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Efficient and safe method in the diagnosis of thoracic lesions: Ultrasound-guided needle aspiration biopsy

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Abstract:

BACKGROUND: This study aimed to investigate the diagnostic value of fine-needle aspiration biopsy (FNAB) performed under the guidance of thoracic ultrasonography (USG) for the diagnosis of thoracic lesions such as peripheral lung lesions, pleural lesions, mediastinal lesions, and chest wall or supraclavicular metastases of lung lesions.

MATERIALS AND METHODS: Cases with thoracic lesions that were found eligible for biopsy by thoracic USG and underwent FNAB between January 2008 and December 2016 were included in the study. Demographical characteristics and radiological findings of the cases, lesion size as detected by USG, sonographic patterns, number of FNABs per lesion, diagnosis based on FNAB, final diagnosis of inconclusive cases and the methods used to establish the final diagnosis, and developed complications were recorded.

RESULTS: FNAB was performed for peripheral lung lesion in 188 (72.6%), mediastinal mass in 23 (8.9%), chest wall metastasis of lung tumor in 23 (8.9%), supraclavicular lymph node metastasis of lung tumor in 18 (6.9%), and pleural lesion in 7 (2.7%) cases. The corresponding diagnostic accuracy was 78.7%, 78.2%, 95.6%, 94.4% and 85.7%, respectively. A diagnosis could be made in 211 (81.4%) of 259 cases (195 [92.4%] malignant and 16 [7.6%] benign). The overall diagnostic success of the procedure was 81.4%, and the success rate to diagnose malignant and benign lesions was 81.9% and 76.1%, respectively. Pneumothorax which needs pleural tube in placement was seen in five patients, with peripheral lesion as the major complication.

CONCLUSION: USG-guided FNAB performed for thoracic lesions is associated with a high rate of diagnostic success (81.4%) and a low rate of major complications (1.9%).

Keywords:

Fine-needle aspiration biopsy, thoracic ultrasonography, transthoracic lung biopsy

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Introduction

Ultrasonography (USG) device functions based on the principle that sound

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waves are transmitted to the tissues with the aid of a transducer, and sound waves are reflected back to the device. Images of the different tissues may vary because the reflecting of the sound waves of different tissues is different. Because the soft tissues transmit the sound waves well, they are sonographically visualized better. Due to its high air content, normal lung parenchyma cannot be visualized as good as the other solid organs. Therefore, thorax USG was limited to only for the investigation of the pleural effusion for years.[1] Thorax USG has recently been used in the diagnosis of various lung diseases and for interventional procedures owing to the increased interest of pulmonologists to thorax USG. The diagnosis of pneumothorax, pulmonary embolism, and pulmonary edema; pleural fluid sampling with thoracentesis; thorax tube and pleural catheter insertion; and USG-guided transthoracic lung biopsies (TTBs) may be counted as the procedures.[2,3]

USG-guided TTB procedure has been used efficiently and safely for long time in the diagnosis of peripherally located pulmonary lesions settled on the chest wall which do not include air inside. The most important advantages of the procedure compared with the computed tomography (CT) and fluoroscopy-guided biopsies may be counted that patients and physicians are not exposed to radiation, and the procedure can be performed in real-time manner (the needle can be followed up within the targeted lesion).[4] The diagnostic success of the USG-guided TTBs was reported as between 64.5% and 96.8% in the studies conducted on this topic.[5-7]

There are large number of studies which were separately published associated with the thorax USG-guided fine-needle aspiration biopsies (FNAB) to peripheral pulmonary tumors, mediastinal masses, chest wall lesions, and supraclavicular lymphoid glands.[6-10] The difference, and the aim of the present study is to demonstrate the safety and efficacy of USG-guided NAB in thoracic lesions and to draw attention to the point that these procedures can be performed by the pulmonologists.

Materials and Methods

Patient population

The files of the patients who were performed USG-guided FNAB between January 2008 and December 2016 in the chest disease clinic of our hospital were investigated in the present retrospective and observational study. The clinical and demographic findings, smoking history, and radiologic findings were recorded. The dimensions of the ultrasonographically detected lesions, the sonographic patterns, the number of NAB per lesion, the diagnoses detected after USG-guided NAB of the patients, the final diagnoses of the patients who were not diagnosed with a disease, final diagnosis methods, and complications after the procedure were recorded.

USG-guided FNAB is performed in the USG unit of our clinic after sonographic detection of peripheral lesions localized in the chest wall with no inclusion of pulmonary tissue with air that stemmed from the pulmonary parenchyma after investigation of the thorax CTs, and of mediastinal lesions localized to the chest wall with no inclusion of an area with air, and of lesions metastasized to chest wall and supraclavicular lymphoid glands in the presence of lesion in the breast and lung. In addition, informed consent form of the patients is routinely obtained before the procedure in our USG unit, and the complete blood, biochemical tests, and coagulometry tests are checked before the procedure. Patients with normal platelet counts and INR levels were included in the study. Our study was planned in accordance with the International Helsinki Declaration.

