

Universitatea de Medicină și Farmacie Craiova

Școala Doctorală

POSTGRADUATE THESIS

SUMMARY

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Differential Diagnosis Issues of Atypical Pleural Lesions

SUMMARY

Keywords:

Pleura, Atypical pleural lesions, Differential diagnosis, Thoracic radiograph, CT

As the pleura cover the entire thoracic cavity and the entire surface of the lungs, almost any pleural lesion can be projected over the lungs. Although common pleural lesions have quite characteristic, easily identifiable aspects, quite often they can be confused with pulmonary, parietal or mediastinal lesions if we examine them in only one projection.

Currently we have a highly sensitive differential diagnostic tool for pleural lesions: the computer tomography (CT), but the plain film radiograph remains the first method used in most cases, because of several good reasons:

- The Irradiation dose problem, as the CT scan exposes the patient to much higher doses compared to plain film radiographs. Both the WHO recommendations and professional ethics force us to avoid overexposure, especially when we have a less irradiating procedure available that often can finalize the diagnostic.

- The Availability problem, as most hospitals are equipped for plain film radiographs, but considerably fewer have their own CT. A properly made radiographic examination can sort out the diagnostic in many cases, thus proving an excellent tool for sorting out the cases that really need a CT examination.

- The procedure Costs are also important, as the significantly more expensive CT scan must be sufficiently justified from the medical point of view. The CT scan is mandatory for a limited number of diseases, but for most patients the plain film radiograph is the primary chest examination procedure.

The pleura itself rarely is the cause of a significant illness, but very often can simulate pulmonary, parietal or mediastinal diseases. Differentiating these images is a key part in the radiological diagnosis and any error made here can have dire consequences on the patient's evolution, so we need a detailed knowledge of all the image modifications generated by the pleura.

This study tries to catalog and analyze the main situations in which relatively benign pleural lesions are simulating or masking diseases of other thoracic structures (lungs, chest wall, and mediastinum). Considering the topography of pleural structures these situations are quite numerous and misleading especially for young radiologists, who may disregard certain details when faced with an unusual image.

The thesis begins with a short chest anatomy review, primarily focused on the pleura: topographic radiological chest anatomy, pleural anatomy and its normal aspect on plain films and CT. (Cap.1)

The next chapter describes some basic technical notions for chest imaging, considering the plain film radiograph as the primary examination tool. It includes a short list of complementary techniques, and some acquisition details for the chest CT scans. (Cap.2)

Pleural lesions etiopathogenesis (Cap.4) is important both for understanding the radiographic aspects and evolution of pleural lesions. It also provides the basics for integrating the clinical data in the process of radiological differential diagnosis. This chapter describes both the macroscopic and microscopic aspects of pleural lesions, plus their main clinical associations. In this chapter only I've used the morphopathology classification of pleural lesions (fluid collections, focal proliferations, fibrosis, and calcifications) because it is closer to the clinical perspective and provides better etiology correlations.

The elementary pleural lesions chapter (Cap.5) describes their main radiological features and the most common classifications used for each type (quantitative for collections, topographic for pleural thickening, regarding aspect for calcifications). For each type of lesion I have described their primary characteristics (common to all forms) and subtype particularities according to the classification used. I also explained a few terms commonly used in radiological results, to help clarify their meaning.

Elementary pleural lesions classification is based on the book "Radiologie si Imagistica Medicala" (C. Zaharia, S.A. Georgescu, ed. 2003), with a few personal modifications that I considered necessary for better association with my study.

