

## ULTRASOUND-GUIDED PERCUTANEOUS FINE-NEEDLE BIOPSY OF THE MEDIASTINUM

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### Summary

The clinicoradiological diagnostic possibilities in mediastinal processes have improved with the introduction of percutaneous and endoscopic biopsies. The aim of this paper is to evaluate the diagnostic reliability of percutaneous mediastinal biopsies (PMB) with a fine needle under ultrasound guidance in patients with a mediastinal mass.

73 PMB with ultrasound guidance have been performed in 66 patients. In this investigation, only patients with primary or secondary solid or cystic formations of the anterior and posterior mediastinum have been included. Patients with achalasia of the oesophagus, diverticles, herniation, mediastinitis and vascular changes have been excluded by conventional radiologic means (summary chest radiographs in two projections), and when required by additional methods (tomography, ultrasound, CT, angiography). The material obtained was examined cytologically. The cytologic results of fine-needle PMB were verified histologically after surgery, surgical biopsies, cytochemical and microbiologic examinations in addition to clinical and radiologic follow-up. The specificity, sensitivity and accuracy of radiological and PMB results was calculated.

A microscopic diagnosis was established in all examined cases: primary malignant processes 31 (46.97%), metastases 14 (21.21%), benign tumors 6 (9.09%), inflammation 9 (13.64%), thyroid goiter and sarcoidosis 6 (9.09%). A high degree of accuracy (90%), specificity (100%) and sensitivity (100%) was obtained. There were no complications.

The diagnostic safety of a technically simple, rapid and low cost method has been established, as a frequent alternative to open surgical biopsy and other biopsies under ionizing radiation devices.

KEY WORDS: *ultrasound, mediastinum, biopsy, fine-needle, mediastinal neoplasms, ultrasonography, interventional*

### PERKUTANA BIOPSIJA MEDIJASTINA TANKOM IGLOM POD KONTROLOM ULTRAZVUKA

#### Sažetak

Kliničkoradiološke dijagnostičke mogućnosti u dijagnosticiranju procesa u medijastinu su napredovale uvođenjem perkutanih i endoskopskih biopsija. Cilj ovog rada je vrednovati dijagnostičku pouzdanost perkutane biopsije medijastina (PMB) tankom iglom pod kontrolom ultrazvuka u pacijenata s ekspanzivnim procesom u medijastinu.

U 66 pacijenata su učinjene 73 PMB pod kontrolom ultrazvuka. U ovo su istraživanje uključeni samo pacijenti s primarnim ili sekundarnim solidnim ili cističkim tvorbama u prednjem ili stražnjem medijastinu. Pacijenti s ahalazijom, divertiklima, hernijama, medijastinitisom i vaskularnim promjenama su isključeni konvencionalnom radiološkom obradom (sumacijski telerendgenogrami u dva smjera) i, eventualno, dodatnim metodama (tomografija, ultrazvuk, CT, angiografija). Dobiveni materijal je analiziran citološki. Citološki rezultati PMB učinjene tankom iglom verificirani su histološki nakon operativnog zahvata, otvorene biopsije, citokemijske i mikrobiološke pretrage uz kliničko i radiološko praćenje. Izračunana je specifičnost, senzitivnost i točnost radioloških i PMB rezultata.

Mikroskopska dijagnoza je postavljena u svim obrađenim slučajevima: primarni maligni proces 31 (46,97%), metastaze 14 (21,21%), benigni tumori 6 (9,09%), upale 9 (13,64%), struma i sarkoidoza 6 (9,09%). Dobiven je visok stupanj točnosti (90%), specifičnosti (100%) i senzitivnosti (100%). Nije bilo komplikacija.

