



# Pneumonia

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# Clinical Manifestations

- CAP can vary from indolent to fulminant in presentation
- from mild to fatal in severity
- Manifestations of progression and severity include both constitutional findings and those limited to the lung and associated structures

- patient is frequently febrile with tachycardia
- or may have a history of chills and/or sweats
- Cough

(nonproductive or productive of mucoid, purulent, or blood-tinged sputum)

\*Gross hemoptysis is suggestive of CA-MRSA pneumonia\*

- Depending on severity, the patient may be able to speak in full sentences or may be very **short of breath**
- If the pleura is involved → **pleuritic chest pain**
- Up to 20% of patients may have **gastrointestinal symptoms** such as:
  - ✓ nausea
  - ✓ vomiting
  - ✓ and/or diarrhea
- Other symptoms may include **fatigue, headache, myalgias, and arthralgias**

- Findings on physical examination vary with the degree of pulmonary consolidation and the presence or absence of a significant pleural effusion
- An increased respiratory rate and use of accessory muscles of respiration are common
- Palpation may reveal increased or decreased tactile fremitus, and the percussion note can vary from dull to flat, reflecting underlying consolidated lung and pleural fluid, respectively

- Crackles, bronchial breath sounds, and possibly a pleural friction rub may be heard on auscultation
- The clinical presentation may not be so obvious in the elderly, who may initially display new-onset or worsening confusion and few other manifestations
- Severely ill patients may have septic shock and evidence of organ failure

- The risk of cardiac complications secondary to enhanced inflammation and procoagulant activity is increased

□ These complications include:

- ✓ myocardial infarction
- ✓ congestive heart failure
- ✓ arrhythmias, particularly in the elderly

- In pneumococcal CAP, the increased risk of acute coronary events may be partially driven by pneumolysis, which increases platelet activation
- Up to 90% of acute coronary syndromes occur in the first week after onset of CAP
- the risk of new-onset congestive heart failure in elderly hospitalized CAP patients can extend up to 1 year

# Diagnosis

- When confronted with possible CAP, the physician must ask two questions:
  - ✓ Is this pneumonia
    - typically answered by clinical and radiographic methods
  - ✓ if so, what is the likely etiology?
    - requires the aid of laboratory techniques

# Clinical Diagnosis

- The differential diagnosis includes both infectious and noninfectious entities:
  - ✓ acute bronchitis
  - ✓ acute exacerbations of chronic bronchitis
  - ✓ heart failure
  - ✓ pulmonary embolism
  - ✓ hypersensitivity pneumonitis
  - ✓ radiation pneumonitis

- ❑ The importance of a careful history cannot be overemphasized
  - ✓ known cardiac disease may suggest worsening pulmonary edema
  - ✓ underlying carcinoma may suggest lung injury secondary to irradiation
  - Unfortunately, the sensitivity and specificity of the findings on physical examination are less than ideal, averaging 58% and 67%, respectively
  - The elderly may initially present with confusion alone
- Therefore, chest radiography is often necessary to differentiate CAP from other conditions

- Radiographic findings may include risk factors for increased severity (e.g., cavitation or multi lobar involvement)
- Occasionally, radiographic results suggest an etiologic diagnosis
  - pneumatoceles suggest infection with *S. aureus*
  - an upper-lobe cavitating lesion suggests tuberculosis
- CT may be of value in a patient with suspected post-obstructive pneumonia caused by a tumor or foreign body or suspected cavitary disease

- For outpatients, the clinical and radiologic assessments are usually all that is done before treatment for CAP is started since most laboratory results are not available soon enough to influence initial management significantly
- In certain cases, the availability of rapid point-of-care outpatient diagnostic tests can be very important
- ✓ rapid diagnosis of influenza virus infection can prompt specific anti influenza drug treatment and secondary prevention

# Etiologic Diagnosis

- The etiology of pneumonia usually cannot be determined solely on the basis of clinical presentation
- Except for CAP patients admitted to the ICU, no data exist to show that treatment directed at a specific pathogen is statistically superior to empirical therapy
- The benefit of establishing a microbial etiology can therefore be questioned, particularly in light of the cost of diagnostic testing

□ Identification of an unexpected pathogen allows:

- ✓ narrowing of the initial empirical regimen
- ✓ decreasing antibiotic selection pressure
- ✓ lessening the risk of resistance
- Pathogens with important public safety implications, such as *Mycobacterium tuberculosis* and influenza virus, may be found in some cases
- without culture and susceptibility data, trends in resistance cannot be followed accurately, and appropriate empirical therapeutic regimens are harder to devise