Procedures

Thorax ultrasonography in peripherally located and pleural-based pulmonary masses

Thorax USG was performed using a 3.5 MHz convex probe and on abdominal mode with the General Electric (GE) Logic 7 device by an experienced pulmonologist. Starting from the region where the lesion was radiologically detected, the whole thorax was screened including the normal areas through the parasternal line, medial and lateral clavicular lines, anterior-medial and posterior axillary lines, lateral and medial scapular lines and paravertebral line moving the probe in transverse and longitudinally through the intercostal spaces in sitting position, or in supine, oblique, lateral decubitus positions if required[11] [Figure 1].

Thorax ultrasonography in mediastinal masses

Thorax USG was performed using a 3.5 MHz convex probe and on abdominal mode with the GE Logic 7 device in mediastinal masses. First, the probe was placed on the intercostal distance adjacent to sternum in bilateral parasternal region, and thorax USG was performed by screening all mediastin including the parasternal regions, then suprasternal and infrasternal–subcostal region. Then, the mass lesion suspected region on thorax CT was screened in sitting position, in supine positions in required patients, oblique, and lateral decubitus position moving the probe transversely and longitudinally through the intercostal spaces until the lesion is detected with parasternal, suprasternal, or infrasternal–subcostal approach in accordance with the lesion localization, and until an appropriate region was detected for performing biopsy procedure.[4]

The sonographic appearance, and dimensions of the lesions, the entry distance to lesion from the subcutaneous

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tissue, and the moving distance of the needle within the lesion were measured by thorax USG examination. The presence of vascular structures within the biopsy region, and in the neighboring region were detected using the color Doppler mode of the device [Figure 2].

Ultrasonography in the chest wall, and supraclavicular lymph gland metastases

USG was performed using the GE Logic 7 device with a 10 MHz linear probe on superficial mode on the chest wall, and in supraclavicular lesions. The sonographic appearances and dimensions of the metastasis/mass and supraclavicular lymphoid glands that were detected radiologically or after examination with palpation, were recorded [Figures 3 and 4].

Thorax ultrasonography-guided transthoracic biopsy procedure

USG-guided NAB was performed using the freehand technique or indirect technique in sitting position, in supine position in required patients, oblique, and lateral decubitus positions moving the probe transversely or longitudinally through the intercostal spaces with parasternal, suprasternal or infrasternal-subcostal approach in accordance with the localization of the lesion in peripheral pulmonary, mediastinal, and pleural lesions.[12] Pre-medication or sedation was not administered to patients before the procedure. The sterilization of the biopsy region, and sterilization of the guiding USG probe were enabled using iodine-alcohol. The biopsy procedure performed on the previously detected, and required measurements, and power Doppler screenings performed region using a 22-G spinal needle (Set Medical San, Istanbul/Turkey) attached to a 20 mL injector. After reaching to the targeted lesion, aspiration was performed by directing the needle in a spectrum aiming to tissue sampling from different regions. Aspiration procedure was completed when adequate material or hemorrhagic material were detected inside the injector.

Pathological investigation

The procedures were performed in real time, on-site pathologist was not available during the procedure. Cytological samples were prepared using both alcohol fixation, and air dryed techniques. Remaining material was separated for preparing the cell block. The microscope slides that were fixated in 95% alcohol in the pathology laboratory were stained using the Papanicolaou stain, and the air-dryed microscope slides were stained using the May Grunwald Giemsa stain. 3 microne sections obtained from the cell block that were prepared using the paraffine embedded method were stained using the h and e stain. Immunohistochemical investigation was performed on the cell block sections in required samples.[13]

Statistical analysis

The statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) 17.0 (IBM Inc Released 2008. SPSS Statistic for Windows Chicago, USA)

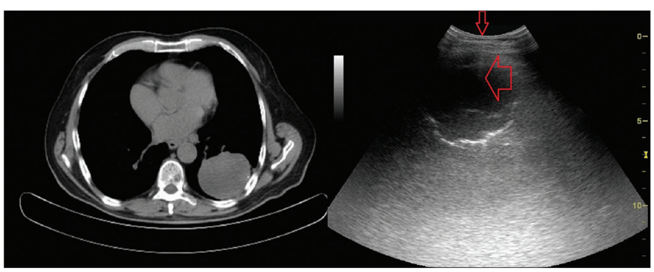

Figure 1: The ultrasonographic image of a 5 cm × 5 cm mass in the lower lobe of the left lung on thorax computed tomography. The entrance localization, and the distance of the needle in the mass were indicated in red color

