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# Ultrasound as the first imaging method in severe lung disease. Considerations about a case of pulmonary tuberculosis and review of the literature

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**Abstract**

Abdominal ultrasound (US) performed as a "primary imaging procedure" is an important diagnostic tool in gastroenterology. Expanding the routine investigation to the lower thoracic region might sometimes accelerate the diagnosis in inconclusive manifestations such as pulmonary pathology.US is a valuable tool in evaluating patients with breathing difficulties, chest pain, hypoxia, or chest trauma. This paper presents the particular situation of a patient hospitalized in the gastroenterology department, where the US identified significant pulmonary alterations and changed the final diagnosis from a gastrointestinal disease to pleuro-pulmonary tuberculosis. A brief review of literature is also included, in relation to chest US.

**Keywords:** chest ultrasound; tuberculosis; pleural effusion; chest X-ray

## Introduction

Tuberculosis (TBC) is the 9th cause of death worldwide. In Romania the incidence is 4 times higher than the Europe average and the low healing rate determines the constant increase of the patient reservoir. TBC diagnosis is based on classical analyses and less on pleuro-pulmonary and thoracic ultrasonography (TUS), although the utility of US in assessing thoraco-pleuro-pulmonary pathology, chest wall conditions and sub-centimetric tumors in contact with the thoracic wall is largely recognized [1,2].

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## Case report

A 47-year-old male patient, heavy smoker, was referred to the gastroenterology department by the general practitioner for investigation due to a severe anemic syndrome (pallor, skin tightening, asthenia) and weight loss (7 kg in 2 months). The steatacustic lung examination found fine crackels in the bilateral basal areas. Abdominal palpation was within normal limits. Laboratory samples revealed: moderate normocytic anemia, hyposideremia, mild thrombocytosis, lymphopenia, high erithocyte sedimentation rate and C-reactive protein, normal range of CEA and CA19-9 tumor markers.

In such a patient, with general non-specific complaints and no significant objective signs, in our gastroenterology department, the current mode of initiating investigations is ultrasound (US) centered on the abdomen.

Abdominal US, performed as a "primary imaging" procedure, excluded abdominal tumor pathology (including digestive tube, liver, pancreas, spleen, kidneys), but identified a small perirenal fluid accumulation considered to be in relation with a severe hypoproteinemia. The evaluation of costal-diaphragmatic sinuses in inspiration/expiration phases (current procedure at the US examination of the abdomen) revealed fluid in both pleural sinuses (fig 1 a-d). As a result, the investigation was extended to the lungs. Evaluation of pleural areas identified pleural thickening and anfractuous surface, interpreted as erosions/exulcerations expressed by anomalies of the distal reverberations (called A and B lines). The magnitude and extension of pleuro-pulmonary changes were considered relevant for a significant respiratory disorder of high severity (fig 1e). An emergency chest X-ray was indicated.

Pulmonary radiography identified apical pulmonary opacities, bilateral pleural collection, raising the suspicion of an infectious bacillary infection (fig 1f). The diagnosis was confirmed by the pneumologist.