# GRAM'S STAIN AND CULTURE OF SPUTUM

- The main purpose of the sputum Gram's stain is to ensure that a sample is suitable for culture
- Gram's staining may also identify certain pathogens (e.g., *S. pneumoniae*, *S. aureus*, and gram-negative bacteria) by their characteristic appearance

\*\* To be adequate for culture, a sputum sample must have:

>25 neutrophils and <10 squamous epithelial cells per low-power field

- The sensitivity and specificity of the sputum Gram's stain and culture are highly variable
- Even in cases of proven bacteremic pneumococcal pneumonia, the yield of positive cultures from sputum samples is  $\leq 50\%$
- Many patients, particularly elderly individuals, may not be able to produce an appropriate expectorated sputum sample
- Others may already have started a course of antibiotics that can interfere with culture results at the time a sample is obtained

- Inability to produce sputum can result from **dehydration**, and its correction may result in **increased sputum production** and a **more obvious infiltrate** on chest radiography
- For patients admitted to the ICU and intubated, a deep suction aspirate or broncho alveolar lavage sample (via bronchoscopy or non-bronchoscopically) has a high yield on culture when sent to the microbiology laboratory as soon as possible

- The greatest benefit of staining and culturing respiratory secretions is to alert the physician of unsuspected and/or resistant pathogens and to permit appropriate modification of therapy
- Other stains and cultures (e.g., specific stains for *M. tuberculosis* or fungi) may be useful as well

# BLOOD CULTURES

- The yield from blood cultures, even when samples are collected before antibiotic therapy, is disappointingly low
- Only 5–14% of cultures of blood from patients hospitalized with CAP are positive
- The most frequently isolated pathogen is *S. pneumoniae*
- Since recommended empirical regimens all provide pneumococcal coverage, a blood culture positive for this pathogen has little, if any, effect on clinical outcome

- Susceptibility data may allow narrowing of antibiotic therapy in appropriate cases
- Because of the low yield and the lack of significant impact on outcome, blood cultures are no longer considered de rigueur for all hospitalized CAP patients

❑ Certain high risk patients should have blood cultured:

- ✓ neutropenia secondary to pneumonia
- ✓ asplenia
- ✓ complement deficiencies
- ✓ chronic liver disease
- ✓ severe CAP

## URINARY ANTIGEN TESTS

- Two commercially available tests detect **pneumococcal** and **Legionella** antigen in urine
- ✓ The test for *Legionella pneumophila* detects only serogroup 1
- ✓ This serogroup accounts for most community-acquired cases of Legionnaires' disease in the United States
- ✓ The **sensitivity** and **specificity** of the Legionella urine antigen test are as high as **70%** and **99%**, respectively

- The pneumococcal urine antigen test is also quite **sensitive** and **specific** (**70%** and **>90%**, respectively)
- Although false-positive results can be obtained with samples from pneumococcus-colonized children, the test is generally reliable
- \* Both tests can detect antigen even after the initiation of appropriate antibiotic therapy

# POLYMERASE CHAIN REACTION

- PCR tests, which amplify a microorganism's DNA or RNA, are available for a number of pathogens
- PCR of nasopharyngeal swabs, for example, has become the standard for diagnosis of **respiratory viral infection**
- PCR can detect the nucleic acid of **Legionella** species, *M. pneumoniae*, *C. pneumoniae*, and **mycobacteria**

- The cost-effectiveness of PCR testing has not been definitively established
- In patients with pneumococcal pneumonia, an increased bacterial load documented in whole blood by PCR is associated with an increased risk of septic shock, the need for mechanical ventilation, and death
- Clinical availability of such a test could conceivably help identify patients suitable for ICU admission

## SEROLOGY

- A fourfold rise in specific IgM antibody titer between acute- and convalescent-phase serum samples is generally considered diagnostic of infection with the pathogen in question
- In the past, serologic tests were used to help identify atypical pathogens as well as selected unusual organisms such as *Coxiella burnetii*
- Recently they have fallen out of favor because of the time required to obtain a final result for the convalescent-phase sample and the difficulty of interpretation

# BIOMARKERS

- A number of substances can serve as markers of severe inflammation
- The two most commonly in use are **C-reactive protein (CRP)** and **procalcitonin (PCT)**
- Levels of these acute-phase reactants increase in the presence of an inflammatory response, particularly to bacterial pathogens

- CRP may be of use in the identification of worsening disease or treatment failure
- PCT may play a role in distinguishing bacterial from viral infection, determining the need for antibacterial therapy, or deciding when to discontinue treatment
- PCT testing can result in less antibiotic use in CAP with no concomitant increase in treatment failure or mortality risk
- These tests should not be used on their own, but, when interpreted in conjunction with other findings from the history, physical examination, radiology, and laboratory tests, may help with antibiotic stewardship and appropriate management of seriously ill patients with CAP