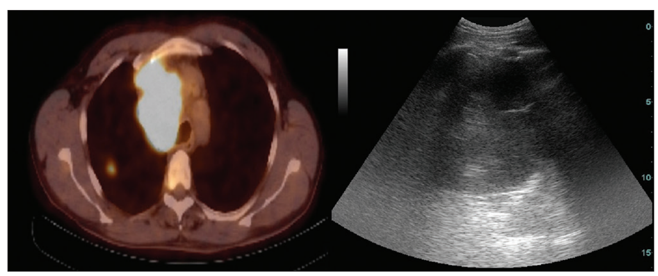

Figure 2: On the left, on positron emission tomography–computed tomography, hypermetabolic lesion compatible with the mediastinal mass lesion. Ultrasonographically in approximate dimensions of 6 cm × 5 cm, irregular margin hypoechoic lesion

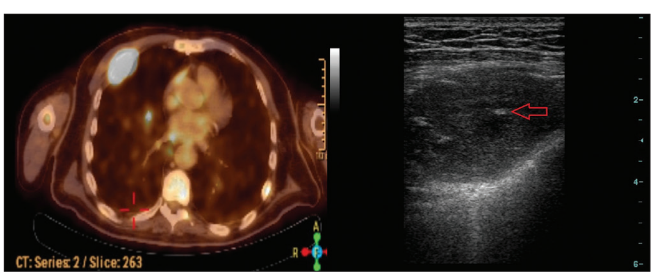

Figure 3: Hypermetabolic lesion in the dimensions of 5 cm × 3 cm in the chest wall on the right hemithorax. Ultrasonographically in approximate dimensions of 5 cm × 3 cm, irregular margin hypoechoic lesion

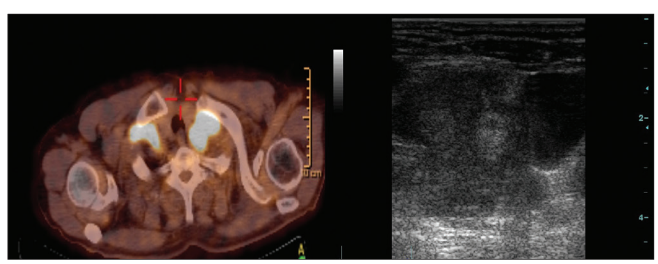

Figure 4: Hypermetabolic lesion in the region compatible with the left supraclavicular lymphoid gland on positron emission tomography–computed tomography. Ultrasonographically in approximate dimensions of 3 cm × 3 cm, irregular margin hypoechoic lesion

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program. The continuous variables were described as the mean ± standard deviation in descriptive statistics, and categorical variables were described as the percentaged values.

Results

The files of 276 patients who were planned transthoracic FNAB (TTFNAB) after performing USG in USG unit in chest diseases clinic between January 2008 and December 2016 were evaluated. 12 patients did not give consent, and TTFNAB was not performed in 5 patients due to inappropriate thrombocyte count, and coagulometry, and these patients were excluded from the study. 203 (78.3%) out of 259 patients were men, and 56 (21.7%) were women, and the mean age was 60.6 ± 11.5 (min 16-max 90 years) years. The mean smoking history was 25.7 ± 14.6 packages per year. The most common symptom was fatigue in 196 patients (75.6%), the most common radiologic finding was the mass in 219 (84.5%) patients. The investigation of the biopsy localizations showed that approximately — (188 patients-72.6%) of USG-NAB were performed to the pulmonary parenchymal nodule/mass lesions [Table 1].

Diagnosis was obtained using this method in 211 out of 259 patients (81.4%) who were performed USG-guided needle aspiration biopsy. 195 patients were diagnosed with malignant disease [Table 2], and 16 patients were diagnosed with benign disease [Table 3]. Then, malignant disease was detected in 43 (89.5%) out of 48 patients who could not be put diagnosis using the other methods, and benign disease was detected in 5 (10.5%) patients. The general diagnostic success of the USG-guided percutaneous NAB procedure was 81.4%, and the success was measured as 81.9% for the malignant lesions, and the success for benign lesions was measured as 76.1%.

The diagnoses of 148 out of 188 patients (78.7%) who had peripherally located pulmonary parenchymal nodule/mass lesion was put using the USG-guided TTFNAB, and malignant disease was detected in 139 patients (93.9%), and benign disease was detected in 9 patients (6.1%) [Table 4]. The final diagnoses of the 22 out of the remaining 40 patients (55%) were put using the CT-guided NAB, the final diagnoses of 10 (25%) patients were put using the fibrobtic bronchoscopy (FOB), and final diagnoses of 6 patients (15%) were put using endobronchial USG Bronchoscopy (EBUS) transbronchial needle aspiration, and final diagnoses of 2 patients (5%) were put after performing the surgical biopsy [Table 5].

Diagnoses of 18 out of 23 patients (78.2%) who were performed USG-guided TTFNAB for mediastinal lesion were obtained using this method, malignant disease was detected in 14 patients, and benign disease was detected in 4 patients [Table 6]. Two patients out of 5 were diagnosed with lymphoma using mediastinoscopy, 2 patients were diagnosed with adenocarcinoma using EBUS, and 1 patient was diagnosed with pericardial cyst using the surgical method.