After describing the elementary pleural lesions, I described their most common differential diagnosis situations with lesions of other chest structures. (Cap.6)

In selecting the most common differential diagnosis situations of elementary pleural lesions I used the following criteria:

- Only typical pleural lesions
- No associated diseases that can influence the local aspect
- Clear, easily identifiable differentiating criteria
- Described in the specialty literature and/or found in the daily radiology practice

For this chapter I used the common classification described at chapter 5, obtaining the following situations:

- Elementary differential diagnosis of free liquid pleural effusions
 - Small liquid effusion vs. Pleural adherence
 - Medium liquid effusion vs. lower lobe pneumonia
 - Medium liquid effusion vs. lower lobe atelectasis
 - Massive liquid effusion vs. massive atelectasis

- Elementary differential diagnosis of free pneumothorax
 - Pneumothorax vs. Diffuse oligaemia of the lungs
 - Small pneumothorax vs. subcutaneous emphysema
 - Pneumothorax vs. artifacts (penetrated film)
- Elementary differential diagnosis of free hydro-pneumothorax
 - Massive hydro-pneumothorax vs. large loculated liquid effusion
 - Hydro-pneumothorax vs. Pneumothorax
- Elementary differential diagnosis of loculated liquid effusions
 - Basal loculated liquid effusion vs. Small free-flowing liquid effusion
 - Parietal loculated liquid effusion vs. peripheral pulmonary hydatid cyst
 - Fissure loculated liquid effusion vs. pulmonary hydatid cyst
 - Oblique fissure loculated liquid effusion vs. diaphragm hump
 - Basal loculated liquid effusion vs. ascended hemi-diaphragm
- Elementary differential diagnosis of loculated pneumothorax
 - Small loculated pneumothorax vs. thin wall pulmonary cavity
- Elementary differential diagnosis of loculated hydro-pneumothorax
 - Loculated hydro-pneumothorax vs. pulmonary cavity with air-fluid level
- Elementary differential diagnosis of solid pleural nodules
 - Solid pleural nodule vs. chest wall nodule
 - Solid pleural nodule vs. peripheral pulmonary nodule
- Elementary differential diagnosis of pleural thickening and adherences
 - Severe retractile pleural thickening vs. lobar atelectasis
 - Apex pleural thickening vs. Pancoast tumor
 - Basal pleural thickening vs. early stages of pneumonia
 - Right anterior-inferior pleural thickening vs. right atrium enlargement
 - Left anterior-inferior pleural thickening vs. left ventricle enlargement
 - Superior mediastinal pleural thickening vs. wide upper mediastinum
 - Horizontal fissure thickening vs. right lung fibrosis line
 - Hemi-diaphragm ascended by pleural adherence vs. hemi-diaphragm pushed-up by an abdominal organ
- Elementary differential diagnosis of pleural calcification
 - Nodular pleural calcifications vs. costal cartilage calcifications
 - Pleural calcifications vs. pulmonary calcifications

Differential Diagnosis Issues of Atypical Pleural Lesions Study (Cap.7)

In the actual study I included only cases that raised serious differential diagnostic problems with other chest structures lesions because of their atypical and/or very complex aspect, often combining several elementary pleural modifications.

Of the main elementary lesions types, free-flowing fluid effusions and calcifications rarely generate diagnostic problems if there are no technical errors in the radiographic process.

Loculated fluids, pleural thickening and nodules are the main problem when sorting out complex differential diagnosis, especially when associated to each-other, a rather frequent situation that generates a wide variety of aspects. This diversity creates extreme difficulties at any radiological classification attempt, thus I considered necessary to include the clinical significance of the lesions in my differential diagnosis analysis.

Materials and method:

The study was done over one year in the Radiology and Medical Imaging Department of the Coltea Clinical Hospital. The study cases were sorted from all the chest imaging cases examined in the department in that period. Depending on the particularities and severity of the main disease, some cases were supplementary examined using imaging and clinical tests.

The initial triage sorted all cases with pleural modifications, regardless of their type or importance. We found that over 50% of the adult patients had at least a minor pleural modification on plain film radiographs, the most common of these being modest asymptomatic pleural thickening.

The cases with typical and/or very obvious pleural lesions were not included in the study, but some of them were used in the thesis for the elementary lesions chapter.

Study case selection was based on the diagnostic difficulties reported by the radiologists who examined the patients. The study includes both cases solved with only radiographs and cases that required complementary examinations.

The study includes a total of 152 cases.

The main method of analysis for the studied cases was successive examination of images by three radiologists, one of them being the study coordinator.