# Community-Acquired Pneumonia

- SITE OF CARE

- ✓ the decision to hospitalize a patient with CAP has considerable implications
- ✓ late admission to the ICU is associated with increased mortality risk
- ✓ Certain patients can be managed at home
- ✓ others clearly require treatment in the hospital

\* but the choice is sometimes difficult\*

- Tools that objectively assess the risk of adverse outcomes, including severe illness and death, can minimize unnecessary hospital admissions

□ The two most frequently used are:

➤ **Pneumonia Severity Index (PSI)**

a prognostic model used to identify patients at low risk of dying

➤ **CURB-65 criteria**

a severity-of-illness score

❑ To determine the PSI, points are given for 20 variables including:

- ✓ age
- ✓ co - existing illness
- ✓ abnormal physical findings
- ✓ abnormal Laboratory findings

□ patients are assigned to one of five classes with the following mortality rates:

➤ class 1 → 0.1%

➤ class 2 → 0.6%

➤ class 3 → 2.8%

➤ class 4 → 8.2%

➤ class 5 → 29.2%

- Determination of the PSI is often impractical in a busy emergency-department setting because of the number of variables
- clinical trials demonstrate that routine use of the PSI results in lower admission rates for class 1 and class 2 patients
- Patients in class 3 could ideally be admitted to an observation unit until a further decision can be made

□ The CURB-65 criteria include five variables:

- confusion (C)
- urea  $>7$  mmol<sub>/L</sub> (U)
- respiratory rate  $\geq 30$ /<sub>min</sub> (R)
- blood pressure, systolic  $\leq 90$  mmHg or diastolic  $\leq 60$  mmHg (B)
- age  $\geq 65$  years

- Patients with a score of 0 → 30-day mortality rate is 1.5% → can be treated outside the hospital
- score of 1 or 2 → the patient should be hospitalized unless the score is entirely or in part attributable to an age of  $\geq 65$  years → In such cases, hospitalization may not be necessary
- scores of  $\geq 3$  → mortality rates are 22% overall → may require ICU admission

- It is not clear which assessment tool is superior
- Whichever system is used, these objective criteria must always be tempered by careful consideration of factors relevant to individual patients, including:
  - ✓ the ability to comply reliably with an oral antibiotic regimen
  - ✓ the resources available to the patient outside the hospital

- Neither PSI nor CURB-65 is accurate in determining the need for ICU admission
- Septic shock or respiratory failure in the emergency department is an obvious indication for ICU care
- mortality rates are higher among less ill patients who are admitted to the floor and then deteriorate than among equally ill patients monitored in the ICU
- A variety of scores have been proposed to identify patients most likely to have early deterioration

## ❑ Risk Factors for Early Deterioration in Community-Acquired Pneumonia

➤ Multi lobar infiltrates

➤ Severe hypoxemia (arterial saturation < 90%)

➤ Severe acidosis (pH < 7.30)

➤ Mental confusion

➤ Severe tachypnea (>30 breaths<sub>/min</sub>)