Diagnosis was obtained after performing the USG-guided TTFNAB for chest wall lesion in 22 out of 23 (95.6%) patients. One patient was diagnosed with squamous cell carcinoma (SCC) after the CT-guided needle aspiration biopsy [Table 7].

Diagnosis was obtained after performing the USG-guided TTFNAB for supraclavicular lymph gland metastasis in

Table 1: The biopsy localizations of the cases

	n (%)
Lung parenchymal nodule/mass lesion	188 (72.6)
Mediastinal mass lesion	23 (8.9)
Chest wall metastasis	23 (8.9)
Supraclavicular lymph gland	18 (6.9)
Pleural lesion	7 (2.7)
Total	259 (100)

Table 2: The distribution of the diagnoses of the cases that were detected malignant using the fine needle aspiration biopsy under ultrasonography guidance

	n (%)
SCC	55 (28.3)
Non-small cell carcinoma	51 (26.1)
Adenocarcinoma	35 (17.9)
Small cell carcinoma	20 (10.3)
Sarcomatoid carcinoma	8 (4.1)
Renal cell carcinoma	5 (2.5)
Large cell carcinoma	4 (2.1)
Lymphoma	4 (2.1)
Mesotelioma	3 (1.5)
Other	10 (5.1)
Total	195 (100)

SCC: Squamous cell carcinoma

Table 3: The distribution of the diagnoses of the cases that were found benign using the fine needle aspiration biopsy under ultrasonography guidance

	n (%)
Tuberculosis	4 (25)
Timoma	3 (18.9)
Abscess	2 (12.7)
Timic cyst	1 (6.2)
Chronic pleurite	1 (6.2)
Fibrolipoma	1 (6.2)
Empyema	1 (6.2)
Pneumonia	1 (6.2)
Nocardiosis	1 (6.2)
Wegener granulomatosis	1 (6.2)
Total	16 (100)

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Table 4: The distribution of the diagnoses after fine needle aspiration biopsy of the cases with lung parenchymal nodule/mass lesion

	***n* (%)**
Malignant	
Non-small cell carcinoma	40 (28.8)
SCC	47 (33.8)
Adenocarcinoma	25 (17.9)
Small cell carcinoma	13 (9.4)
Sarcomatoid carcinoma	5 (3.6)
Large cell neuroendocrine cell carcinoma	4 (2.9)
Other	5 (3.6)
Total	139 (100)
Benign	
Tuberculosis	3 (33.3)
Abscess	2 (22.3)
Empyema	1 (11.1)
Pneumonia	1 (11.1)
Nocardia infection	1 (11.1)
Wegener granulomatosis	1 (11.1)
Total	9 (100)

SCC: Squamous cell carcinoma

Table 5: The final diagnoses of the lung parenchymal nodule/mass lesions which could not be diagnosed with fine-needle aspiration biopsy

	***n* (%)**
Malignant	
SCC	12 (32.5)
Small cell carcinoma	8 (21.6)
Non-small cell carcinoma	6 (16.2)
Adenocarcinoma	5 (13.5)
Other	6 (16.2)
Total	37 (100)
Benign	
Abscess	1 (33.3)
Tuberculosis	1 (33.3)
Behcet's disease	1 (33.4)
Total	3 (100)

SCC: Squamous cell carcinoma

Table 6: The distribution of diagnosis after fine needle aspiration biopsy of the mediastinal lesions

	***n* (%)**
Malignant	
Lymphoma	4 (28.7)
Non-small cell carcinoma	2 (14.3)
SCC	2 (14.3)
Small cell carcinoma	2 (14.3)
Timoma malignant	1 (7.1)
Sarcomatoid carcinoma	1 (7.1)
Teratocarcinoma	1 (7.1)
Nervous tumor	1 (7.1)
Total	14 (100)
Benign	
Timoma	3 (75)
Timic cyst	1 (25)
Total	4 (100)

SCC: Squamous cell carcinoma

Table 7: The distribution of diagnosis after fine needle aspiration biopsy of the chest wall lesions

	***n* (%)**
Malignant	
Non-small cell carcinoma	6 (27.2)
Adenocarcinoma	3 (13.7)
SCC	3 (13.7)
Small cell carcinoma	3 (13.7)
Sarcomatoid carcinoma	2 (9.1)
Adenoid cystic carcinoma	1 (4.5)
Other	4 (18.1)
Total	22 (100)

SCC: Squamous cell carcinoma

patients with pulmonary mass in 17 out of 18 (94.4%) patients [Table 8]. The final diagnosis of the remaining 1 patient was detected as SCC using the fibroptic bronchoscopy.

6 out of 7 patients (85.7%) were diagnosed using the USG-guided TTFNAB for pleural lesion. One patient was diagnosed with tuberculosis using the surgical biopsy [Table 9].

