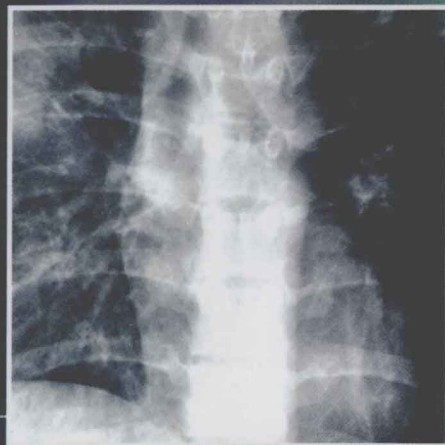


MÜLLER • SILVA

# HIGH-YIELD IMAGING



## Chest

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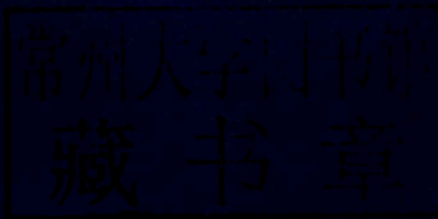
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# HIGH-YIELD IMAGING

Chest

*To Alison and Phillip Müller  
and to Nicinha Silva*



# Preface

The aim of *High-Yield Imaging: Chest* is to provide an overview of the main aspects of chest imaging in a succinct and user-friendly bulleted format and with state-of-the art illustrations. It includes a review of the various radiographic and high-resolution CT patterns of disease and their differential diagnosis and a summary of the main pulmonary, mediastinal, pleural, and chest wall diseases. The text provides the essential information that the radiologist needs to know, including definition of the various abnormalities, radiologic manifestations, clinical utility of the various imaging modalities, characteristic clinical presentation, pathologic features, main diagnostic pearls, and differential diagnosis, as well as the key information that the referring physician needs to know about the condition and its imaging manifestations. The text is based on the 2-volume book *Imaging of the Chest*, published in 2008 by Elsevier, with the text updated in 2009. The figures include the most representative illustrations from that textbook plus new updated images.

The chest radiograph continues to be the most common imaging modality used in diagnostic imaging. The combination of high-quality chest radiographs and a good clinical history allows the radiologist and the respiratory physician to diagnose or to markedly narrow the differential diagnosis of many chest diseases. However,

it is well recognized that the chest radiograph has important limitations. High-resolution CT and multidetector spiral CT have become the imaging modalities of choice in many chest diseases, and one or the other technique is performed almost routinely in the evaluation of patients with suspected interstitial lung disease, bronchiectasis, pulmonary embolism, abnormalities of the aorta, and pulmonary or mediastinal tumors. MR imaging has an important role in the assessment of cardiovascular, mediastinal, and chest wall abnormalities. PET imaging and integrated PET-CT have replaced CT as the imaging modalities of choice for the staging of pulmonary carcinoma and lymphoma. The main role of ultrasound in chest imaging is as a guide for aspiration and drainage of pleural fluid collections and for biopsy of pleura-based tumors.

This book is aimed at radiologists, respiratory physicians, and radiology and pulmonary medicine residents and fellows, as well as internists and family practitioners taking care of patients with chest disease. We hope that it will be of value in improving the understanding of the various chest diseases and thus be helpful in improving patient care.

Nestor L. Müller  
C. Isabela S. Silva

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The text of *High-Yield Imaging: Chest* is based on the 2-volume book *Imaging of the Chest*, published in 2008, with the text updated in 2009, and the figures include the most representative illustrations from that textbook plus new updated images. We wish to acknowledge all of our colleagues throughout the world listed below who contributed to *Imaging of the Chest* and without whom

neither that book nor this one would have been possible. Our special thanks to the outstanding contributions by Drs. David Hansell, Kyung Soo Lee, Martine Remy-Jardin, Jacques Remy, and Kiminori Fujimoto. We wish also to thank Drs. Philippe Grenier, Catherine Beigelman-Aubry, Jim Barrie, Gustavo Meirelles, Claudia M. Figueiredo, and Marcos Manzini for the images they kindly provided.