➤ Hypoalbuminemia

➤ Neutropenia

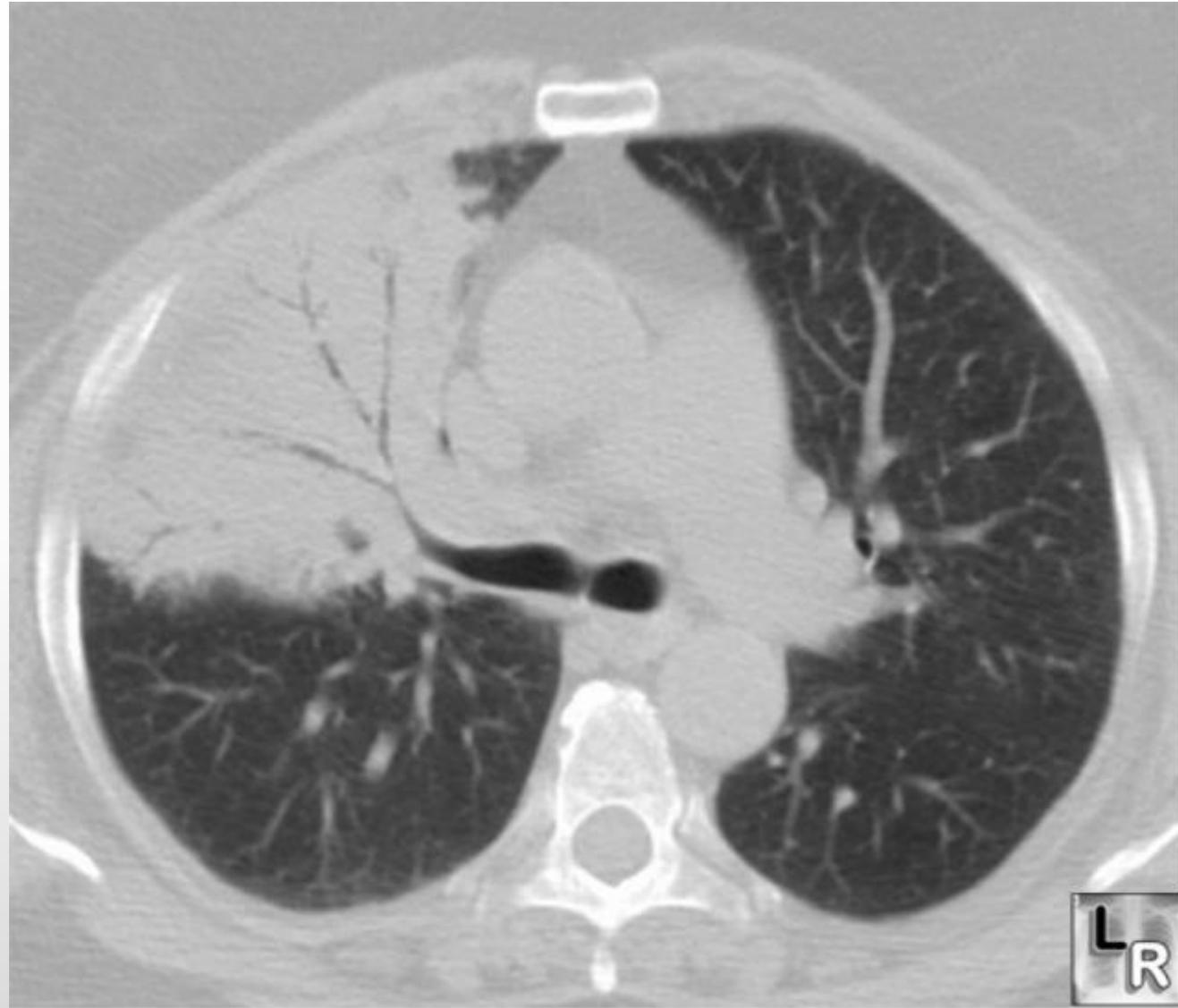
➤ Thrombocytopenia

➤ Hyponatremia