240 lesions (92.6% that were detected in the lung were in hypoechoic appearance. The mean long axis diameter of the pulmonary parenchymal lesions was 6.2 ± 2.3 (2–18 cm) cm, and the mean short axis diameter was 5.3 ± 2.7 (2–12 cm) cm. The mean long axis diameter of supraclavicular lymphoid glands was 2.4 ± 0.7 (1–4 cm) cm, and the mean short axis diameter was 2.2 ± 0.7 (1–3 cm) cm. The mean long axis diameter of the chest wall lesions was 3.8 ± 2 (0.7–8 cm) cm, and the mean short axis diameter was 2.9 ± 1.4 (0.7–5 cm) cm. The mean long axis diameter of mediastinal lesions was 7 ± 4.8 (3-18 cm) cm, and the mean short axis diameter was 5.9 ± 5.9 (2.5–15 cm) cm. The mean number of NAB per lesion was measured as 1.05 ± 0.2.[1-3]

Complication was detected in 16 patients (6%) after the procedures. The complications were pneumothorax which did not require thorax tube insertion in 10 patients, and pneumothorax which required thorax tube insertion in 5 patients (1.9%), and mild hemoptysis in 1 patient which only required monitoring. Pneumothorax was detected with USG investigation and confirmation with lung radiography after the procedure in 10 patients, however pneumothorax was detected using the lung radiography in 5 patients.

Discussion

We accomplished a higher diagnostic success of 81.4% in a 9 years period by performing thorax USG-guided NABs by pulmonologists in the present study, and the

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Table 8: The distribution of diagnosis in cases with supraclavicular lymph gland who had mass in the lung

	n (%)
Malignant	
Adenocarcinoma	6 (35.2)
Non-small cell carcinoma	3 (17.7)
SCC	3 (17.7)
Small cell carcinoma	2 (11.7)
Other	3 (17.7)
Total	17 (100)

SCC: Squamous cell carcinoma

Table 9: The distribution of the diagnosis after fine-needle aspiration biopsy in pleural lesions

	n (%)
Malignant	
Mesotelioma	2 (66.7)
Adenocarcinoma	1 (33.3)
Total	3 (100)
Benign	
Tuberculosis	1 (33.3)
Fibrolipoma	1 (33.3)
Chronic pleurite	1 (33.4)
Total	3 (100)

complication rate was detected as 1.9% during these procedures. We suggest that the present study is an important study which reveals the diagnostic success of USG-guided NABs in all thoracic lesions mainly the peripheral located pulmonary lesions, and suggesting that thorax USG performed by pulmonogists may be used as an efficient diagnostic tool in all thoracic lesions.

The current USG platforms are easily accessible, inexpensive, mobile and light weighted devices. Compared with the old technologies, the improved image quality, and USG devices as small as the size of one palm, and even EBUS devices as tiny as a broncoscope end have been developed.[14] The most important advantage of the thorax USG-guided NABs is the performing of the procedure in real-time. The visualization of the needle within the lesion during the procedure, sonographically detection of necrotic cavitary structures in the lesion, and avoiding the close vascular structures particularly with the Doppler mode increased the diagnostic success, and facilitated the decrease of the complication rate.[4,15,16] In addition, USGs are mobile devices therefore the procedure may be performed in bedside in patients with deteriorated general condition, and may be performed in different body positions. One another advantage is that there is no radiation exposure compared with fluoroscopy, and CT, and the device is more inexpensive than those devices.[17-19] Thorax USG-guided NAB procedure has been used for long years, and its safety has been proven.

The investigation of the studies on this topic showed that the most current study was performed by Laursen *et al.*,[5] and they reported the success of the procedure as 76.9% in 215 patients. There were other studies which reported the diagnostic success of USG-guided TTFNAB between 64.9% and 96.5%.[6,7,20-23] The common conclusion of these recent studies was that thorax USG-guided TTFNAB was a procedure with high sensitivity and lower complication rates. In compliance with the literature, we found the diagnostic success as 78.7% in USG-guided TTFNAB performed on patients with peripherally located pulmonary parenchymal lesions in our study.

Thorax USG is an efficient and safe diagnostic method used in mediastinal lesions, and in Pancoast tumors which mainly present in the neighboring of the chest wall in addition to its use in pulmonary peripherally located tumors. The efficacy and safety of biopsies performed in real time and with color Doppler mode safety in mediastinum where there are large vascular structures, and heart were proven with various studies.[24-26] Measuring the tumor dimension before the procedure using thorax USG, having the data of the distance to be passed after measuring the skin, subcutaneous distances to be passed, and the ability to track the needle during the procedure gives advantage in the biopsies of the mediastinal lesions. Rubens DJ *et al.*[27] reported the diagnostic success of USG-guided TTFNAB as 96% in mediastinal lesions. They reported the advantages of the procedure as performing of a real time procedure, being fast and easy, ability to more appropriate positioning of the patients, avoidance of the vascular injuries with the Doppler signals, no need for the use of intravenous contrast substance, being more inexpensive, and the time of procedure being shorter. We found the success rate as 78.2% by the diagnosis of 18 out of 23 mediastinal tumors using thorax USG in our study. No complication was detected.