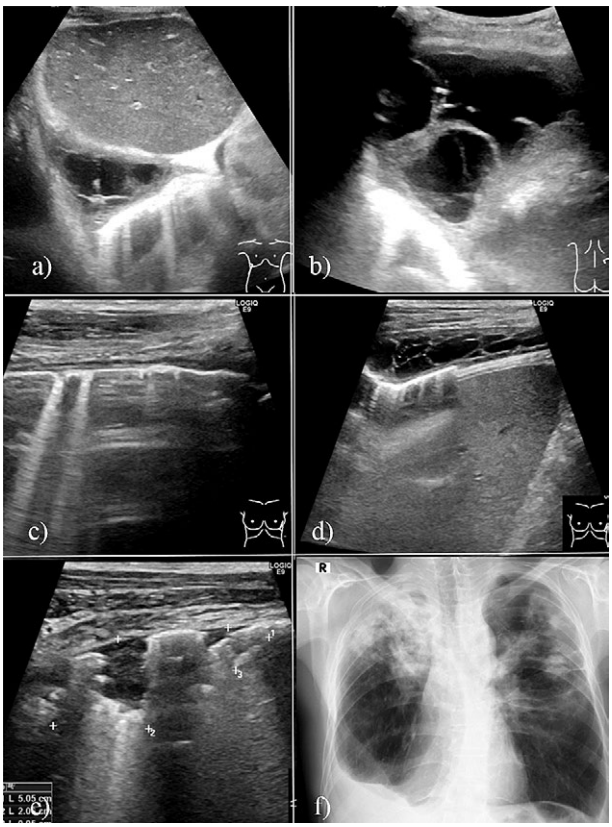


**Fig 1.** a) and b) Right pleural collection. Gray scale examination focused on the right hypochondrium using the liver as acoustic window (a) and the base of right hemothorax (b). In both incidences a moderate amount of fluid may be seen, with a relatively transonic aspect (suggesting fluid consistency), septa (possibly secondary to abundant fibrin content) and marked thickening of parietal, visceral and diaphragmatic pleura; c) Left pleural thickening; d) Fluid accumulation and septa; e) gray scale examination focused on the right anterior hemithorax (subclavicular). Discontinuities of the pleuro-pulmonary surface. Area of parenchyma condensation (hypoechoic) and small amount of fluid between pleura sheets; f) X-ray examination. Lung caverna – right apex. Bilateral pleural effusions.

## Discussions

US is the imaging procedure recently introduced into the pleuropulmonary exploration portfolio. The benefits of the US are well known: high image accuracy; noninvasiveness; low cost; repeatability; accessibility; possibility to be used in the emergency department; "real time" imaging; substitution in many situations of costly/risky procedures; "friendly" (painlessness) procedure largely reccommended for infants/pregnant women; higher sensitivity than pulmonary X-ray in detecting minor peripheral lesions. Nevertheless, these qualities have not led to the use of US at its maximum potential [1,3-5]. US allows exploration of the pleura, pericardium, spleen, abdominal cavity, lymph nodes (simultaneously affected, suggests TBC) and it is superior to pulmonary X-ray in assessing lung changes over time, in response to therapy [1,6].

The TUS accuracy and efficacy in detecting pleural, lung parenchyma and thoracic wall anomalies are known [7]; for the pleura the method identifies effusions, thickening and tumors. The nature of pleural fluids differs according to the echogenity and echostructure; an anechoic, homogeneous space between the parietal and visceral pleura indicates pleural collection [2]. A non-septated anechogenic space indicates a transsudate (in heart failure, liver cirrhosis, hypoalbuminemia); an anechoic space with hyperechoic structures floating inside indicates the exudate from the tuberculous, parapneumonic or paraneoplastic effusions [8-10]; hyperechoic collections indicate hemorrhages/empyema [11,12]. Pleural thickening appears like a hypoechoic enlargement of the pleura and it is associated with the presence of scars, fibrosis, empyema and pleuritis [12]. Pleural thickening >1 cm or nodularity predict malignancy with high specificity in areas with low TBC prevalence [13]. Benign pleural tumors are rare (5%) and appear as round/oval, well defined, encapsulated and hypoechoic [14]. Irregular pleural thickening and effusions, as well as infiltration of adjacent structures, represent US aspects of pleural malignant tumors [2,12,14]. TUS indications are represented by qualitative/quantitative description and identification of

minimal localized pleural effusions (more sensitive than x-ray), highlighting chest wall tumors, guiding safe performance of thoracocentesis, aspiration, biopsy of lung infiltrations/nodules/abscesses [5,6,15]. The efficiency depends on examination protocol: 3.5-5 MHz transducers are used for rapid identification of pathological aspects, but sometimes a higher frequency transducer (7.5-13 MHz) is required [2].

In our case report, the non-specific but alarming clinical context (anemic syndrome, altered clinical status, underweight) and the absence of fever in the patient admitted to the gastroenterology department determined the current course of investigations centered on the suspicion of abdominal neoplasia. Abdominal US exploration was performed at the level of "primary imaging". The method excluded abdominal neoplasia but identified a perirenal fluid accumulation (sign of severe hypoproteinemia) and, by extension to lung exploration, it identified suggestive elements for a severe pleuro-pulmonary pathology. US findings – erosions and surface exudates of the pleura and lung, abundant membranes, semimolten liquid, bilateral changes – raised the suspicion of TBC pathology. This condition was intuited ultrasonographically and, subsequently, certified by specific investigations.

According to the literature, the good resolution of US images and integration into clinical diagnosis provided new criteria for a prompt diagnosis of TBC. Arguments in this regard were brought by some authors who pointed out the importance of US. Thus, Lobo V et al emphasized that the sensitivity/specificity of US in lung disease were higher than that of radiography, speeding up the diagnosis [16]. Yang et al highlighted the US value in determining the nature of pleural effusions, showing that transudate / exudate could be clearly distinguished [9]. Agostinis et al emphasized the role of TUS in identifying typical TBC changes, although the radiological appearance was normal [1].

In conclusion the small pleural effusions accidentally detected by US require an extensive assessment centered on the lungs. The identification of membranes in the fluid and the presence of pleural discontinuations should take TBC into consideration. The presented case and literature data recommend US as a potential imaging method even for TBC, especially in children and pregnant women.

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