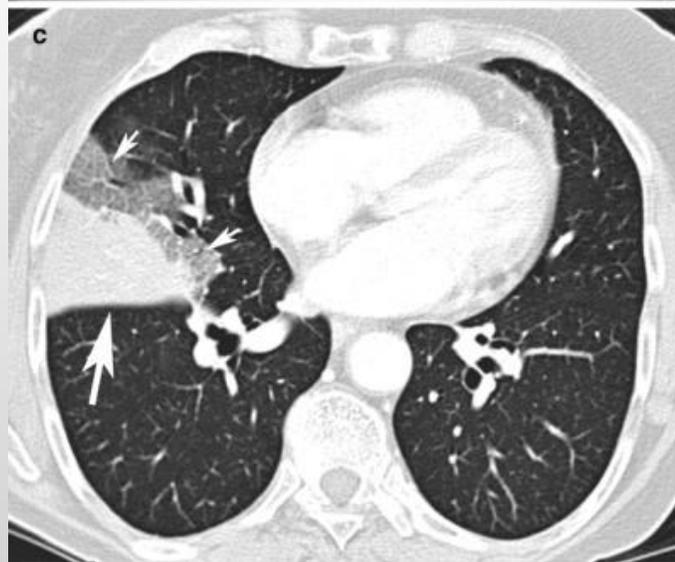
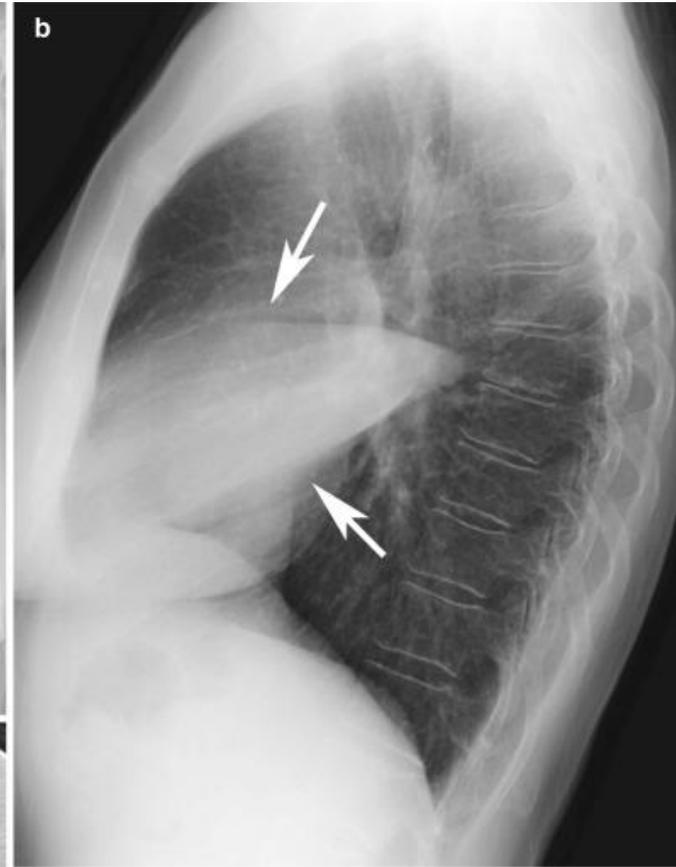
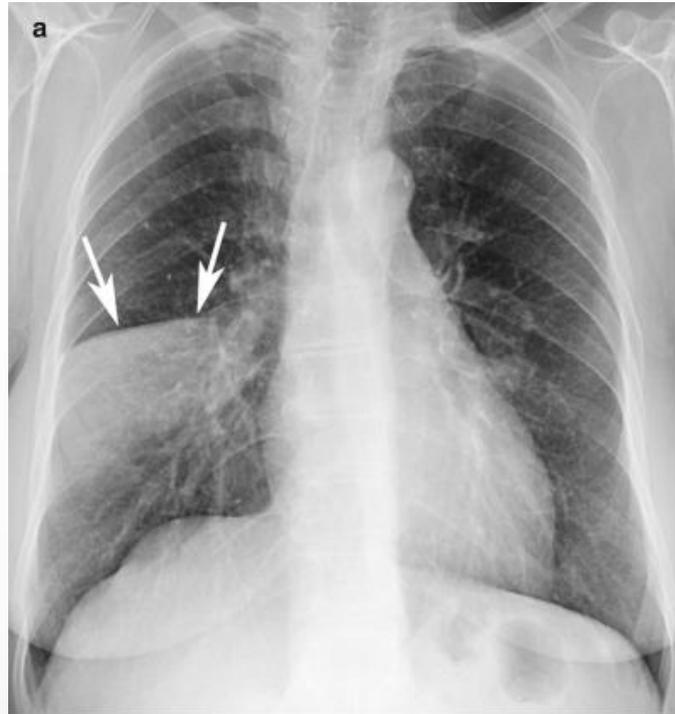
➤ Hypoglycemia