Pancoast tumors stem from the apex region of the lung, and involve the parietal pleura, endothoracic fascia, the lower part of the brachial plexus, cots, and vertebrae due to their peripheral localization. Characteristically, they present with the arm, and shoulder pain symptoms. They may easily be visualized using thoracic USG owing to their unique anatomic localization. 28 (10.8%) patients in our study were radiologically compatible with Pancoast tumor. 24 out of 28 patients were diagnosed with USG-guided TTFNAB, and the diagnostic success for Pancoast tumors was calculated as 85.7%. Yang *et al.*[28] reported the diagnostic success of USG on Pancoast tumors which could not be diagnosed with conventional methods as 91%, and Cömert SŞ *et al.*[29] reported the success rate as 84.2%.

Primary chest wall tumors are the rarely detected tumors which stem from the bone, cartilage, and soft tissue. The metastases to the chest wall from other system and organs may stem from the organ

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malignancies such as primarily from lung, pleura, mediasten, and breast.[30] The invasion/metastasis rate of primary lung cancers to chest wall was reported as 5%–8%.[31] Supraclavicular lymph gland metastases in lung cancers are the important findings which change the cancer stage, and treatment. Some studies reported the supraclavicular metastasis rate between 20% and 59% in lung cancer.[32] USG-guided biopsy on supraclavicular lymphoid glands is a highly simple and safe procedure.[33] Choe *et al*.[34] put diagnosis to 224 out of 229 patients after performing USG-guided biopsy, and found the diagnostic accuracy of the procedure as 97.8%, and no complication developed during the procedures. The USG-guided biopsy procedure performed on the chest wall and supraclavicular lymphoid glands is a more easier procedure compared to the procedure performed on the peripheral/parencymal tumors of lung, and mediasten. The USG-guided biopsy procedure is more conveniently and safely performed in chest wall lesions because shorter needles are used, sonographically detected more easily, lesions are in very close location to the skin-subcutaneous distance, and they have no neighboring large vessels as in mediastinal lesions, and they do not move during respiration. In our series, the diagnosis was put in 22 out of 23 patients with chest wall lesion using the USG-guided needle aspiration biopsy, and the diagnostic success was calculated as 95.6%. The diagnosis was put using the USG-guided NAB to 17 out of 18 patients with lung mass which had supraclavicular lymph gland. The diagnostic success was calculated as 94.4%. No complication developed during the procedure.

During the diagnosis stage, the USG-guided NABs are more advantageous owing to having no radiation exposure, and being real time procedure compared with CT, and floroscopic biopsies, and more advantageous compared with the mediastinoscopic and surgical biopsies owing to being more invasive.[27,35,36] They may be regarded more advantageous compared with the FOB owing to requiring no general anesthesia or sedation and in peripherally located pulmonary lesions which are difficult to reach through bronchoscopic procedure.[37,38] However, there is the fact that the tools such as FOB, and EBUS are more superior compared with USG in disease staging.[39]

Thorax USG-guided NABs are the procedures which relatively have lower complication rate. The most common complication is pneumothorax. Although detected mainly in NABs performed on pulmonary parenchymal lesions, pneumothorax was reported to be rarely detected in mediastinal, pleural, and chest wall lesions.[40] The complication rate was associated with the underlying lung disease such as emphysema, lesion dimension, patients age, and biopsy technique.[41] Researchers have recently investigated 58 articles which involved a total of 10909 cases in a collection, and found the pneumothorax complication of CT-guided NAB as 20.5%, and pneumothorax complication of USG-guided NAB as 4.4%. Researchers in that article suggested that the reason for lower complication rate in USG-guided NAB was that real time procedure was performed with USG, and lesions was localized on the pleura.[42] Complications developed only in patients with pulmonary parenchymal lesion in our study. The complications were pneumothorax in 10 (3.8%) patients which required no thorax tube insertion, pneumothorax which required thorax tube insertion in 5 (1.93%) patients, and mild hemoptysis in 1 (0.3%) patient which required no treatment except monitorization.

One of the limitations of our study was that there was no pathologist available for on-site evaluation during the biopsy procedure. Researchers in some studies reported that diagnostic efficiency would increase in rapid on-site evaluation (ROSE)-guided biopsy procedures. In addition, the time of procedure may be shortened with on-site evaluation, and may decrease the complication risk by reducing the number of intervention.[43,44]

One another limitation of our study was that the study involved a long period of 9 years. The first cases in our learning period were also included among the cases involved in this long period study, therefore we might have behaved more selective in selecting cases with larger tumors for avoiding complication during our learning period. In addition, we report that the results cannot be generalized because our study provided the data of a single center experience.

Conclusion

The diagnostic success of the USG-guided NAB procedure is higher, complication rate is lower, and is an easily accessible and relatively less invasive procedure which may be performed in chest diseases clinic by experienced pulmonologists to almost all thoracic lesions with highly diagnostic accuracy and lower complication rate.

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Conflicts of interest
There are no conflicts of interest.

