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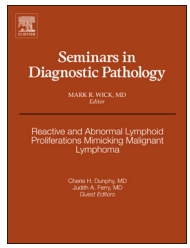

Lung cancer imaging

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ABSTRACT

Lung cancer remains the leading cause of cancer-related deaths in the US. Imaging plays an important role in the diagnosis, staging, and follow-up evaluation of patients with lung cancer. With recent advances in technology, it is important to update and standardize the radiological practices in lung cancer evaluation. In this article, the authors review the main clinical applications of different imaging modalities and the most common radiological presentations of lung cancer.

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Introduction

Lung cancer is the leading cause of cancer deaths, accounting for 29% of all male cancer deaths and 26% of all female cancer deaths in the USA in 2012.[1] Imaging plays a role in the identification of the primary lesion in the symptomatic patient or the asymptomatic screened individual and in the staging and follow-up of lung cancer. The purpose of this article is to review the strengths of the different imaging modalities used in lung cancer, to review certain characteristic imaging findings of different histologic types of lung cancer, and to acquaint the reader with the current standard and promising future radiological techniques in lung cancer imaging.

Diagnostic methods in lung cancer imaging

Technological advances in medical imaging, such as digitized radiography, multidetector computed tomography (MDCT), diffusion-weighted imaging (DWI) sequences in magnetic resonance imaging (MRI), and the advent of positron emission tomography/computed tomography (PET/CT) have allowed better characterization of the morphological and metabolic findings in lung cancer. Imaging plays an important role in the detection of lung nodules and masses, distinguishing between benign and malignant lesions, staging of lung cancer, evaluation for tumor resectability, and follow-up to assess response to therapy and to detect the progression or recurrence following disease treatment.

Each imaging modality has different roles in lung cancer evaluation. Chest radiographs are still used as the initial choice for evaluation of suspected lung diseases. CT offers the best evaluation of the morphologic features of lung lesions. The clinical use of MRI is still limited to specific clinical scenarios in the evaluation of lung cancer, such as the evaluation of superior sulcus (Pancoast) tumor extension into the brachial plexus or malignant invasion of the chest wall, mediastinum, or spine.[2] Fluorodeoxyglucose (FDG)-PET/CT is the most accurate imaging modality for the staging of metastatic lung cancer.[3–5]

Chest radiography

Chest radiography is the initial imaging modality of choice for the evaluation of any suspected lung disease.[6–9] The sensitivity and specificity of chest radiography have recently improved with the advent of digital radiography and dual-

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energy subtraction technique.[10] This technique allows image post-processing to reduce the interference caused by overlapping structures and improves the detection of pulmonary parenchymal abnormalities, including the primary pulmonary nodule (Fig. 1). A nodule is recognized as benign by chest radiography when calcifications are demonstrated in the nodule, or, if old comparison radiographs are available, by showing absence of growth for over 2 years.[11,12] If malignancy is suspected, a chest CT is performed for further evaluation. Chest radiography is not sufficiently sensitive for nodal and distant metastatic staging.[13]

Computed tomography

CT is the best imaging modality for evaluating a suspected lung tumor. CT is more sensitive than chest radiography in detecting pulmonary nodules because of its ability to get thin slices and eliminate overlapping structures. CT is superior to chest radiography in determining the margins and internal characteristics of these nodules.[14] Tumor margins may be spiculated, smooth and well circumscribed, or have lobulations. Spiculated margins are highly suggestive of, but not pathognomonic for, malignancy.[15] Spiculations can reflect the presence of peritumoral fibrosis, infiltration of tumor cells into adjacent lung parenchyma, or localized lymphangitic spread.[16,17] Lobulation of margins implies uneven growth that is often associated with malignancy,[18] but it is not useful in distinguishing benign from malignant nodules. Determination of a nodule's benignity takes into account patient risk factors such as age and tobacco use, as well as the CT features that are statistically known to be strongly associated with malignancy.[19] Air bronchograms within a

