Missed lung cancer at chest radiography: prevalence and radiographic lesion characteristics

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Objectives

The diagnosis of lung cancer on the chest radiograph may be difficult. Failure to detect lung lesion on the chest radiograph, which has become one of the most frequent causes of missed diagnosis in radiology, is a major cause of medicolegal action [1].

In the literature, the proportion of missed lung cancers on chest radiographs varied between 25% and 90%, depending on study designs. Some were designed to measure the miss rate of pulmonary nodules in general rather than lung cancer while other studies were planned to investigate different parameters influencing failure to detect pulmonary lesions or to detect early lung cancer in high-risk patients [2]. Thus, the exact miss rate in the detection of early lung cancer on the chest radiograph is difficult to estimate. The generally accepted error rate for the radiologic detection of early lung cancer is between 20% and 50% [1].

Pulmonary nodules are often missed because of poor lesion conspicuity caused by superimposition of hilar and mediastinal structures, blood vessels, clavicles or ribs. Poor viewing conditions and poor technical quality of the images are also reasons why small lesions can be missed [1, 3]. Factors that contribute to missed lung cancer can be categorized as arising from observer error, lesion characteristics or technical considerations [4, 5].

The purpose of our study was to investigate the prevalence and characteristics of missed lung cancer on the chest radiography and to understand the reasons of overlooked lesions.
Materials and Methods

From June to December 2011, 250 consecutive patients with lung cancer diagnosed at our institution and surgically treated were retrospectively identified. Of these, 82 patients had chest radiographs and computed tomography (CT) exam available.

Two chest radiologists analyzed images looking for missed lung cancer in consensus.

Missed lesion on chest radiography was defined as evidence of pulmonary opacity identified at CT exam that had not been described in the initial report at the previous chest radiography and subsequently histopathologically proved to be lung cancer.

Prevalence of missed lung cancer was recorded.

Lesion size, location, attenuation and margins were reported.

- The size of each lesion was defined as the maximal diameter that was measured in centimeter on the initial radiograph.

- The lobar locations were determined with chest CT exam into upper and lower lobe region; the lingula and the middle lobe were labeled as the lower lobe region. Each missed lesion on chest radiograph was also categorized as central (hilar and juxtahilar site) or peripheral (any site distal to juxtahilar).

- Solid and non solid tumors were classified according to the lesion attenuation.

- The margins of these lesions were categorized into well defined and ill-defined.

Possible reasons of overlooking lung cancer were searched among:

- the superimposition of structures obscuring the lesion (ribs, hilar structures, heart, diaphragm);
- the morphological characteristics of lesion (size and attenuation);
- the mechanism of "satisfaction of search";
- the incorrect interpretation of a recognized pulmonary abnormality.
Results

In our study, 14 of 82 lung cancers were missed on chest radiography with a prevalence of 17%.

11 missed lung cancers occurred in men (78%) and 3 occurred in women (28%). Age of the patients ranged from 46 to 80 years with mean age of 66 years.

The mean diameter of the 14 missed lesions on the initial chest radiograph was 2.4 cm, ranging from 0.6 cm to 7 cm.

According to lobar locations, 8 missed lung lesions occurred in the upper lobe region (57%) and 6 occurred in the lower lobe region (43%). The majority of missed lung cancers was peripheral (10/14; 71%).

All missed lung cancers had solid attenuation except for one lesion that had a non solid density (Fig. 1 on page 5).

Most of missed cancers (8/14; 57%) had a well-defined appearance; 6 of 14 lesions showed ill-defined margins (43%) (Fig. 2 on page 5).

In most cases (10/14) lesions were partially obscured by superimposed structures, such as ribs (5/10) (Fig. 3 on page 6), hilar structures (3/10) (Fig. 4 on page 7), heart (1/10) and diaphragm (1/10) (Fig. 5 on page 8).