References

1. Smargiassi A, Inchingolo R, Soldati G, Copetti R, Marchetti G, Zanforlin A, *et al.* The role of chest ultrasonography in the management of respiratory diseases: Document II. Multidiscip Respir Med 2013;8:55.
2. Soldati G, Inchingolo R, Smargiassi A, Sher S, Nenna R, Inchingolo CD, *et al. Ex vivo* lung sonography: Morphologic-ultrasound relationship. Ultrasound Med Biol

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2012;38:1169-79.

3. Koenig SJ, Narasimhan M, Mayo PH. Thoracic ultrasonography for the pulmonary specialist. Chest 2011;140:1332-41.
4. Wang HC, Yu CJ, Chang DB, Yuan A, Lee YC, Yang PC, *et al.* Transthoracic needle biopsy of thoracic tumours by a colour Doppler ultrasound puncture guiding device. Thorax 1995;50:1258-63.
5. Laursen CB, Naur TM, Bodtger U, Colella S, Naqibullah M, Minddal V, *et al.* Ultrasound-guided lung biopsy in the hands of respiratory physicians: Diagnostic yield and complications in 215 consecutive patients in 3 centers. J Bronchology Interv Pulmonol 2016;23:220-8.
6. Scisca C, Rizzo M, Maisano R, Monaco M, Ferrari M, Munaò S, *et al.* The role of ultrasound-guided aspiration biopsy of peripheral pulmonary nodules: Our experience. Anticancer Res 2002;22:2521-3.
7. Yang PC, Chang DB, Yu CJ, Lee YC, Wu HD, Kuo SH, *et al.* Ultrasound-guided core biopsy of thoracic tumors. Am Rev Respir Dis 1992;146:763-7.
8. Ozkan G, Tutar M, Bayram M, Bakan D, Gür A, Camsari G. The impact of ultrasonography-guided fine needle aspiration of no palpable supraclavicular lymph nodes on diagnosis and staging in advanced lung cancer. Tuberk Toraks 2009;57:186-91.
9. Kumaran M, Benamore RE, Vaidhyanath R, Muller S, Richards CJ, Peake MD, *et al.* Ultrasound guided cytological aspiration of supraclavicular lymph nodes in patients with suspected lung cancer. Thorax 2005;60:229-33.
10. Yu CJ, Yang PC, Chang DB, Wu HD, Lee LN, Lee YC, *et al.* Evaluation of ultrasonically guided biopsies of mediastinal masses. Chest 1991;100:399-405.
11. Kıral N. Toraks ultrasonografisine giriş. İn: Çağlayan B, editör. Thorax Ultrasonography in Clinical Practice. Vol. 1. Baskı. İstanbul: Probiz; 2010. p. 9-18.
12. Çağlayan B, editor. Girişimsel toraks ultrasonografisi. In: Thorax Ultrasonography in Clinical Practice. İstanbul: Probiz; 2010. p. 79-89.
13. Cömert SŞ, Çağlayan B, Salepçi B, Fidan A, Parmaksız ET. The diagnostic value of ultrasound guided transthoracic needle aspiration in superior sulcus tumors. İzmir Göğüs Hastanesi Dergisi 2013;27:41-8.
14. Doğan C, Güvenç TS, Yıldırım BZ, Kantarcı UH. Diagnostic value of hand-held thoracic ultrasound scanning in pulmonary outpatient clinic. J Kartal Tr 2015;26:193-201.
15. Yang P. Applications of colour Doppler ultrasound in the diagnosis of chest diseases. Respirology 1997;2:231-8.
16. Yang PC. Color Doppler ultrasound of pulmonary consolidation. Eur J Ultrasound 1996;3:169-78.
17. Diacon AH, Schuurmans MM, Theron J, Schubert PT, Wright CA, Bolliger CT. Safety and yield of ultrasound-assisted transthoracic biopsy performed by pulmonologists. Respiration 2004;71:519-22.
18. Beckh S, Bölcskei PL, Lessnau KD. Real-time chest ultrasonography: A comprehensive review for the pulmonologist. Chest 2002;122:1759-73.
19. Herth FJ, Becker HD. Transthoracic ultrasound. Respiration 2003;70:87-94.
20. Seyfarth HJ, Wirtz H, Borte G, Gradistanac T, Gessner C, Hammerschmidt S. Ultrasound guided transthoracic biopsy – Safety and efficaces. Pneumologie 2007;61:563-7.
21. Sagar P, Gulati M, Gupta SK, Gupta S, Shankar S, Joshi K, *et al.* Ultrasound-guided transthoracic co-axial biopsy of thoracic mass lesions. Acta Radiol 2000;41:529-32.
22. Mathis G, Gehmacher O. Ultrasound-guided diagnostic and therapeutic interventions in peripheral pulmonary masses. Wien Klin Wochenschr 1999;111:230-5.
23. Zamiati W, Ousehal A, Abdelouafi A, Kadiri R. Ultrasound-guided transparietal thoracic puncture biopsy. J Radiol 1996;77:111-5.
