# Variations in pulmonary infections: A radiological interactive approach

Prof.Emmanuel Coche
Department of Medical Imaging
Cliniques Universitaires St-Luc
1200 Brussels-Belgium

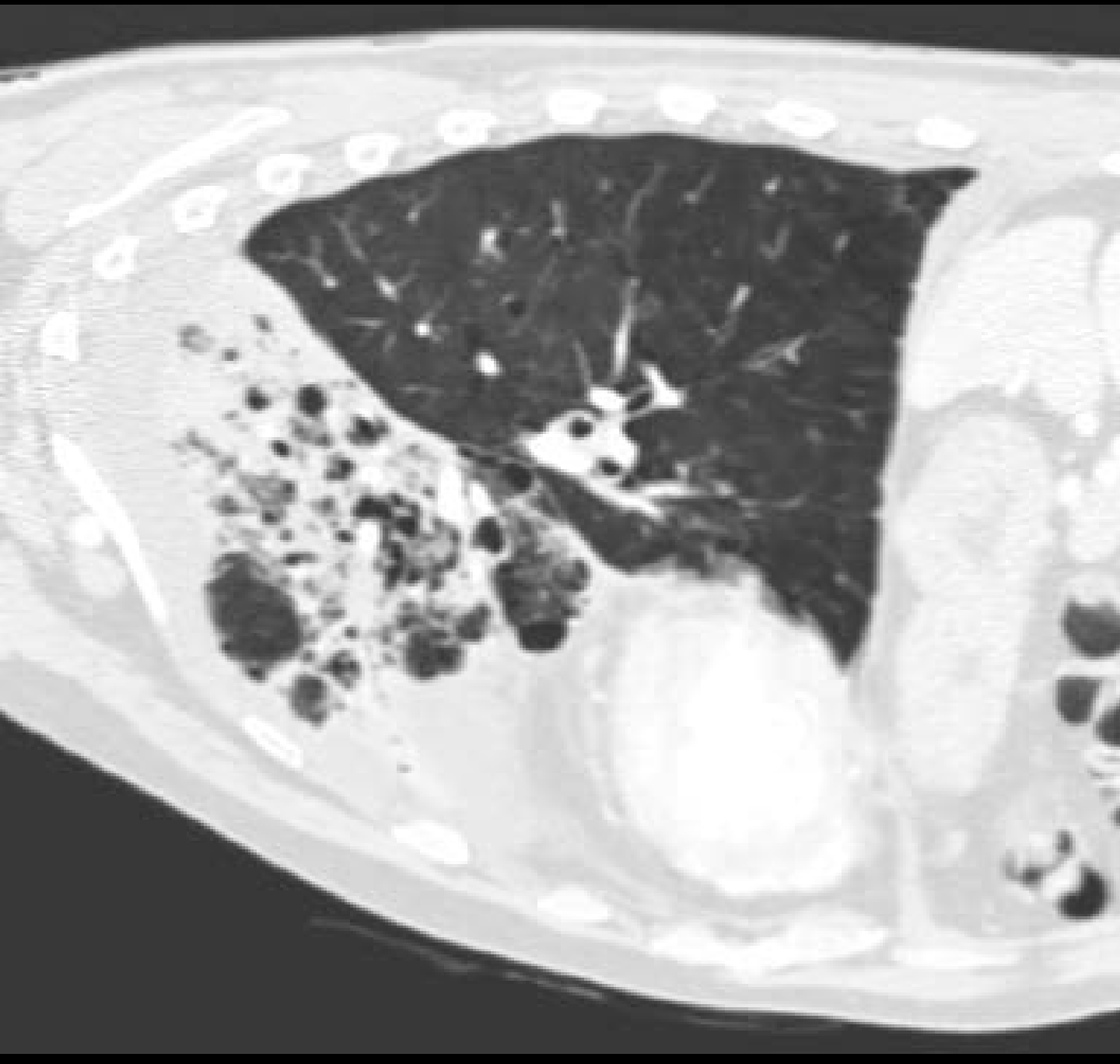
Cours RDGN
2130
Vendredi 11
octobre 2019

