



Pitfalls in Chest Radiographic Interpretation: Blind Spots

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Introduction

Errare humanum est. Latin proverb, attributed to Seneca the Younger

Chest radiographs are the single most commonly performed radiologic study.¹ They are the workhorse of the health care system, because they are readily accessible, inexpensive, and can be completed efficiently.² The radiation dose from a chest radiograph is quite low, with an effective dose of 0.1 mSv, equivalent to 10 days' worth of background radiation.³ They are used extensively in emergency departments, inpatient and intensive care units, and outpatient centers for initial investigation and follow-up of signs and symptoms related to cardiac and pulmonary diseases and in immunocompromised patients as a screening tool.² The chest radiographic interpretation often directs the subsequent investigations, including clinical and laboratory analyses and additional imaging studies if needed.

The practice of radiology, like all endeavors, is subject to human error. Mistakes can occur at multiple points in the process, including the placement of orders, the acquisition and processing of images, and interpretation of the studies.⁴ Mistakes in image interpretation can result in delayed or erroneous diagnoses, leading to belated treatment for a variety of conditions, both benign and malignant. It is important to consider errors as opportunities for improvement. Inquiry into how and why radiologic mistakes are made allows for an objective analysis of ways to better our methods, procedures, and routines to promote patient care. Other areas of medicine and nonmedical industries have made great strides in

safety improvement through research, education, and communication about error patterns and their relation to the underlying systems in place.⁵

In this article, we examine several factors that contribute to errors in interpretation and detection of abnormalities on chest radiograph, with the purpose of increasing accuracy in chest radiographic interpretation.

Factors in Radiographic Reporting Errors

Radiologic reporting errors fall into 2 categories. Errors of detection, or perceptual errors, occur when the reader fails to perceive an abnormality. Interpretive errors occur when an abnormality is identified but is attributed to the wrong cause or is mistaken for a normal variant. A range of proportions of these errors have been reported in literature.^{4,6,7} Although errors occur in all imaging modalities, radiographs are especially prone to detection errors.⁴ To produce flat, 2-dimensional radiographs, multiple anatomical structures in the 3-dimensional body are necessarily superimposed on each other. In addition, the chest radiograph has limited contrast resolution.

The most studied error on chest radiographs is missed primary lung cancer, which becomes evident on subsequent imaging.⁸⁻¹¹ There are several analogous situations involving the necessity of identifying a nodular density on chest radiography, including detection of metastatic disease in a patient with malignancy or recognition of an infectious nodule in an immunocompromised patient. The reported error rate for missed lung cancer on radiographs is 20%-50%, a figure that has remained unchanged for decades.^{12,13} False-positive interpretations, that is, reporting an abnormality that is not present, are also fairly stable at 2%.¹³ Based on studies of missed lung cancers, several factors have been shown to contribute to detection and interpretation errors in the reporting of chest radiographs.

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Lesion Characteristics

In many cases, the characteristics of the lesions themselves contribute to the degree of conspicuity they display on radiographs.

Location

An important factor in the identification of pathology on radiography is its position within the chest¹² (Fig. 1). In multiple studies, most undetected lung cancers are located in the upper lobes.^{14,15} The predominance of misses in the upper lobes is partly because more lung cancers occur in the upper lobes¹⁵ but also because multiple overlapping structures in this

area affect visual evaluation.^{12,16} In the study by Monnier-Cholley et al,¹⁰ the lung apices were followed by the paramediastinal region as the most common location of missed tumors. Perihilar tumors have also proved difficult to see.^{12,14} Proximity to the pleural surfaces, diaphragm, and rib cage can decrease visualization.¹⁷

Size

Nodules less than 1 cm in diameter are generally considered below radiographic resolution, unless exceptionally dense, as in the case of calcified nodules. Some investigators have found 4 mm to be the lower limit of visibility.^{1,17} In fact, only 50% of 1-cm nodules are detected.¹ Austin et al⁸ showed missed lung