Ustanovljena je dijagnostička sigurnost jednostavne, brze i jeftine metode kao česte alternative otvorenoj biopsiji i drugim biopsijama izvedenim pod kontrolom uređaja s ionizantnim zračenjem

KLJUČNE RIJEČI: *karcinom dojke, muškarci, liječenje*

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## INTRODUCTION

Mediastinal processes may be discovered on chest radiograms accidentally or in the course of targeted examinations in patients with symptoms caused by compression or invasion of adjacent structures by a mediastinal mass. Additional attention is warranted in patients with the above symptoms in whom conventional radiologic findings fail to present visible mediastinal pathology.

The most frequent mediastinal processes are thymomas, neurogenic tumors, various cysts and lymphomas. In children neurogenic tumors, germinal and gastric cysts are more common, while in adults thymus neoplasia, thyroid changes and lymphomas are more frequent.

In about 80% of cases, mediastinal processes are asymptomatic, found accidentally and usually benign. Approximately a third of mediastinal tumors are malignant and cause symptoms of compression or spreading onto surrounding structures (1). In patients with myasthenia gravis, mediastinal processes are also present (2).

Unrelated to the clinical status, the location of the mediastinal process is the main point of departure in the course of establishing assumptive and definitive diagnosis. The radiologic features are insufficient in the differentiation of benign from malignant processes. Only signs of penetration of surrounding structures (US, CT, MRI) suggest malignancy.

In disease detection, verification, estimation of extent and follow-up of its course and success of therapy, radiologic examinations of the thoracic region play an important role. An important contribution to this has been added with the introduction of US, CT, MRI and intervention procedures with the aim of obtaining material directly for microscopic analysis.

In view of the variety of mediastinal processes, drug, surgical, irradiation and combined therapy is applied. For this reason, before the treatment is commenced, it is of utmost impor-

tance to establish the precise location of the process, its character and extent.

This paper gives an overview of patients with pathologic changes of the anterior and posterior mediastinum, selected with the aim of obtaining samples directly by means of percutaneous mediastinal biopsy (PMB) under ultrasound (US) guidance. The goal is to determine the microscopic characteristics of the process, to verify the final diagnosis and to evaluate the diagnostic reliability of US guided PMB. Patients with a mediastinal mass in the mid region are not included as transesophageal ultrasound and biopsy have not been performed.

## PATIENTS AND METHODS

Our group of examinees consists of 66 patients in whom 73 percutaneous mediastinal biopsies (PMB) were performed under ultrasound. There were 33 women and 33 men aged 11 to 80 years (median 48 years). The largest group of 41 patients (62.12%) was 40 to 70 years old. In 12 cases (18.18%), the mediastinal substrate was discovered accidentally while in 54 (81.82%), symptoms of primary mediastinal disease or of an extramediastinal origin were present. In 18 (27.27%) patients, myasthenia gravis (MG) was diagnosed. Before patient selection, chest radiograms in two projections were analyzed. The lateral view was performed with a barium contrast bolus. Subsequently, patients with achalasia of the esophagus, diverticles and hernias were excluded. Further conventional procedures (tomography), ultrasound, CT and angiography excluded additional patients with vascular changes (aneurisms) and mediastinitis. This investigation included only patients with primary or secondary solid or cystic mediastinal formations. When ultrasound uncovered a cystic mass, those with a positive serologic test for echinococcosis were also excluded and referred for direct surgical therapy. In all our patients chest radiograms revealed changes of the mediastinal silhouette. Af-