In the remaining cases, 2 lung cancers were missed for a mechanism of "satisfaction of search" (Fig. 1 on page 5), 1 for a diameter less than 1 cm (Fig. 6 on page 9) and 1 was misinterpreted as a nipple (Fig. 7 on page 10).
Fig. 1: 84 yo patient hospitalized for surgical resection of a meningioma - (a) Pre-operative PA chest X-ray shows a 1 cm not calcified pulmonary nodule, with smooth and regular margins, close to the aortic arch (white arrow). (b) Lateral view confirms the presence of the nodule in the anterior segment of the left upper lobe. (c, d) CT exam reveals a "ground-glass" area, later diagnosed as lung cancer, in the apicodorsal segment of the left upper lobe, retrospectively visible also on chest radiograph (white arrowhead). Once found the nodule, radiologist probably did not search for other abnormalities on chest X-ray, missing a low conspicuity lesion.

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Fig. 2: 67 yo heavy smoker patient with fever - (a, b) Axial and coronal CT images show a lesion with ill-defined margins in the apical segment of the right upper lobe, missed in a PA chest X-ray (c) performed three days before, probably because of its poor conspicuity (white arrow).

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Fig. 3: 66 yo patient with a brain metastasis - (a, b) CT exam, performed for staging purpose, shows, on axial and coronal images, a 2 cm nodular solid not calcified lesion with irregular margins in the apical segment of the right upper lobe, later diagnosed as primitive lung cancer. (c) A retrospective review of the AP chest X-ray, performed in supine position after surgical resection of the brain lesion, demonstrates an ill-defined opacity in the right lung apex (white arrow), probably not identified by the reporting radiologist for the presence of overlapping dense structures, such as ribs and right clavicle.

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Fig. 4: 65 yo patient with previous tuberculosis and hemoptysis - (a) PA chest X-ray demonstrates the presence of calcified nodules in the right perihilar region. (b, c) Axial and coronal contrast-enhanced CT images show a solid inhomogeneous tissue located in the right hilum (white arrows). A different attenuation of the hilar regions and the enlargement of the right hilum were retrospectively identified on the chest radiograph.

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Fig. 5: 71 yo COPD patient with fever and cough - (a) PA chest X-ray shows an opacity located close to the heart silhouette and upon the left hemidiaphragm (white arrowheads), perhaps interpreted as pericardial fat and not reported by the radiologist. (b, c, d) CT exam, performed for the persistence of clinical symptoms, demonstrates, on axial, coronal and sagittal images, the presence of a large parenchymal consolidation in the left lower lobe, adjacent to the left fissure and the left hemiadiaphragm, later diagnosed to be an adenocarcinoma.

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Fig. 6: 57 yo heavy smoker patient with COPD exacerbation - (a, b, c) Axial, coronal and sagittal CT images show a 6 mm not calcified nodule in the lateral basal segment of the right lower lobe with irregular and spiculated margins and with a central bubble lucency. (d, e) A retrospective review of a chest X-ray, performed a week before the CT exam, shows a very small opacity projecting upon the anterior arch of the sixth right rib, visible only in the PA projection and probably missed for its small size and low conspicuity (white arrow).

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Fig. 7: 85 yo patient with severe emphysema - (a) Routine PA chest X-ray shows a nodular opacity projecting upon the posterior arch of the left sixth rib (white arrowhead); another nodular opacity in the right basal region was not reported, probably because interpreted as a nipple (white arrow). (b, c) A CT exam, performed immediately after the chest radiograph, confirms the presence of a round nodule with regular margins in the apical segment of the left lower lobe; another nodule with lobulated margins is visible in the right lower lobe, corresponding to the nodular opacity missed on the chest radiograph. (d, e) A CT exam, performed three months later, shows a growth of the nodule of the right lower lobe, suggesting its malignant nature; the diameter of the nodule of the left lower lobe is unchanged.

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Conclusions

Missed lung cancers at chest radiography are not rare. In our study, the rate of missed lung cancer on chest radiography was 17%.

Most missed lung cancers are nodular opacities located at the lung parenchyma periphery, particularly in the upper lobes.

Superimposed normal structures are the major contributing factor to overlooked lesions.

The knowledge of the most common characteristics of missed lung cancer may help detection and avoid misinterpretation.

References