Results validation was based primarily on complementary CT scans, but some cases required other investigative procedures, as cardiac ultrasound, guided pleural fluid extraction, guided pleural biopsy, etc.

Objectives:

1. To identify the main pleural lesions that can raise differential diagnosis problems for a senior radiologist.
2. To describe and classify the most frequent differential diagnosis problems for atypical and/or complex pleural modifications.
3. To analyze the main differential diagnosis problems for atypical and/or complex pleural lesions using the achieved classification.
4. To integrate the clinical perspective in differential diagnosis problems for atypical and/or complex pleural lesions.

The study does not target a statistical analyze because I believe it wouldn't actually be of any practical use and because the total number of cases is too small to be statistically relevant.

Results and Discussion:

A. Classification:

The common classification based on the individual type of pleural modifications proved impractical because:

- a. In most cases the diagnostic difficulties were generated by the coexistence of multiple types of lesions on the same image.
- b. The same morphological type of lesion can generate different aspects and problems depending on its severity and location.
- c. From the clinical point of view the pleural lesions rarely represent the major concern.

Consequently I considered more useful a classification based primarily on the lesions location and the clinical importance of the differential diagnosis.

Based on these considerations, I elaborated the following classification:

1. Pleural modifications difficult to localize and quantify exactly

In this category at senior radiologist level are included only very small loculated effusions and guidance for the puncturing of diverse loculated effusions. (Cap. 7.1 and 7.2)

2. Pleural lesions that require differential diagnosis with pulmonary diseases

This category includes both pleural lesions simulating pulmonary disease (Cap. 7.3) and pleural lesions hiding neighbor lung lesions (Cap. 7.4).

3. Pleural lesions that require differential diagnosis with cardiovascular diseases

Both pleural lesions that simulate cardiac modifications (Cap. 7.5) and the ones that hide cardiac disease (Cap. 7.6) are included.

4. Pleural lesions that require differential diagnosis with mediastinal diseases, especially tumors (Cap. 7.7)

5. Specific differential diagnosis problems generated by pleural nodules, where the main concern is establishing if the complementary CT scan is needed.

B. Differential diagnosis discussion:

B.1. Very small or complex/multiple loculated pleural effusions:

Very small loculated pleural effusions (below 300ml) are difficult to see on plain film radiographs, especially if they are associated with pleural adherences. Their significance depends on the primary disease; usually they are significant only for cardiac and cancer patients. The best, fastest and safest way to verify their presence is by performing a complementary targeted ultrasound examination.

Larger loculated pleural effusions are easy to diagnose, but require precise imaging guidance in case they have to be punctured.

B.2. Pleural lesions that require differential diagnosis with pulmonary diseases

At senior radiologist level in this matter we discuss only error and uncertainty sources, not elementary modifications. From all the differential diagnosis elements I believe the most important are:

- Spotting any modification due to technical errors
- Knowing the clinical and biological context
- Exactly localizing of every noticed lesion
- Evaluating all effects of pleural lesions upon the position of the neighboring structures
- Following-up the case

B.3. Pleural lesions that require differential diagnosis with cardiovascular diseases

As plain film radiographs no longer represent the primary means of diagnostic for cardiac lesions, we developed a tendency to neglect the radiological modifications of the heart, but both during the study and in my daily practice I've noticed a lot of cases where due to other severe diseases nobody checked the heart and significant heart problems were revealed on chest radiographs.

This chapter also discusses analyses of the observed modifications, not how to spot them, as for a specialist they are quite obvious. The main differential diagnosis elements are:

- Evaluating all mass effects of pleural modifications
- Analyzing the true shape of the heart
- Analyzing the great vessels contours
- Analyzing the hila and pulmonary circulation
- Examining the lung areas

B.4. Pleural lesions that require differential diagnosis with mediastinal diseases

From all the studied cases only some cases of mediastinal pleura thickening were diagnosed only on plain film radiographs, most patients with this type of differential diagnosis problems required a complementary CT scan to finalize the diagnostic.