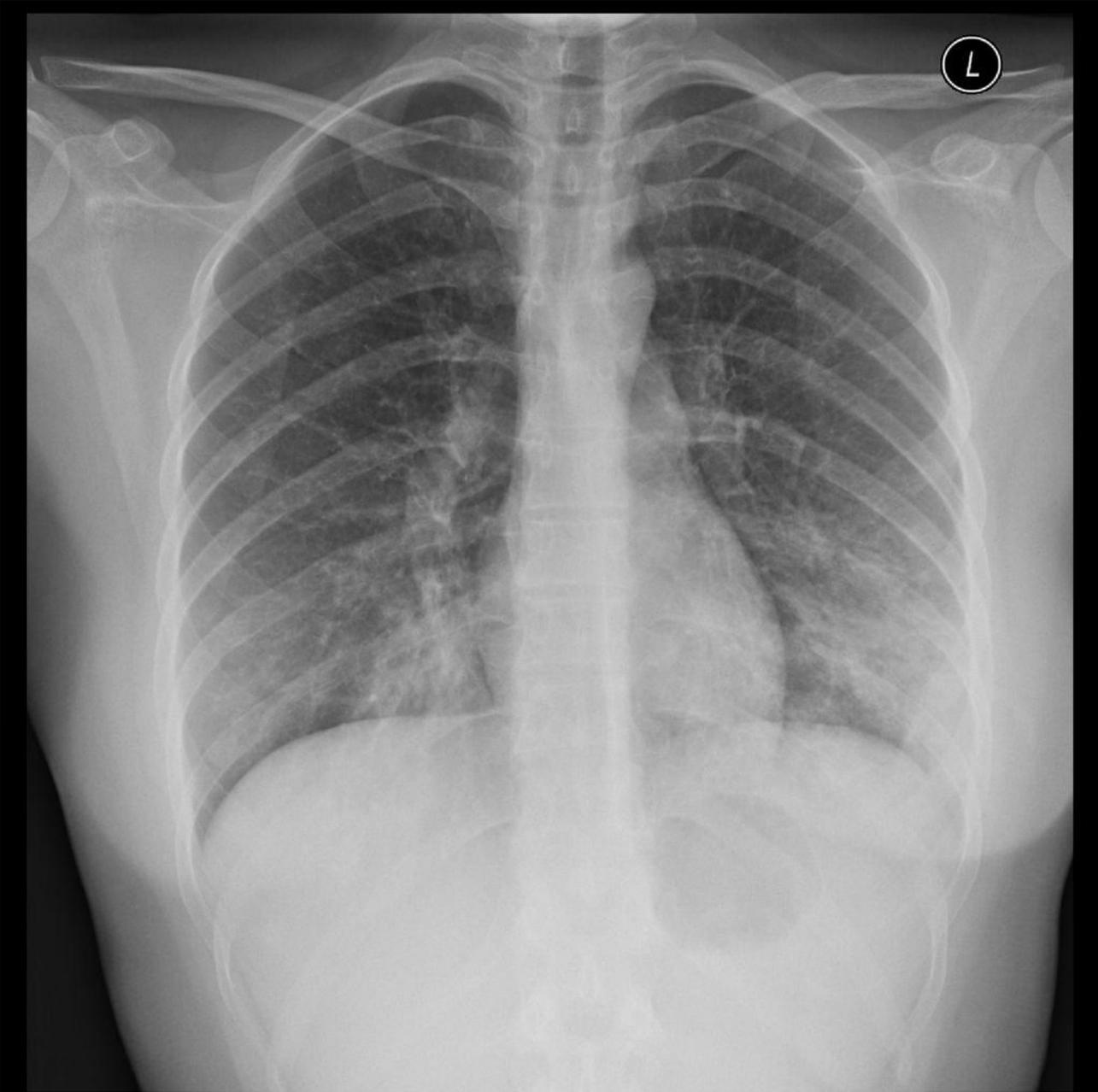
• Recent data suggest that thrombocytopenia, leukopenia, and hypothermia can be removed from the list of minor criteria