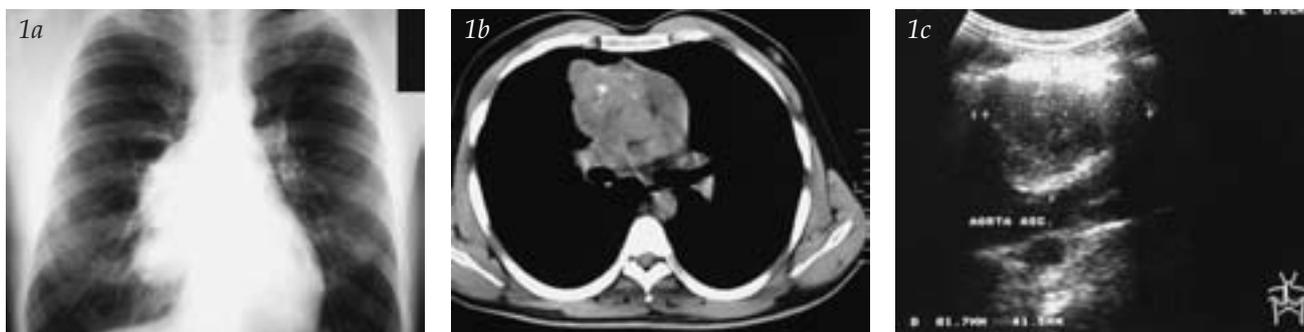


Figure 1a, 1b, 1c. Erect chest radiogram, CT scan of the chest and sonogram: thymoma malignum – invasive form

ter additional conventional tomography, US and CT, three experienced thoracic radiologists estimated whether the mediastinal mass had sharply defined margins towards adjacent structures (possibly benign) or poorly defined diffuse ones (possible malignancy) (Figure 1A, 1B, 1C). The location of the process was determined. Diagnostic examinations were carried on in patients with a left-sided or right-sided mass in the superior, middle and lower quadrants of the anterior or posterior mediastinum (Figure 2). In order to obtain microscopic characteristics of these masses, US-guided PMB was performed in all patients under local anesthesia by means of a 22 gauge

needle, with patients in either the prone or supine position. The specificity, sensitivity and accuracy of the results were calculated for radiologic and PMB assessments.

## RESULTS

Based on radiological findings, 38 (57.58%) were assumed to be malignant processes, mainly located in the anterior mediastinum, while the remaining 28 (42.42%) were considered benign and inflammatory. PMB was performed in 48 examinees in the supine position and in 18 in the prone position. The material obtained was judged inadequate in 7 samples, and the biopsy was repeated in these cases, with a total of 73 PMB with local anesthesia in 66 patients. Where insufficient elements were found for a microscopic conclusion, the sample was considered inadequate. Cytological examinations of samples obtained in this manner confirmed: in 31 (46.97%) patients a malignant primary process, and in 14 (21.21%) a secondary one. In 6 (9.09%) patients, the mass was benign, and in 9 (13.64%), it was inflammatory. Of the remaining 6 (9.09%), 3 patients had a thyroid goiter and in 3 sarcoidosis was found (Table 1). Among the 31 patients with a primary malignant process, thymoma was diagnosed and confirmed additionally by pathohistology after surgery in 18 cases. They all had myasthenia gravis (2). In the remaining 13, lymphoma was established by cytology. For further differentiation a surgical biopsy was obtained and the cytologic diagnosis was confirmed histologically. In 14 cases, cytology of the PMB sample confirmed a secondary malignant process. Lymph node metastases of lung cancer, breast cancer

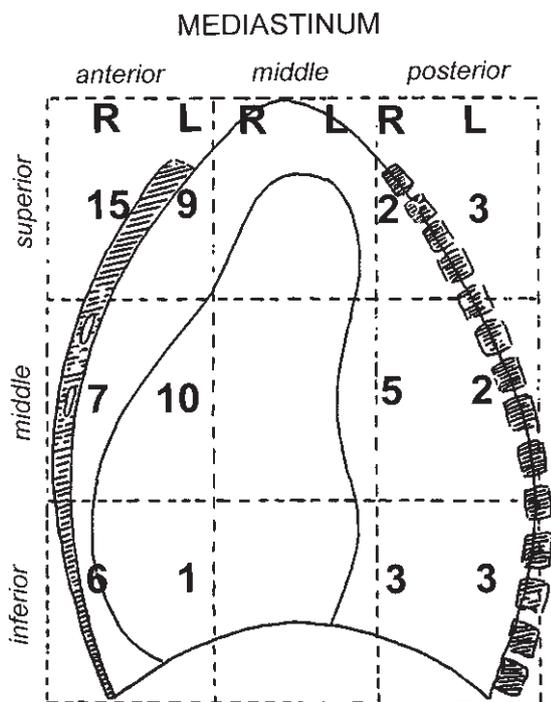


Figure 2. Localization of mediastinal masses. L, left; R, right

Table 1.