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	<b>Hiatal Hernia</b>		

# Radiologic Manifestations of Lung Disease

## Focal Consolidation: Acute Causes

**DEFINITION:** Focal consolidation is replacement of gas within airspaces by fluid, protein, cells, or other material at a single pulmonary focus.

### IMAGING

#### Radiography

##### Findings

- Fairly homogeneous opacity that is associated with obscuration of the pulmonary vessels and little or no volume loss.
- Adjacent soft tissue structures are obscured: silhouette sign.
- Margins are poorly defined except where the consolidation abuts the pleura.
- Air-containing bronchi (air bronchograms) are frequently visible within areas of consolidation.
- Nonsegmental (lobar) pneumonia may be associated with increased volume and bulging of the interlobar fissure.
- Segmental consolidation may be seen in pneumonia, distal to bronchial obstruction, and in association with acute pulmonary embolism.
- Spherical (round) areas of consolidation may occur in pneumonia or occasionally in pulmonary hemorrhage.
- Lung contusion results in focal consolidation that crosses normal anatomic boundaries.
- Focal right upper lobe pulmonary edema typically occurs secondary to papillary muscle dysfunction after acute myocardial infarction.

##### Utility

- Silhouette sign is most useful in differentiation of middle lobe and lingular disease from lower lobe disease and may also provide precise anatomic information in other sites.
- Radiography is usually the first and often the only imaging modality used in the assessment of focal consolidation.

#### CT

##### Findings

- Consolidation: homogeneous increase in pulmonary parenchymal attenuation that obscures the margins of vessels and airway walls.
- Ground-glass opacities indicating incomplete filling of alveoli adjacent to airspace consolidation.

### DIAGNOSTIC PEARLS

- Nonsegmental consolidation is associated with air bronchograms and normal or increased lung volume.
- Segmental consolidation is typically associated with atelectasis and lack of air bronchograms.
- Parenchymal consolidation may result in poorly defined 5- to 10-mm nodular opacities known as airspace nodules.

##### Utility

- Superior to radiography in demonstrating presence of focal consolidation or ground-glass opacity and the presence of underlying lung disease.

### CLINICAL PRESENTATION

- Fever and cough are present in patients with pneumonia.
- Acute shortness of breath may occur in patients with pulmonary embolism.
- Some patients may be asymptomatic or present with nonspecific symptoms.

### DIFFERENTIAL DIAGNOSIS

- Bacterial, viral, or fungal pneumonia
- Aspiration pneumonia
- Acute pulmonary embolism
- Pulmonary hemorrhage

### PATHOLOGY

- Replacement of gas within the airspaces by fluid, blood, or other material.

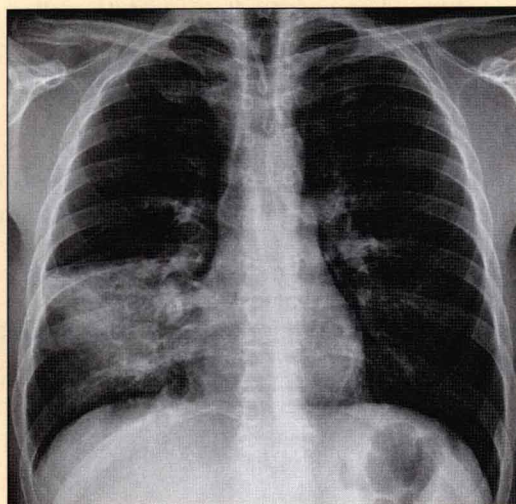
### INCIDENCE/PREVALENCE AND EPIDEMIOLOGY

- Common causes of acute focal consolidation include pneumonia (bacterial, viral, fungal), hemorrhage, and pulmonary edema.