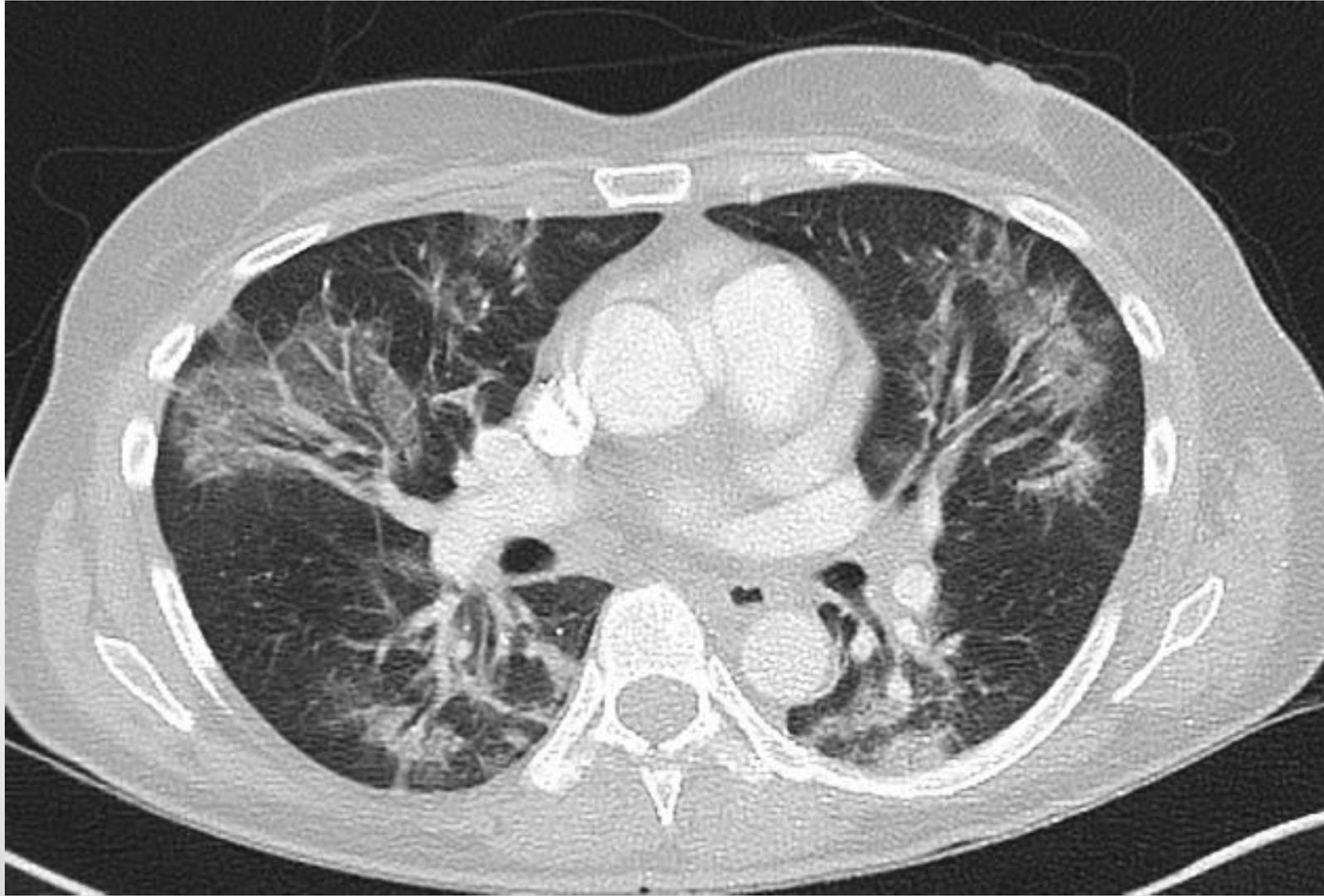


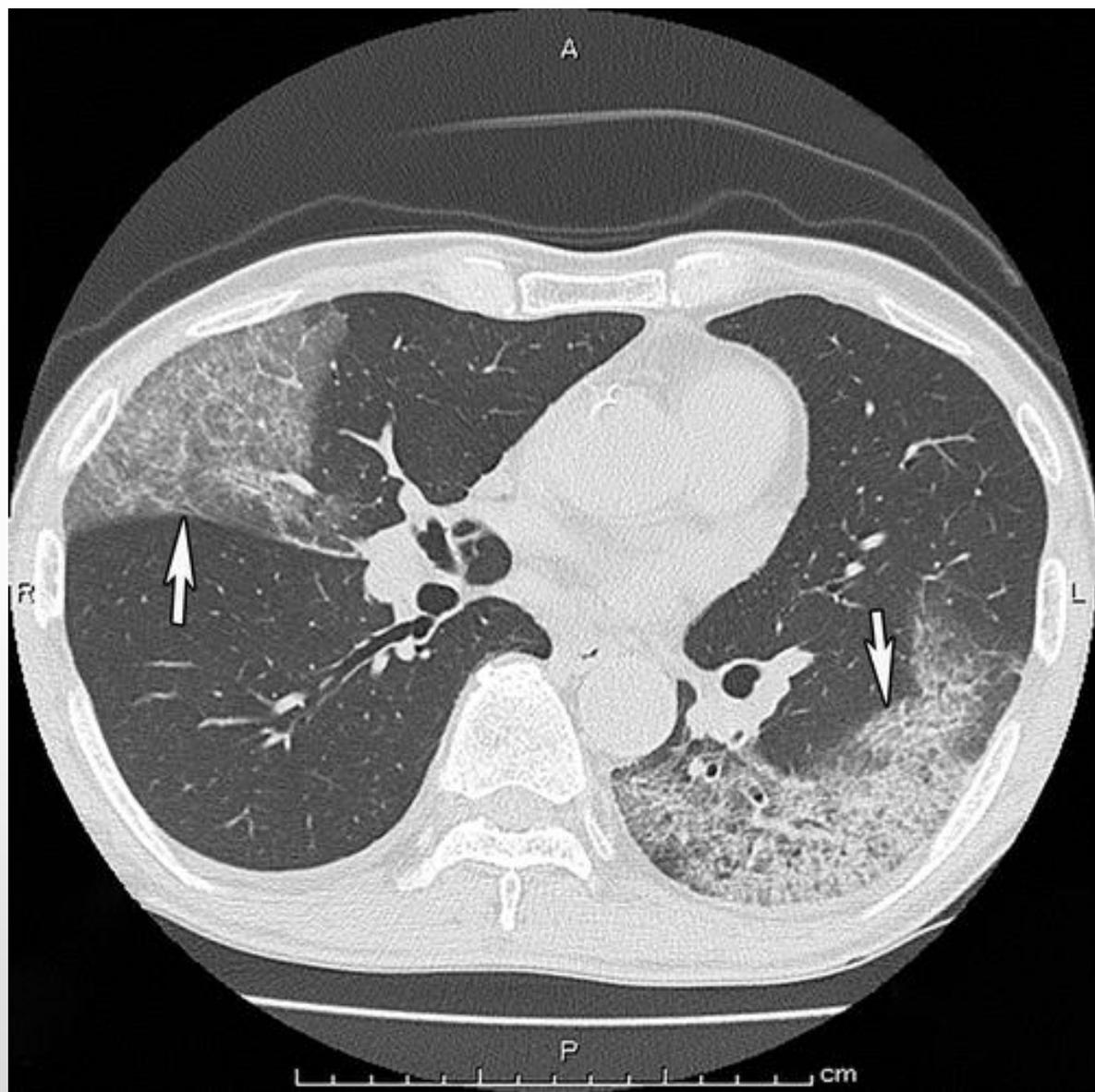