CYTOLOGIC AND PATHOHISTOLOGIC FINDINGS

	Malignant					Benign		Inflammation		Other		Total
	Primary		Secondary					Spec	Nonspec			
No	31		14			6		5	4	6		66
%	46.97		21.21			9.09		7.58	6.06	9.09		100
	thym	lymp	bro	bre	kid	neur	cyst			goi	sarc	
No	18	13	10	2	2	4	2	5	4	3	3	66
%	27.26	19.70	15.15	3.03	3.03	6.06	3.03	7.58	6.06	4.55	4.55	100

Legend: spec – specific inflammation; nonspec – nonspecific inflammation; thym – thymoma; lymp – lymphoma; bro – bronchus; bre – breast; kid – kidney; neur – neurogenous; goi – goiter; sarc - sarcoma

Table 2.

RADIOLOGICAL FINDINGS (CONVENTIONAL, CT, US) WHEN MALIGNANT NEOPLASM OF THE MEDIASTINUM IS SUSPECTED

	Suspected malignant mediastinal neoplasm (N=66)
True positive	38
True negative	21
False positive	0
False negative	7

Accuracy: 0.89 (89%)  
 Specificity: 1 (100%)  
 Sensitivity: 0.84 (84%)

Table 3.

RESULTS OF ULTRASOUND GUIDED PERCUTANEOUS FINE NEEDLE BIOPSY OF SUSPECTED MALIGNANT MEDIASTINAL NEOPLASMS

	Suspected malignant mediastinal neoplasm (N=73)
True positive	45
True negative	21
False positive	0
False negative	0
Inadequate sample	7

Accuracy: 0.90 (90%)  
 Specificity: 1 (100%)  
 Sensitivity: 1 (100%)

and kidney cancer were found in 10, 2 and 2 cases, respectively. The further clinical and radiologic disease course and therapy results were followed in these patients (Table 1). In 6 patients, of whom 4 with neurinoma and 2 with cysts, surgery was performed showing the pathohistologic diagnosis was identical to the cytologic one. The clinical and radiologic follow-up of 15 patients, including 5 with cytologic and microbiologic confirmation of tuberculosis, 4 with nonspecific inflammation and 3 with thyroid goiter or sarcoidosis, contributed to the confirmation of the cytologic and microbiologic re-

sults obtained by PMB sample analysis (Table 1). Analysis of data obtained by radiologic methods (conventional, CT, US) indicates 89% accuracy, 100% specificity and 84% sensitivity rates (Table 2) of these diagnostic procedures. After PMB under US guidance, the percentage of accuracy is a high 90%, of specificity 100% and of sensitivity 100% (Table 3). Samples with insufficient elements for a microscopic conclusion were judged inadequate.

DISCUSSION

In the detection of mediastinal processes, conventional radiologic examinations of the thoracic area are helpful. Today, however, CT, US and MRI play an important role in both the differentiation between mediastinal masses (solid, cystic, vascular) and the determination of location, contours, size and extent of processes (10,13,16,17).

Imaging of penetration into surrounding structures is of special importance.

By means of conventional radiologic examinations, CT and US, patients with solid and cystic formations of the anterior and posterior mediastinum have been selected for this study. In view of the fact that the location of a mediastinal mass and clinical features allow a presumptive diagnosis, but do not provide a definitive one (microscopically confirmed), invasive surgical or nonsurgical procedures have to be applied in order to obtain material directly for microscopic analysis. Although PET has a high percentage of sensitivity and specificity (95%) in the detection of mediastinal lymph node metastases as well as distant ones, a final diagnosis requires microscopic verification (18). However, a teratoma can

be diagnosed by conventional radiograms, US and CT (4,17).

