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## Mini Review

# Ultrasound elastography: A new tool in pulmonology

## Introduction

Lung cancer continues being a serious cause of death in developed countries with an increase in its incidence in recent years. According to the above, it is not uncommon to think that new techniques are being investigated to facilitate diagnosis, as well as its staging. In recent decades, the use of Endobronchial Ultrasound-Guided Transbronchial Needle Aspiration (EBUS-TBNA) has become widespread until nowadays, as the technique of choice for mediastinal and hilar nodal staging of bronchopulmonary neoplasia [1]. Given the great interest in staging systematics, other techniques have been developed, such as Trans-Oesophageal Endobronchial Ultrasound-Guided Fine-Needle Aspiration (EUS-B-FNA), transvascular access and elastography.

Elastography is an ultrasound mode that began to be used in the 1990s. Currently this technique is used in the study of various organs such as the liver, thyroid, breast and prostate [2-4]. However, it is a recent technique in pulmonology that has begun to be used five years ago.

Ultrasound elastography is a new imaging method used for measurement of tissue elasticity. The method reveals the physical properties of the tissue by characterizing the difference of hardness between pathological tissue and normal tissue in response to compression or vibration [1,5]. In this way, the analysis of tissue elasticity provides information that, with the help of conventional ultrasound and Doppler-mode, can help us in the ultrasound diagnosis [6].

## Elastography modes

**We can differentiate between [6]:**

- “**Strain elastography**”: The pressure applied to the lesion

or organ to be studied is carried out by an external compressor (ultrasound transducer), so there may be intra and interobserver variability.

- “**Shear-Wave Elastography (SWE)**”: The pressure is applied by acoustic micro-impulses to the different tissues, so with this method we get the advantage of not having to compress with the transducer and therefore there is a greater reproducibility. We can distinguish three subtypes:
  - **Qualitatively elastography:** It offers a colour map (red, green and blue) of the lesion with respect to the adjacent tissue. Usually, the stiffest lesions will be shown in blue and those less rigid in red or vice versa depending on the manufacturer. According to the predominance of colours, we could classify lesions in type 1, 2 and 3 [7]. Type 1 lesions (predominantly non-blue) are less rigid lesions that usually correspond to benign pathology, while type 3 lesions (predominantly blue) are rigid lesions compatible with malignant pathology. Type 2 lesions (partly blue, partly non blue) lesions may correspond to both benign and malignant lesions.
  - **Quantitative elastography:** It gives us numerical values, measured in kPa or m/s about the major or minor deformity in a region of interest. As a general rule, we will observe a faster propagation of the shear wave in those stiffer tissues with respect to healthy tissues.
  - **Qualitative and Quantitative:** Combine the previous, that is, on a qualitative map of colors we can measure the hardness value of the tissue in a region of interest.

## Applications in pneumology

As we have previously discussed, the use of elastography for the study of lung lesions is recent. Within the applications it could be used for the study of pleural lesions and for mediastinal lymph node staging in lung cancer as a complementary technique to EBUS-TBNA.

- **Pleural lesions:** Elastography can be a complementary tool that, together with conventional transthoracic ultrasound, can help us in the diagnosis of pleural or pulmonary lesions in contact with the chest wall. In addition, elastography allows for obtain a valid sample, so that it increases diagnostic yield. In order to obtain accurate pleural stiffness values there are a set of mandatory rules [8].
1. The conventional transducer should be held in place with minimal pressure on the chest wall, and placed parallel to the intercostal window to avoid rib shadowing.
  2. Measurements should be performed during the holding of breath in the mid-respiratory phase.
  3. Optimal B-mode images are required.
  4. An imaging confidence map should display whether measurements are being obtained on tissue areas with adequate shear wave propagation.

The pleura can be added to the growing list of ultrasounds elastography applications, according to a few preliminary studies [9,10]. With this new technique, malignant pleural lesions can be distinguished from benign ones. It could also be useful in the evaluation of a pleural effusion. Recently, a study by Jiang, et al., [10], evaluates elastography for the diagnosis of malignant pleural effusions. In this study, a total of 244 patients with pleural effusions, who were separated into development and validation sets, were explored through 2D-SWE applied to the parietal pleural surfaces. The results of this study were in favour of the use of Ultrasound Elastography in combination with traditional thoracic ultrasound.

- **Mediastinal ganglionic diagnosis and staging in lung cancer:** Another advantage that elastography can offer us is to increase diagnostic profitability and lymph node staging when used together with EBUS-TBNA. Lymph node features as hypoechoicity, distinct margins, roundness, and diameter greater than 10mm traditionally are used to identify the most suspicious lymph nodes. However, a definitive correct classification as either malignant or benign is possible only in approximately 25% of mediastinal lymph nodes using those criteria [11]. Elastography informs us about the stiffness of the lymph nodes and therefore gives us one more piece of information to differentiate benign from malignant nodules. In different studies, elastography has proven to be a useful technique in the differentiation of benign nodules from malignant nodules, with superiority compared to the isolated use of EBUS-TBNA [5]. Therefore, this technique could prevent punctures of benign nodules.

It can also facilitate the selection of the puncture site, because it allows to know those regions of the lymph node suggestive of malignancy. Thus, endosonographic elastography may save time in mediastinal nodal staging, reduce the risk of false-negative cytopathological results, and prevent repeat endosonographic sampling procedures and surgical staging [11].

## Conclusions

Ultrasound elastography is a relatively new tool in the field of pneumology but with promising advantages both for the study of pleural lesions as well as for mediastinal lymph node staging of lung cancer, as a complementary technique to EBUS-TBNA.

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