# Introduction

- Material:clinical cases retrieved from our daily routine in Cliniques Universitaires St-luc + additional cases from abroad
- Aim: To interactively discuss (Questions)
  - the variety of pulmonary infections on chest X-ray and CT
  - The added value of CT in various thoracic infectious conditions
  - the difficulty to provide a specific diagnosis in some cases

# Case 1: Clinical History

- 65-year old man
- Fever and dyspnea
- Chest X-ray
- Dyspnea

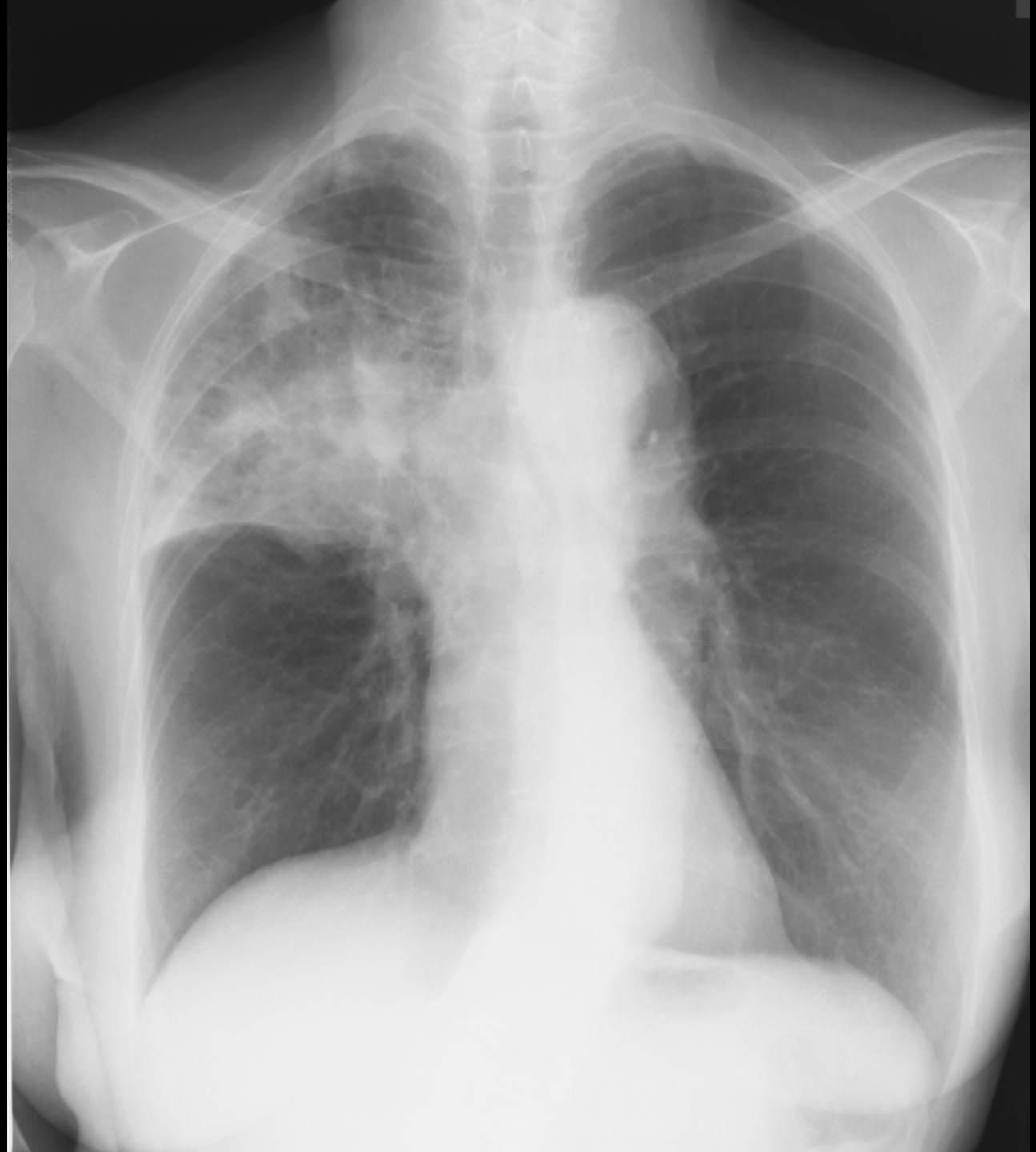


# What is the significance of the air lucencies seen in the lung consolidation?

- 1. Lung necrosis
- 2. Presence of cavitation and possible anaerobic surinfection
- 3. Surimposed lung emphysema
- 4. None of the above