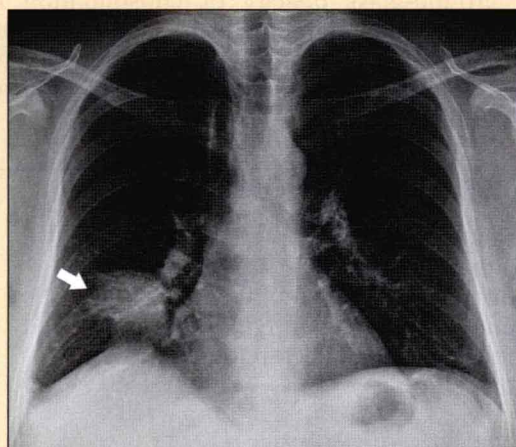
### WHAT THE REFERRING PHYSICIAN NEEDS TO KNOW

- Assessment of silhouette sign is only reliable on radiographs performed using proper technique.
- Hemorrhage should be considered particularly in patients with hemoptysis and those with blunt chest trauma.
- Focal opacities are more commonly seen on high-resolution CT than on radiography.

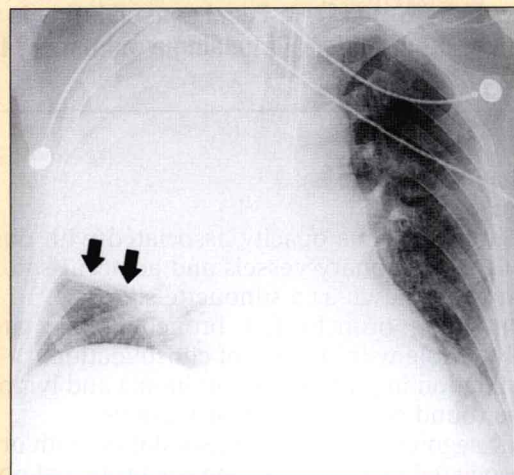




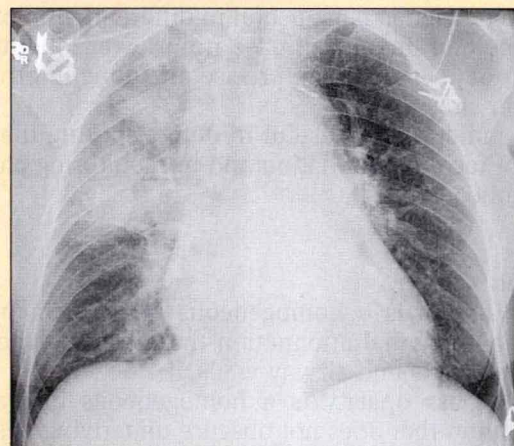
**Figure 1. Parenchymal consolidation and silhouette sign.** Posteroanterior chest radiograph shows consolidation in the right lower lung zone. Note obscuration of the right-sided heart border (silhouette sign) consistent with consolidation in the right middle lobe. The dome of the right hemidiaphragm is clearly seen consistent with sparing of the basal segments of the lower lobes. The patient was a 37-year-old man with right middle lobe pneumonia.



**Figure 3. Round pneumonia.** Posteroanterior chest radiograph shows round mass-like area of consolidation (arrow) in the right middle lobe. The patient was a 41-year-old man who presented with fever and cough. Incidental note is made of azygos fissure.



**Figure 2. Bulging fissure sign.** Anteroposterior chest radiograph shows dense right upper lobe consolidation with increase in volume of the right upper lobe and inferior bulging of the minor fissure (arrows). The patient was a 64-year-old man with *Streptococcus pneumoniae* pneumonia.



**Figure 4. Right upper lobe pulmonary edema due to acute mitral regurgitation.** Anteroposterior chest radiograph shows prominence and ill-definition of the pulmonary vascular markings and septal lines consistent with interstitial pulmonary edema. Also noted is extensive right upper lobe consolidation. Although the upper lobe consolidation is most suggestive of a pneumonia, it was proved to be due to airspace pulmonary edema secondary to acute mitral regurgitation after myocardial infarction. The patient was an 83-year-old woman.

- Segmental consolidation with or without volume loss typically results from endobronchial obstruction or pulmonary infarction.
- Segmental distribution seen after aspiration and with pneumonia caused by *Staphylococcus aureus*, *Streptococcus pyogenes*, or a variety of gram-negative bacteria.
- Round pneumonia occurs much more frequently in children than in adults.
- Although round pneumonia in adults may result from bacterial infection, most commonly no organism is identified.
- Focal right upper lobe pulmonary edema is seen most typically with myocardial infarction resulting in papillary muscle dysfunction or rupture and acute mitral regurgitation.

