“Assessment of Pleural Infiltration by Thoracic Ultrasound”; a Pre-Requisite to Thoracic Onco-Surgeries: Preliminary Results

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Abstract

Aims & Objectives: To assess the usefulness of ultrasound in the diagnosis of pleural infiltration in pulmonary neoplasms, given the relevance of this information in the TNM staging and in the planning of the surgical approach.

Material & Methods: Thirteen patients were included, with a mean age of 64.8 years, with a diagnosis of malignant pulmonary neoplasia with pleural contact, who did not present with costal infiltration in the Computed Tomography (CT) scan. It was decided to include only those patients in whom the CT was not conclusive of invasion of the chest wall since the reason for the present study was to demonstrate the usefulness of ultrasound in doubtful cases with conventional imaging techniques.

Conclusion: Thoracic ultrasound is a useful technique in the assessment of the degree of infiltration of the visceral and parietal pleura, with values of sensitivity and specificity of 100% in our study.

Ultrasonographic examination of peripheral pulmonary neoplasms may allow a more precise staging in those patients receiving non-surgical treatments and, in addition, allows a better planning of the surgery, indicating en bloc resections in patients with parietal pleura infiltration.

Keywords: Pleural; Imaging; Ultrasound; Malignancy; Surgery.

Introduction

Peripheral pulmonary neoplasms, whether primary or secondary, can be externalized through the pleura and extend to the chest wall [6]. This fact has implications in staging and, therefore, in the therapeutic management, and in the type of surgical intervention in cases in which these tumors are respectable and operable patients [2,16].

A high percentage of patients with lung neoplasms cannot be operated on due to comorbidities, so the staging will be mostly clinical and the anatomopathological assessment of the tumor and its possible pleural infiltration will not be available [1]. Hence the importance of having imaging techniques that allow proper staging [10].

The new classification TNM v72-4 proposes that the T increase according to the degree of pleural infiltration. Thus, invasion of the visceral pleura is considered to be T2 and the involvement of the parietal layer will be classified as T34.

Regarding surgical resection, many published studies advocate en bloc resection involving the thoracic wall in those cases diagnosed with invasion of the parietal pleura (T3) [5,16]. Although it is a more aggressive surgery, it allows a correct resection of the tumor [10-12].

Material & Methods

Thirteen patients were included, with a mean age of 64.8 years, with a diagnosis of malignant pulmonary neoplasia with pleural contact, who did not present with costal infiltration in the Computed Tomography (CT) scan. It was decided to include only those patients in whom the CT was not conclusive of invasion of the chest wall since the reason for the present study was to demonstrate the usefulness of ultrasound in doubtful cases with conventional imaging techniques (like Chest x ray)[9].

Thoracic ultrasound was performed using a linear and concave probe [20]. The concave probe was used to identify the pleural masses and the linear probe is used to assess the actual pleural infiltration [24]. It was considered that the tumor did not infiltrate the pleura when the pleuro-pulmonary movement was in agreement with that of the adjacent healthy lung and if the lesion disappeared during the exploration [13,19]. The degree of pleural infiltration was assessed according to the pleuro-pulmonary movement and the morphology of the lesion-pleura interface [5-7]. Criteria for visceral pleura invasion were considered: the decrease (not disappearance) of the movement of the tumor with respect to the surrounding healthy lung parenchyma, the protrusion of neoplastic tissue above the pleuro-pulmonary line and the introduction of the pleuro-pulmonary line inside the tumor [18,24]. Therefore, diagnostic criteria for invasion of the parietal pleura were considered: the absence of movement of the tumor during respiration and the invasion of extra pleural fat [9].
In all histological specimens, elastic stains were made that allow to determine with greater precision the degree of pleural infiltration [11] (Figure 1).

Recent studies propose that all histological studies of pulmonary neoplasms include this type of staining [17]. Lesions were classified according to the degree of pleural infiltration as follows [8]:

- PL0: The tumor is found in the lung parenchyma or infiltrating the pleural connective tissue superficially but does not exceed the elastic layer of the visceral pleura.
- PL1: the tumor overpasses the elastic layer of the visceral pleura.
- PL2: the tumor infiltrates the entire surface of the visceral pleura.
- PL3: the tumor infiltrates the parietal pleura or elements of the chest wall.