24. Sheppard MN. Percutaneous biopsy of mediastinal tumours under sonographic guidance. Thorax 1991;46:740.
25. Yang PC, Chang DB, Lee YC, Yu CJ, Kuo SH, Luh KT. Mediastinal malignancy: Ultrasound guided biopsy through the supraclavicular approach. Thorax 1992;47:377-80.
26. Smith S, Besien K. Diagnosis and treatment of mediastinal lymphomas. In: Shields TW, LoCicero J, Reed Carolyn E, Feins RH, editors. General Thoracic Surgery. 7th.ed., Vol. 2. Philadelphia: Lippincott Williams and Wilkins; 2009. p. 2379-88.
27. Rubens DJ, Strang JG, Fultz PJ, Gottlieb RH. Sonographic guidance of mediastinal biopsy: An effective alternative to CT guidance. AJR Am J Roentgenol 1997;169:1605-10.
28. Yang PC, Lee LN, Luh KT, Kuo SH, Yang SP. Ultrasonography of pancoast tumor. Chest 1988;94:124-8.
29. Cömert SŞ, Çağlayan B, Salepçi B, Fidan A, Parmaksız ET. The diagnostic value of ultrasound guided transthracic needle aspiration in superior sulcus tumors. İzmir Göğüs Hastanesi Derg 2013;27:41-8.
30. Magdeleinat P, Alifano M, Benbrahem C, Spaggiari L, Porrello C, Puyo P, *et al.* Surgical treatment of lung cancer invading the chest wall: Results and prognostic factors. Ann Thorac Surg 2001;71:1094-9.
31. Hacıibrahimoğlu G, Çevik AG, Yılmaz MA, Fazlıoğlu M, Bedirhan MA. The surgical treatment of primary and metastatic chest wall tumors. Turk J Thorac Cardiovasc Surg 2003;11:232-35.
32. Tian HY, Xu D, Liu JP, Mao WM, Chen LY, Yang C, *et al.* Contribution of ultrasound-guided fine-needle aspiration cell blocks of metastatic supraclavicular lymph nodes to the diagnosis of lung cancer. J Cancer Res Ther 2015;11 Suppl: C234-8.
33. Fultz PJ, Harrow AR, Elvey SP, Feins RH, Strang JG, Wandtke JC, *et al.* Sonographically guided biopsy of supraclavicular lymph nodes: A simple alternative to lung biopsy and other more invasive procedures. AJR Am J Roentgenol 2003;180:1403-9.
34. Choe J, Kim MY, Baek JH, Choi CM, Kim HJ. Ultrasonography-guided core biopsy of supraclavicular lymph nodes for diagnosis of metastasis and identification of epidermal growth factor receptor (EGFR) mutation in advanced lung cancer. Medicine (Baltimore) 2015;94:e1209.
35. Sheth S, Hamper UM, Stanley DB, Wheeler JH, Smith PA. US guidance for thoracic biopsy: A valuable alternative to CT. Radiology 1999;210:721-6.
36. Davids RD, Oldham HN, Sabiston DC. The mediastinum. In: Sabiston and Spencer Surgery of the Chest. 6th ed. Philadelphia: W. B. Saunders Co.; 1996. p. 576-611.
37. Asano F. Advanced bronchoscopy for the diagnosis of peripheral pulmonary lesions. Respir Investig 2016;54:224-9.
38. Milman N, Faurschou P, Grode G. Diagnostic yield of transthoracic needle aspiration biopsy following negative fiberoptic bronchoscopy in 103 patients with peripheral circumscribed pulmonary lesions. Respiration 1995;62:1-3.
39. Moreira BL, Guimaraes MD, de Oliveira AD, Maciel MJ, Bitencourt AG, Costa FD, *et al.* Value of ultrasound in the imaging-guided transthoracic biopsy of lung lesions. Ann Thorac Surg 2014;97:1795-7.
40. Anzidei M, Porfiri A, Andrani F, Di Martino M, Saba L, Catalano C, *et al.* Imaging-guided chest biopsies: Techniques and clinical results. Insights Imaging 2017;8:419-28.
41. Collings CL, Westcott JL, Banson NL, Lange RC. Pneumothorax and dependent versus nondependent patient position after needle biopsy of the lung. Radiology 1999;210:59-64.
42. DiBardino DM, Yarmus LB, Semaan RW. Transthoracic needle biopsy of the lung. J Thorac Dis 2015;7:S304-16.
43. Cardoso AV, Neves I, Magalhães A, Sucena M, Barroca H, Fernandes G. The value of rapid on-site evaluation during EBUS-TBNA. Rev Port Pneumol (2006) 2015;21:253-8.
44. Wohlschläger J, Darwiche K, Ting S, Hager T, Freitag L, Schmid KW, *et al.* Rapid On-Site Evaluation (ROSE) in cytological diagnostics of pulmonary and mediastinal diseases. Pathologe 2012;33:308-15.