In this type of situation, on plain film radiographs examination I consider the following aspects to be most useful:

- Rigorous patient positioning
- Acknowledging all pleural modifications, not only the mediastinal ones
- Analyzing the neighboring lung areas

B.5. Specific differential diagnosis problems generated by pleural nodules

At senior level confusing them with pulmonary nodules is very unlikely, but even for seasoned radiologists some chest wall nodules that associate pleural thickening can be very difficult to differentiate from actual pleural masses. There are also two benign entities that can simulate pleural nodules: a very small loculated effusion and a severe irregular pleural thickening (often called "pseudo-nodular" thickening).

The only nodular modification of the pleura that can be diagnosed exclusively on plain film radiographs is the pseudo-nodular thickening, usually associated with chronic infections (most frequently TB). In these cases detection of the associated pulmonary modifications finalizes the diagnostic. For all other nodular lesion of the pleura a complementary CT scan is mandatory.

C. The complementary CT recommendation:

A limited number of cases that surpass the diagnostic possibilities of plain film radiographs can benefit from simpler complementary examinations, as ultrasound, fluoroscopy or radiographic monitoring. There are also some cases in which all diagnostic suspicions are benign and relatively unimportant for the patient's wellbeing, so the final diagnostic can be postponed and the patient programmed for long term radiographic monitoring. But most complex cases require a CT scan in order to finalize the diagnostic process.

Considering the new classification elaborated by this study, the complementary CT scan for atypical and/or complex pleural modifications is recommended for:

1. Pleural modifications difficult to localize and quantify exactly do NOT usually require a CT scan. The only exceptions are:

- The patient also suffers from other diseases that require CT
- The patient is about to undergo chest surgery and the surgeon asks for a precise mapping of all modifications

2. Pleural lesions that require differential diagnosis with pulmonary diseases:

A. Plain film radiographs raise a suspicion of:

- Metastases
- Malignant tumors
- Embolism
- Chronic infection

B. The patient's evolution does not match the radiographic diagnostic

3. Pleural lesions that require differential diagnosis with cardiovascular diseases are in most cases differentiated by cardiac ultrasound.

The CT scan is useful only when:

- Ultrasound windows are insufficient
- Ultrasound detects a tumor
- There are severe associated diseases that require CT by themselves

4. Pleural lesions that require differential diagnosis with mediastinal diseases, especially tumors – complementary CT is mandatory for ALL cases that cannot be firmly diagnosed on the plain film radiographs.

5. Specific differential diagnosis problems generated by pleural nodules – complementary CT is mandatory for ALL cases, with only two exceptions:

- Pseudo-nodular pleural thickening (if it can be diagnosed on plain film)
- The nodule was already analyzed on a CT scan and the current plain film examination is ordered for other purpose (not for monitoring the nodule)

Conclusions:

1. Atypical and/or very complex pleural lesions can generate serious differential diagnostic problems and require a very careful examination of plain film images.

2. The plain film radiograph still is the primary chest examination and if correctly made and examined can finalize the differential diagnostic in many cases of atypical or very complex pleural lesions.

3. Atypical or very complex pleural lesions classification by location and main differential diagnostic issues is superior to the standard classification by lesion types because it offers fewer alternatives to be considered in the differential diagnostic, better concentration on the important details and a much better clinical correlation.

4. Clinical and biological data integration in the radiological analysis can be decisive for finalizing the differential diagnostic in patients with atypical or very complex pleural lesions.

5. Direct communication between the radiologist and the clinician allows a better case management for patients with atypical or complex pleural lesions.

6. Plain film radiographs don't always finalize the differential diagnostic in patients with atypical or very complex pleural lesions, but they always offer important diagnostic data and help select the best complementary examinations for each patient.

7. A thorough examination of plain film radiographs facilitates the decision to perform a CT examination when needed, especially for patients with atypical or very complex pleural lesions.

8. Plain film examination results offer the justification required by the WHO and by professional ethics for performing the CT examination, a more irradiating but superior diagnostic procedure.

9. Contrast enhanced chest CT scans solve all differential diagnostic issues in most cases of atypical or very complex pleural lesions that mimic or hide other organs diseases.