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Letter to the Editor

Lung ultrasonography in pulmonary tuberculosis: Integrating chest radiology?

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Dear Editor,

We read with interest the article by Montuori et al. evaluating the role of lung ultrasonography (LUS) in pulmonary tuberculosis (PTB). Authors conclude that "*chest ultrasonography may be a promising tool to support clinical, radiological and microbiological data in the diagnosis of PTB, a high burden pathological condition for which the delay in diagnosis represents a critical point in the control of the disease*" [1]. We would like to express some methodological and technical considerations.

We agree with Authors saying that epidemiology of PTB varies around Countries [1]. In fact, there is a dramatically high prevalence in endemic areas (e.g. developing Countries) mainly due to malnutrition, while Western Countries are experiencing a growing incidence of disease due to several factors including migrations from endemic areas, high prevalence of chronic diseases and immunosuppression, elderly population, drug abuse, etc. [2]. In any case, a missed or a late diagnosis carries several public health concerns. Thus, there is a need for a rapid instauration of an effective treatment and, above all, for a correct diagnosis. Basing on these considerations it is conceivable that the use of diagnostic tests could vary among Countries depending on resources availability and on pre-test probability of PTB. With this regard, LUS is certainly useful in the management of patients with pulmonary consolidations (i.e PTB). However, it should be considered as a complementary tool instead of a feasible substitute of traditional radiologic images such as chest X-ray or chest computed tomography (CT).

With this regard, in the study by Montuori et al. [1] it is not clear if LUS findings were compared to the final diagnosis of PTB (the sum of clinical, microbiological and radiological findings), or if they were compared to chest X-ray/CT-scan findings, given the significant differences in terms of specificity and sensitivity of these two exams. These aspects are of particular relevance for determining the c-statistic of a new test (i.e. LUS) in comparison to the gold standard for the diagnosis and follow-up of PTB. According to the Italian HTA (Health Technology Assessment) statements, a gold standard technique is needed to validate any imaging technique [3].

Moreover, technical limitations of LUS should be underlined. First of all, given the anatomical constraints of thoracic cage, LUS can at best explore about 70% of the pleural surface. In addition, even in zones amenable to LUS examination, only lesions adherent to the pleural surface may be visualized [4]. The mediastinum (i.e. mediastinal lymphoadenopaties) is not explorable with ultrasound. Only masses adherent to the antero-superior mediastinal pleural are visible. This means that LUS is useful for viewing pleural and sub-pleural diseases adherent to the pleura – a portion of the pleura that corresponds to a very small part of the entire pulmonary tissue [5]. As for consequence, lesions not adherent to the pleura or placed in inaccessible areas (behind the scapula) – *this last being a frequent condition in PTB* – are not visible with LUS (Fig. 1). In other words, the use of transthoracic ultrasound as a follow-up examination to monitor treatment efficacy may be not applicable.

Another limitation is represented by cardiac and respiratory movements which cause a reduction in diagnostic accuracy of color and power Doppler – *flash artifacts* – obstructing a thorough study of possible vascular alterations.

Furthermore, the lack of shared and approved international guidelines has caused transthoracic ultrasound diagnoses to be reported in unclear and inconsequent ways, this endangering patients' management. Such risks have been amplified by an increase in borderline and off-label ultrasound approaches to the study of pleuropulmonary pathology [6].

Authors emphasize the role of LUS in the evaluation of some echographic findings such as subpleural consolidations [1]. With regards to "bronchograms" it should be stressed that no study or meta-analysis has so far demonstrated that such hyperechoic images do really correspond to the CT imaging finding of air bronchogram. There is no specific ultrasonographyc pattern that distinguishes inflammatory density from other conditions (e.g., neoplasms). Indeed, these images can also be detected in lung neoplasm masses. With these premises, LUS is useful after the diagnosis, in the follow-up of pulmonary densities undergoing treatment, as it enables their healing/regression to be monitored [7]. Nevertheless, the term "air bronchogram" is inappropriate because there is no clear evidence in literature that the hyperechoic spots and/or lines inside consolidations correlate to the CT imaging of a real air bronchogram. Hyperechoic spots can be due to fibrotic tissue or calcification, vascular/lymphatic interfacing and may even be linked to the interposition of air micron between consolidation

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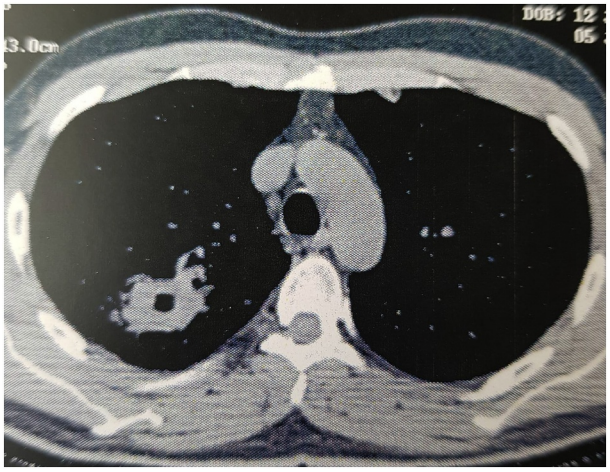

Fig. 1. Chest CT scan image showing a consolidation with central escavation located in the posterior upper right pulmonary lobe, behind the right scapula. The consolidation, despite significant dimensions, does not show any contact to the pleura. Thus, it is not visible to transthoracic ultrasonography.

and pleural surface in case of not complete adhesion at the interface. For these reasons, we can only rely on CT for the evaluation of air or fluid bronchograms in its structures. Anyhow the presence of bronchogram, either air or fluid, is not specific of benign pathologies and can also be found in neoplasm [8].

Finally, comparing US and HRCT scans, it is clear that subpleural nodules adhering to the pleura are not differentiable by LUS from fibrotic changes (as in the patterns for UIP, NSIP, DIP, and CHP) or other consolidations [9]. For all the above reasons, LUS represents a useful complementary tool but it cannot be a substitute of conventional radiological methods (chest X-ray and CT scan) which allow a complete investigation of thoracic volume in multi-parametrical details (MDCT), which are useful – *and necessary* – for an accurate diagnosis and follow-up.

Declaration of Competing Interests

The authors report no conflicts of interest.

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