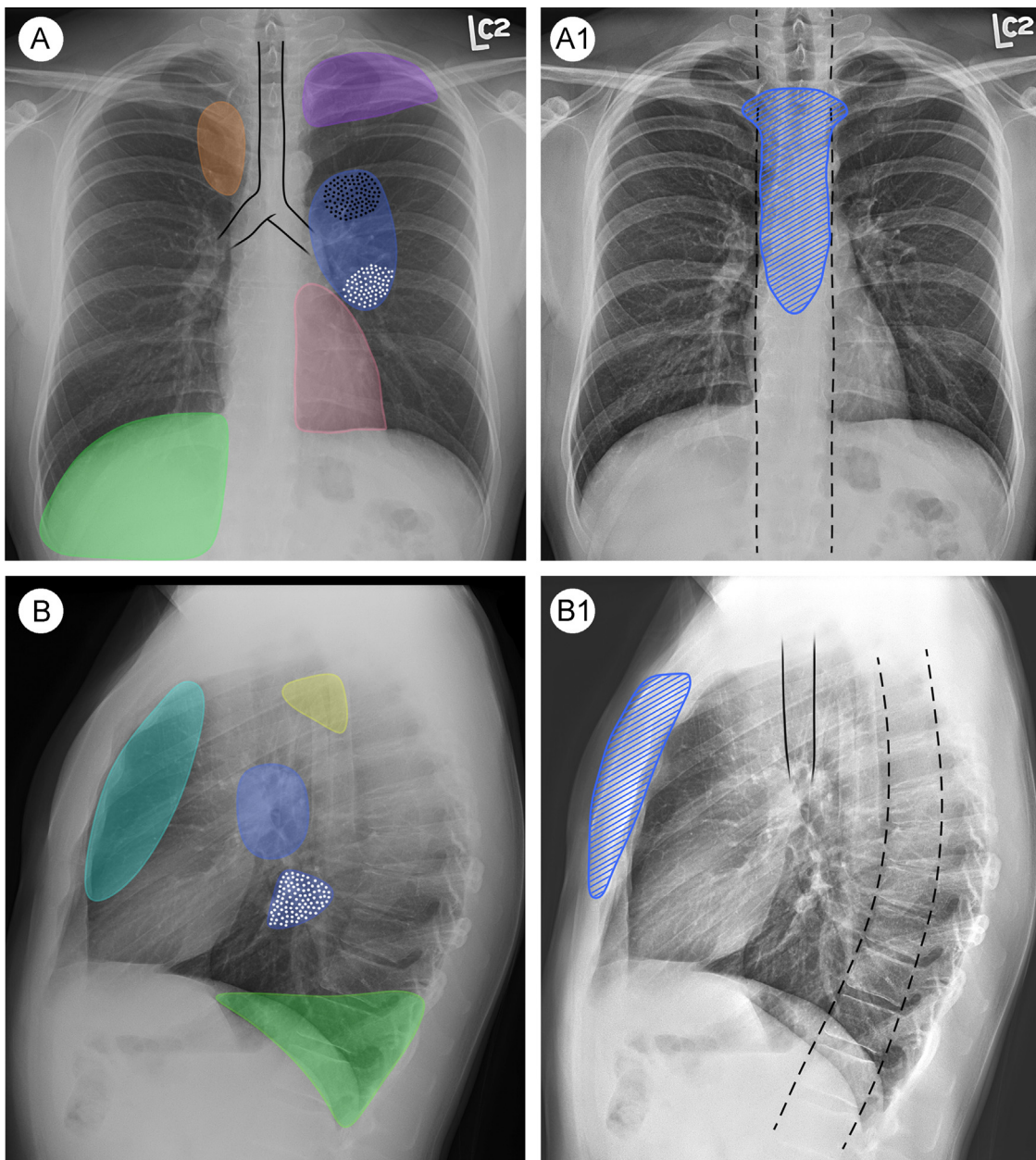


Figure 1 Common blind spots on posteroanterior (PA) and lateral chest radiographs. Purple, lung apices; teal, retrosternal space; orange, paramediastinal space; pink, retrocardiac space; yellow, retrotracheal space; blue, hilum, including the suprahilum space (black dots) and infrahilum space (white dots); green, lung bases behind the diaphragms; black solid line, trachea; black dotted line, spine; and blue crosshatch, sternum. (Color version of figure is available online.)

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