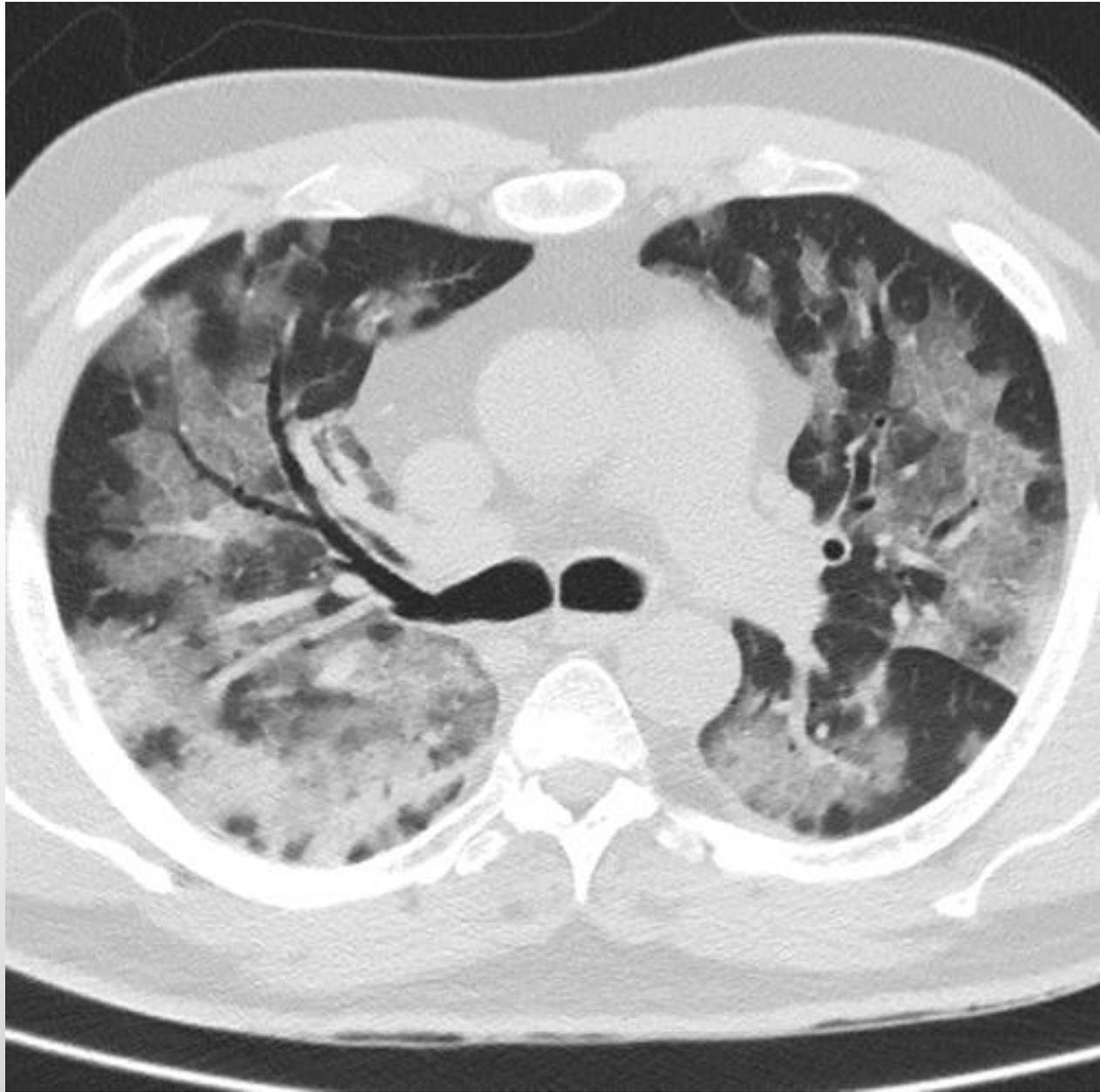














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