**Results**

In 8 cases, histological confirmation of the degree of involvement was obtained and in one patient the infiltration after iatrogenic pneumothorax was confirmed during the diagnostic biopsy.

The remaining 4 patients were excluded from the study because they corresponded to unrespectable neoplasms because they were stage IV (3 patients) or because they were inoperable patients (1 patient).

After the histological study, pleural infiltration was demonstrated in 8/9 cases, of parietal and visceral pleural leaves in 4/8 and 4/8 only of the visceral pleura. In one case, indemnity was found for the pleural blades.

Regarding the different sonographic signs, it was found that the four cases with absence of tumor movement presented infiltration of the parietal pleura (Figure 2).

The tumor that did not present pleural infiltration showed a correct movement during the ultrasound examination, which was consistent with that of the adjacent healthy lung, and even disappeared from the acquisition plane (Figures 3,4).
The cases that presented infiltration of the visceral but not the parietal pleura showed a decreased movement of the tumor with respect to that of the adjacent healthy lung in three of the four patients (Figures 5, 6).

The remaining case, with infiltration of visceral pleura, presented a discrete adjacent pleural effusion that probably allowed the normal movement of the lesion (Figure 6).

In only one case infiltration of extra pleural fat was observed, this being punctuate, confirming this fact in the histological piece (Figures 7, 8).

![Figure 5: Thoracic CT in the mediastinum (upper) and lung (lower) windows. Lung mass in left lower lobe with broad pleural contact. There was no evidence of thoracic wall infiltration in this exploration.](image)

![Figure 6: Histological piece of tumor visualized. Superior: Squamous carcinoma very close to visceral pleura that is thickened (Hematoxylin-eosin, 4x). Inferior: Elastic technique that shows a small carcinoma focus surpassing the elastic layer of the visceral pleura (yellow circle), indicating focal infiltration of the same (Elastic technique, 4x).](image)

Three tumors presented protrusion on the pleural line: two of them showed infiltration of the parietal pleura and the third only of the visceral pleura (Figures 9-11). The insertion of the pleural line in the breast of the tumor was not observed in the tumor without pleural infiltration and was manifested in the four cases with involvement of visceral pleura (100%) and in 2/4 of those that showed infiltration of the parietal layer (Figures 12, 13). In one case, involvement of the parietal pleura was demonstrated after the onset of pneumothorax after the diagnostic biopsy (Figure 14). Works published in the 1990’s showed that pneumo-CT allows the diagnosis of parietal pleura infiltration.

The overall results of the study, following the proposed diagnostic schemes, were 100% sensitive and specific.
Figure 9: Thoracic ultrasound. Pulmonary nodule (the same as in figure 8) that showed an indentation (yellow arrow) inside the extra pleural fat (thick blue arrow). These findings, together with the absence of movement of the lesion, suggested the diagnosis of parietal pleura infiltration that was confirmed in the histological study.

Figure 10: Thoracic CT in mediastinal (left) and lung (right) windows. A mass with internal cavitation and extensive contact with the peripheral pleura was observed. There was no evidence of infiltration of bone structures.

Figure 11: Thoracic ultrasound. Lung mass (the same as in figure 10) that showed noticeable protrusion (yellow arrows) on the pleuro-pulmonary line (wide blue arrow). A consistent central hyperechoic image with cavitation was also evident (correct correlation with CT findings).

Figure 12: Histological piece of lung mass. Section of adenocarcinoma surpassing visceral pleura infiltrating the parietal pleura and extra pleural soft tissues (Hematoxylin-eosin, 2 x). The upper, middle and lower marked arrow heads correspond to the extra pleural adipose tissue. Parietal and visceral pleura respectively.

Figure 13: Thoracic ultrasound. Pulmonary hypo echoic nodule showing insertion inside (yellow arrow) of the pleuro-pulmonary line.

Figure 14: Chest CT in the lung window prior to percutaneous biopsy (left) and after the procedure (right). Lung mass with ample contact with the peripheral pleura and that, in the post-biopsy examination, infiltration of the parietal pleura was observed as the tumor was not separated from the chest wall. Previous sonographic examination revealed the absence of movement of the tumor, suggestive of parietal pleura infiltration.

References


