# Missed Lung Cancer

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**KEYWORDS**

• Lung cancer • Lung nodule • Chest radiography • Computed tomography • Observer performance

**KEY POINTS**

- Early detection of lung cancer can change therapeutic and surgical management options for patients.
- Familiarity with frequently encountered blind spots, lesion characteristics (such as size, location, and density), observer errors, and imaging quality issues that may contribute to missed lung cancer can help radiologists improve detection of suspicious lesions.
- Recognizing normal anatomy, developing a thorough search pattern, and scrutinizing for causes of unexplained findings (such as lymphadenopathy or pleural effusion) can help radiologists avoid missed lung cancer.

## INTRODUCTION

In the United States, lung cancer is the leading cause of cancer-related deaths; early detection can significantly change both therapeutic options and the long-term prognosis for patients. Early diagnosis and complete surgical resection remain the key to improved survival, but more than two-thirds of patients are diagnosed at an advanced stage. Radiologists play an important role in lung cancer detection, particularly in incidental cancers found on imaging performed for unrelated reasons, as up to 39% of patients with lung cancer are asymptomatic at the time of diagnosis. Chest radiographs (CXRs) are the most frequently ordered imaging study for numerous clinical indications. The increased clinical demand on radiologists has resulted in less time for interpretation of studies, with a potential risk for more errors to occur. Missed lung cancer is one of the leading causes of medical malpractice among radiologists. About 90% of the missed cancers involved CXR, whereas computed tomography (CT) and other imaging studies account for the remaining 10%.[1]

## FACTORS LEADING TO MISSED LUNG CANCER

Three types of observer errors have been described by Kundel and colleagues[2]: (1) scanning, (2) recognition, and (3) decision-making. Failure to fixate on the lesion region of interest causes scanning error and requires the observer to focus on the lesion of interest for at least 360 milliseconds on the fovea of the retina. If a nodule is adequately scanned but not detected, this is considered a recognition error. In a study by Kundel and colleagues,[2] both scanning and recognition errors each accounted for 30% of observer errors. The most common observer error in the study was due to a decision-making error (45%), which is the result of adequate detection of the abnormality but misinterpretation of a malignant lesion as a benign or a normal finding.

Other confounding factors that may cause failure to detect a lesion include reader fatigue, satisfaction of search, and intentional underreading. With increasing emphasis on turnaround time, radiologists are forced to interpret a larger volume of images in a shorter period of time, resulting in

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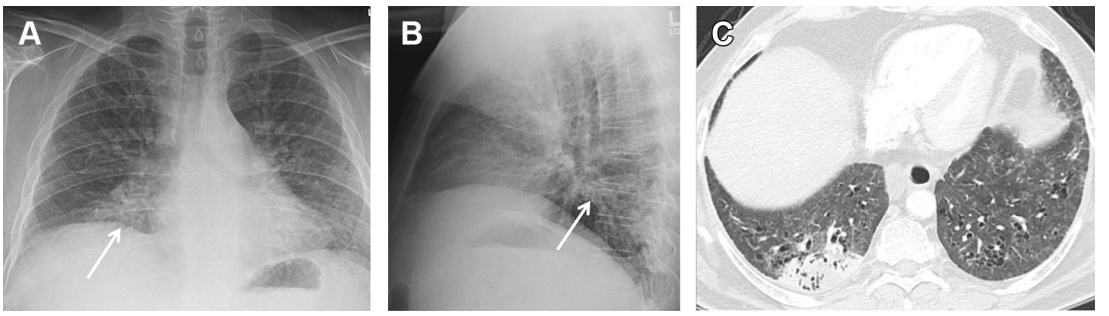


**Fig. 1.** (*A*) PA chest demonstrates bilateral diffuse hazy opacities and low lung volume thought to be related to patient's known non-specific interstitial pneumonia (NSIP). Focal opacity in the right lower lobe (*arrow*) was not recognized. (*B*) Lateral chest radiograph shows positive spine sign (*arrow*), absence of normal progressive lucency over the lower thoracic vertebral bodies, which was not recognized. (*C*) Chest CT performed months later demonstrates bilateral groundglass opacities and traction bronchiectasis consistent with NSIP and a right lower lobe consolidation, eventually proven to represent adenocarcinoma. The lung cancer was missed on chest radiograph due to satisfaction of search and failure to recognize the "spine sign" on the lateral chest radiograph.

both visual fatigue and central nervous system fatigue. Satisfaction of search is another potential observer error that occurs when a second but more visually alarming or obvious finding results in loss of attention to more subtle abnormalities (**Fig. 1**). As more imaging studies are ordered and performed, there is increasing detection of incidentalomas. Perceived pressure from referring colleagues to decrease the number of reported incidentalomas and recommended additional workup can result in intentional underreading by radiologists.

## MISSED LUNG CANCER ON CHEST RADIOGRAPH

In general, poor image quality and poor viewing conditions can play a role in observer error. In addition, some of the most common reasons for missed lung cancer on CXR are largely poor nodule conspicuity due to small size, ill-defined margins, ground-glass density, and overlying structures.

### *Locations of Most Common Missed Cancers*

In the hallmark retrospective study performed by Austin and colleagues[3] in 1992, twenty-seven cases of missed lung cancers were reviewed. The investigators concluded that up to 81% of missed lung cancers are located in the upper lobes, favoring the right upper lobe particularly (56%). This predominance could be explained by the higher frequency of lung cancer occurrence in the upper lobes[4] and the presence of overlapping clavicle and ribs (**Fig. 2**). The perihilar region is the second most common location for missed lung cancers. Lin and colleagues[5] described 17 out of 37 missed lung cancers that were hilar in location. Centrally


**Fig. 2.** (*A*) PA chest radiograph shows a subtle right upper lobe nodule which is obscured due to overlying bone. (*B*) Dual energy chest radiograph with bone subtraction significantly improves the conspicuity of the right upper lobe nodule. (*C*) Coronal chest CT shows the spiculated right upper lobe nodule. This nodule was missed on the initial chest radiograph due to overlying osseous structures.