.001
Tumor size (cm)	6.25±2.92	9.52±4.39	7.73±3.18	0.004
SUVmax value	13.53±6.36	13.81±8.64	11.63±7.41	0.650
Length of hospital stay	3.37±2.01	2.79±1.37	0.50±0.50	<0.001
Gender Male Female	18 (%60) 12 (%40)	13 (%44.8) 16 (%55.2)	9 (%64.3) 5 (%35.7)	0.368
Side Right Left	11 (%36,7) 19 (%63.3)	9 (%31) 20 (%69)	5 (%35.7) 9 (%64.3)	0.894
Diagnostic accuracy Diagnostic Not Diagnostic	28 (%93,3) 2 (%6.7)	28 (%96.6) 1 (%3.4)	10 (%71.4) 4 (%28.6)	0.025
Complications Present Absent	4 (%13.3) 26 (%86.7)	6 (%20.7) 23 (%79.3)	1 (%7.4) 13 (%92.9)	0.479

VATS: Video-Assisted Thoracoscopic Surgery, AM: Anterior Mediastinotomy, TTFNAB: Transthoracic Fine Needle Aspiration Biopsy

were more commonly found than those presenting with symptoms. The incidence of incidental findings notably increased during the COVID-19 pandemic. Following incidental detection, chest pain was reported as the most frequent presenting symptom (4). In our study, chest pain was similarly the most common presenting symptom, and nearly a quarter of patients had asymptomatic masses incidentally detected.

The therapeutic approach to anterior mediastinal masses can vary significantly depending on the pathological diagnosis, highlighting the importance of accurate and timely diagnosis. Studies have reported that the diagnostic yield of needle biopsies is lower compared to surgical methods (5). In studies assessing the diagnostic efficacy of transthoracic needle biopsy in patients with anterior mediastinal masses, diagnostic rates are around 75% (6,7). In our study, this rate was 71.4%, which aligns with the literature and is significantly lower than the rate for surgical biopsies. The lower diagnostic yield of needle biopsies not only necessitates additional procedures but also delays the attainment of a correct diagnosis. Nevertheless, TTNB is used in cases where the patient's clinical condition is unsuitable for surgery under general anesthesia. In our cohort, the mean age of patients who underwent TTNB was significantly higher compared to those who underwent surgical biopsies, which is likely related to the clinical status of the patients.

Anterior mediastinal masses are frequently thymic in origin (4). A survey among ESTS members regarding the management of thymic malignancies revealed that 91% of surgeons did not routinely seek histopathological confirmation of diagnosis when a thymic lesion was sus-

pected. Surgeons generally prefer surgical biopsy when lymphoma is suspected, when neoadjuvant therapy is planned, or when the lesion is considered irresectable (8). In our center, preoperative confirmation of diagnosis is not routinely sought for suspected thymic malignancies; however, biopsy is preferred for suspected lymphoma or irresectable anterior mediastinal lesions. In our study, lymphoma constituted the majority of diagnoses in biopsied patients, supporting these findings.

Anterior mediastinal masses can grow to substantial sizes. As the size of the mass increases, complications such as cardiac compression, bronchospasm, and arrhythmias may arise, depending on the patient's position and anesthesia. Consequently, anesthesia management in patients with anterior mediastinal masses is particularly challenging. Moreover, the use of local anesthesia for surgical biopsy has become more prevalent as an alternative to general anesthesia (9-12). Studies have shown that VATS (Video-Assisted Thoracic Surgery) performed in the lateral decubitus position offers advantages over anterior mediastinotomy performed in the supine position in terms of operative complications (11,13). In addition to anesthesia-related complications, other potential complications include bleeding, chylothorax, pneumothorax, and wound infections (14). Hybrid approaches using both AM (Anterior Mediastinotomy) and VATS have also been investigated. These studies suggest that combining standard mediastinotomy with a small incision along the anterior axillary line for camera placement allows for easier biopsy and better detection of procedural bleeding (15,16). In our AM group, one patient required a blood transfusion due to hemorrhage during biopsy. Mass size was significantly larger in patients who underwent AM compared to those who underwent VATS. This difference is likely attributable to the limited exposure in AM, which may lead surgeons to feel more comfortable performing biopsies of larger lesions. Although exposure in AM is not as optimal as in VATS, the advantage of completing the procedure without routine chest drain placement and without entering the pleural cavity is noteworthy. Additionally, AM causes fewer pleural adhesions compared to VATS in patients for whom mass excision is planned in a second session based on pathological results. Despite a roughly half-day shorter hospitalization in the AM group, no significant differences were observed between the groups in terms of hospitalization duration or complications.

The main limitation of our study is the potential selection bias inherent in its retrospective design.

In conclusion, we have demonstrated that the diagnostic value of surgical biopsies, which can be safely and effectively performed in patients with anterior mediastinal masses, is superior to that of needle biopsies. Anterior mediastinotomy, whose use has declined in recent years, can still be performed with diagnostic accuracy and complication rates comparable to those of VATS, particularly in the case of larger masses.

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Abbreviations list

AM: anterior mediastinotomy
CT: computed tomography
ESTS: European Society of Thoracic Surgeons
PET/CT: Positron Emission Tomography/Computed Tomography
SUVmax: standard uptake value maximum
TTFNAB: transthoracic fine-needle aspiration biopsy
VATS: video-assisted thoracoscopic surgery

Ethics approval and consent to participate

The study was approved by Ankara Atatürk Sanatoryum Training and Research Hospital Ethical Committee (Approval Date: 12.06.2024 Approval Number:2024- BÇEK/80)

Consent for publication

All data used in this publication, including imaging and surgical records, were deidentified to ensure patient confidentiality. Consent for publication of the anonymized data was obtained from the relevant institutional authority.

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Idea/Concept: İT, HE. Desıgn: İT, HE. Control/Supervısıon: SŞEG, PB. Data Collectıon And/Or Processıng: NS, EHİ, NG. Analysıs And/Or Interpretatıon: İT, NS, EHİ. Lıterature Revıew: İT, HE. Wrıtıng The Artıcle: İT, MÇ. Crıtıcal Revıew: NG, PB.

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