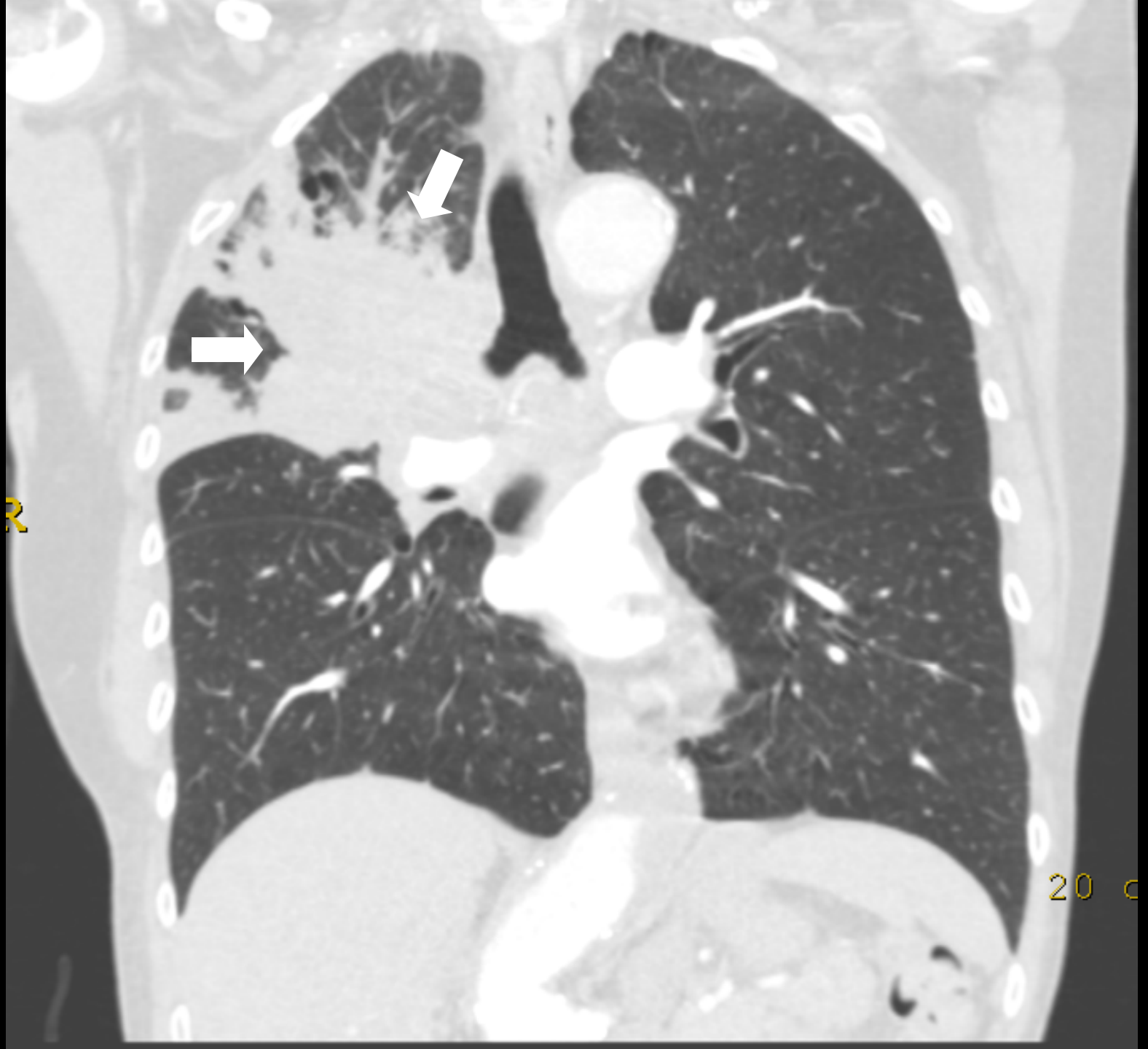
# Case 2: Clinical History

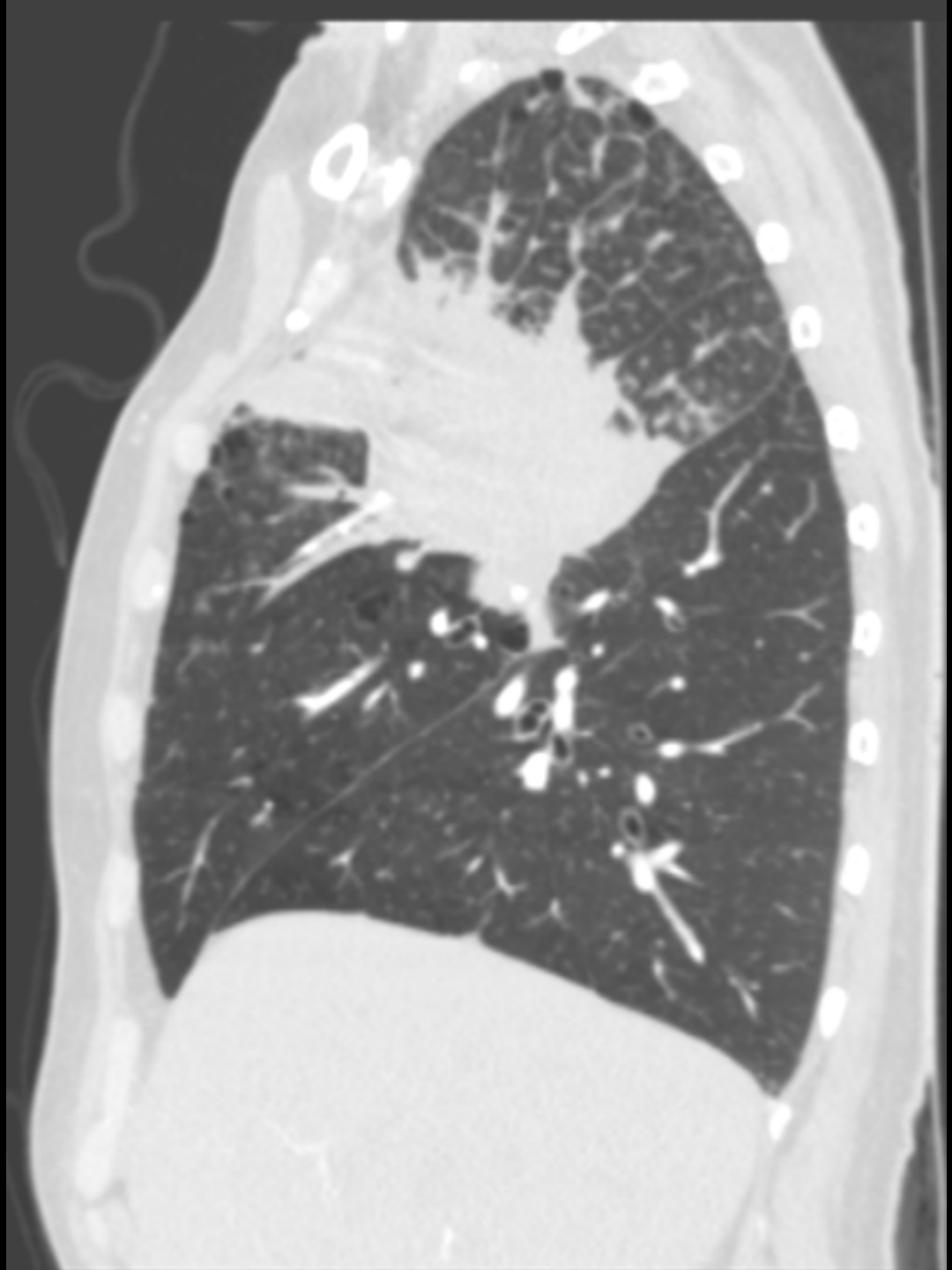
- 60-year old man
- Smoker
- Admitted to the emergency room
- Loss of consciousness
- Blood sample: White blood cell count: 18,8 $10^3$ /$mm^3$, CRP: 5,7 mg/dL