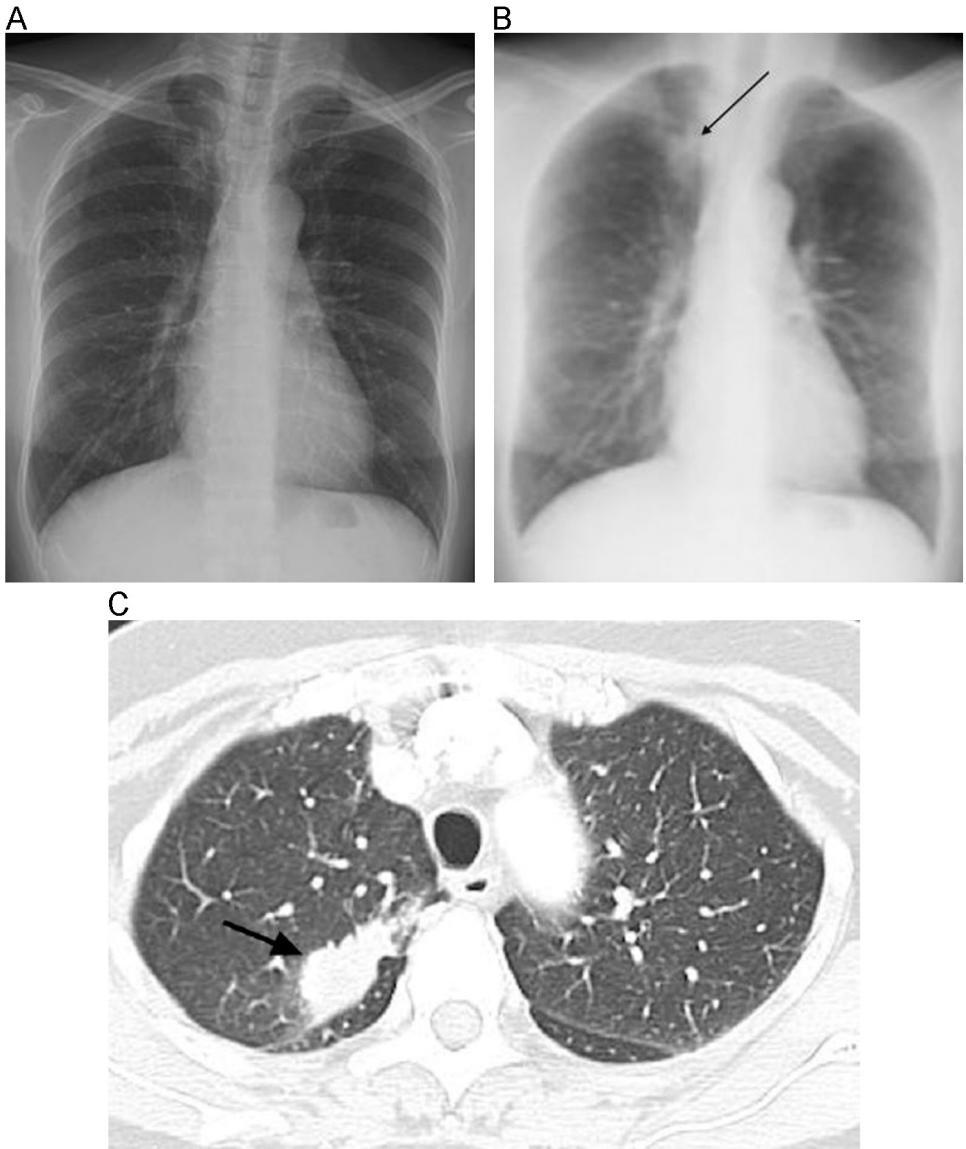

Fig. 1 – Dual-energy chest radiograph of a 60-year-old woman with non-small cell lung cancer. The primary malignancy in the right upper lobe is suboptimally seen radiographically due to superimposed bone structures (A) but becomes much more evident after bone subtraction (arrow) (B). A CT image with lung window settings (C) confirms the presence of a right upper lobe mass (arrow).

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