For a long time, US has had a subordinate place in thoracic diagnostics. Recently US is having an increasingly wider application in the thorax as is evident in research results published in the literature (3-9).

Before the introduction of CT and US, various percutaneous biopsies of the thoracic region were performed under fluoroscopy. Today the authors perform percutaneous biopsies of the thorax with the guidance of fluoroscopy, CT and US (10-15), using various needles.

Each strives to secure with the method employed as high as possible a percentage of positive microscopic results with a minimum of complications. Some authors publish results of CT-guided needle biopsies on smaller series of patients and in certain diseases (8,10,11,16).

We use CT guidance for needle biopsies rarely. Diascopic guidance was used routinely up to the introduction of US in the thorax. In the literature, results of endoscopic use of US, with and without needle biopsies, in the detection of mediastinal masses have been reported (19,20), but in our patients this has not been used because of the selected location. In all radiologically detected processes of the mid mediastinum accessible to bronchoscopy, endo and transbronchial biopsies were performed. Following available literature (3-5,7,9) we have introduced fine-needle aspiration biopsies under US guidance into everyday practice using a free-hand technique, for patients with pathologic processes of the thoracic region (14).

As three experienced radiologists presumed, basing their judgement on radiologic examinations of the mediastinum, a malignant process in 38 patients (57.58%), and a benign or inflammatory process in the remaining 28 (42.42%), this data corresponded to previous results (1) and directed the statistical analysis. It resulted in an accuracy rate of 89%, specificity rate of 100% and sensitivity rate of 84% (Table 2), similar to results reported in the literature (6,10,13). In order to establish a final diagnosis, a PMB guided by US was performed in all of the 66 examinees. Statistical results show an accuracy of 90%, specificity of 100% and sensitivity of 100%. PMB was repeated in 7 patients because of insufficient elements for a

microscopic conclusion. Immediately after PMB and in the course of the next 3 hours, no complications arose. Some of the results of this study differ from the results in the literature reported by authors who performed PMB in various mediastinal diseases using different biopsy needles and methods (10,11,16,19,20). The high degree of accuracy (90%), specificity (100%) and sensitivity (100%) obtained by PMB in our examinees is most probably due to patient selection for this method. The absence of complications is certainly the result of fine-needle use with a free-hand technique.

As the cytological diagnosis established from samples collected by percutaneous mediastinal biopsy under ultrasound guidance from our examinees was further verified by histology after surgical biopsy and by cytochemical and microbiologic assays in addition to clinical and radiological follow-up of patients, the diagnostic reliability of ultrasound-guided PMB has been confirmed.

## CONCLUSION

The clinical and radiologic parameters are limited in diagnosing benign, inflammatory or malignant mediastinal processes. Percutaneous mediastinal biopsy (PMB) under ultrasound guidance with fine-needle aspiration is a simple, quick and reliable method for establishing a microscopic and therefore final diagnosis. Furthermore, PMB is a safe initial method in microscopic diagnosing. The microscopic parameters determine subsequently whether this procedure will be the final one or whether further surgical biopsy methods (mediastinoscopy, parasternotomy) will be indicated, especially when the immunological classification of a tumor is required. Accordingly, PMB was the initial and final diagnostic method used in all our patients with the exception of those with lymphoma. When the selection of patients for US-guided PMB is based on radiologic criteria, a high percentage of accuracy, specificity and sensitivity in microscopic findings of mediastinal processes is obtained. In these cases, this method takes the place of a handy alternative to CT-guided mediastinal biopsy. Furthermore, it is less costly, technically

simple, and both the patient and the radiologist avoid exposure to ionizing radiation.

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