### Suggested Readings

- Gluecker T, Capasso P, Schnyder P, et al: Clinical and radiologic features of pulmonary edema. *RadioGraphics* 19:1507-1531, 1999.
- Grenon H, Bilodeau S: Pulmonary edema of the right upper lobe associated with acute mitral regurgitation. *Can Assoc Radiol J* 45:97-100, 1994.
- Wagner AL, Szabunio M, Hazlett KS, Wagner SG: Radiologic manifestations of round pneumonia in adults. *AJR Am J Roentgenol* 170:723-726, 1998.



# Focal Consolidation: Chronic Causes

**DEFINITION:** Focal consolidation is replacement of gas within airspaces by fluid, protein, cells, or other material at a single pulmonary focus.

## IMAGING

### Radiography

#### Findings

- Fairly homogeneous opacity associated with obscuration of the pulmonary vessels and adjacent soft tissue structures is known as a silhouette sign.
- Air-containing bronchi (air bronchograms) are frequently visible within areas of consolidation.
- Consolidation in pulmonary carcinoma and lymphoma may be round or have irregular margins.
- Chronic segmental or lobar consolidation with or without associated volume loss suggests bronchial obstruction by tumor or foreign body.
- Chronic focal nonsegmental consolidation often with irregular and poorly defined margins may be seen in lipoid pneumonia.

#### Utility

- Silhouette sign is most useful in differentiation of middle lobe and lingular disease from lower lobe disease and it may also provide precise anatomic information in other sites.
- Chest radiograph is useful in demonstrating the presence of focal consolidation and in monitoring changes over time.

### CT

#### Findings

- Consolidation is a homogeneous increase in pulmonary parenchymal attenuation that obscures the margins of vessels and airway walls.
- Ground-glass opacity is a homogeneous increase in attenuation that does not obscure underlying vessels.
- A small, round, focal ground-glass opacity is a common manifestation of bronchioloalveolar cell carcinoma.
- The presence of a solid component in association with the focal ground-glass opacity is suggestive of adenocarcinoma.
- Chronic focal area of consolidation with air bronchograms may represent a carcinoma or primary pulmonary lymphoma (maltoma).
- Focal consolidation with localized areas of fat density ( $-30$  to  $-120$  Hounsfield units) is virtually diagnostic of extrinsic lipoid pneumonia.

## DIAGNOSTIC PEARLS

- Focal consolidation progressing slowly over several months is suggestive of bronchioloalveolar carcinoma or lymphoma.
- Pulmonary lymphoma may result in single or multiple mass-like areas of consolidation.
- Presence of fat attenuation in focal consolidation is characteristic of lipoid pneumonia.

#### Utility

- Superior to radiography in the differential diagnosis.
- Superior to radiography in demonstrating presence of bronchial obstruction.
- Frequently allows diagnosis of lipoid pneumonia by demonstrating areas of fat density.

## CLINICAL PRESENTATION

- Focal ground-glass opacity or consolidation is frequently an incidental finding in asymptomatic patients.
- Symptoms when present are nonspecific, usually consisting mainly of cough and, occasionally, shortness of breath and hemoptysis.

## DIFFERENTIAL DIAGNOSIS

- Organizing pneumonia
- Lipoid pneumonia
- Pulmonary Hodgkin lymphoma
- Pulmonary non-Hodgkin lymphoma
- Bronchioloalveolar cell carcinoma
- Adenocarcinoma

## PATHOLOGY

- Replacement of gas within the airspaces by fluid, protein, cells, or other material
- Bronchial obstruction with distal obstructive pneumonitis and atelectasis in endobronchial lesions

## WHAT THE REFERRING PHYSICIAN NEEDS TO KNOW

- Pulmonary carcinoma should be suspected in patients with ground-glass opacities or consolidation that is progressive over several months.
- Chronic segmental consolidation with or without atelectasis should suggest the presence of an endobronchial lesion with distal obstruction.
- CT commonly allows the diagnosis of lipoid pneumonia by demonstrating the presence of fat within the consolidation.