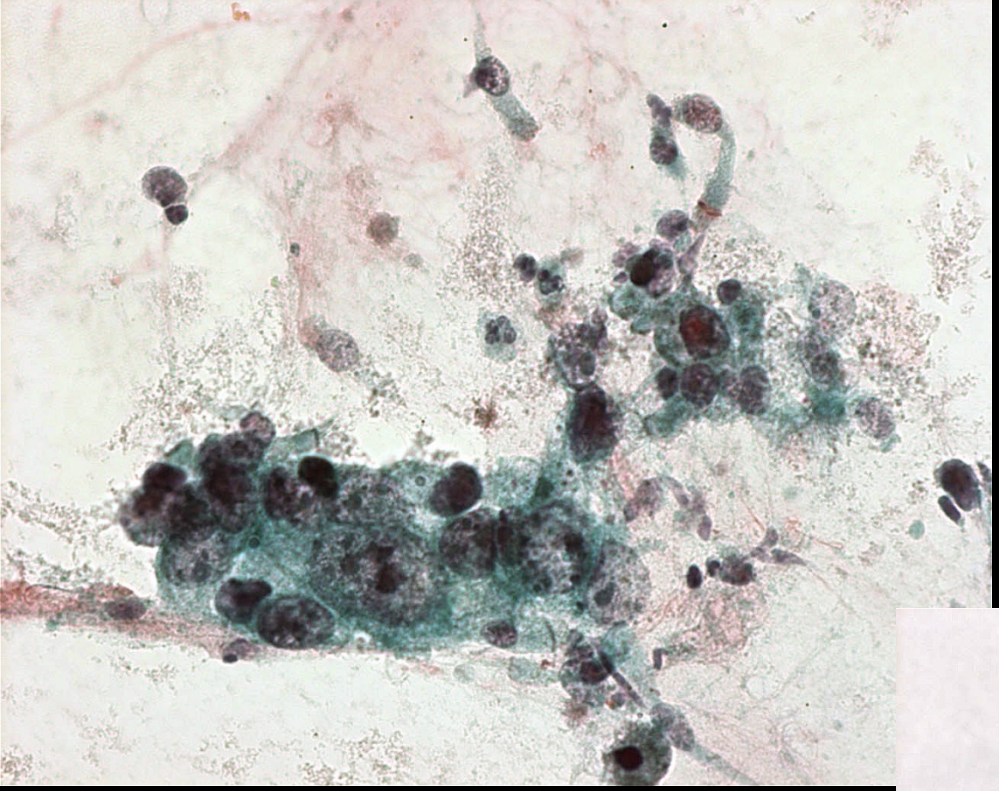


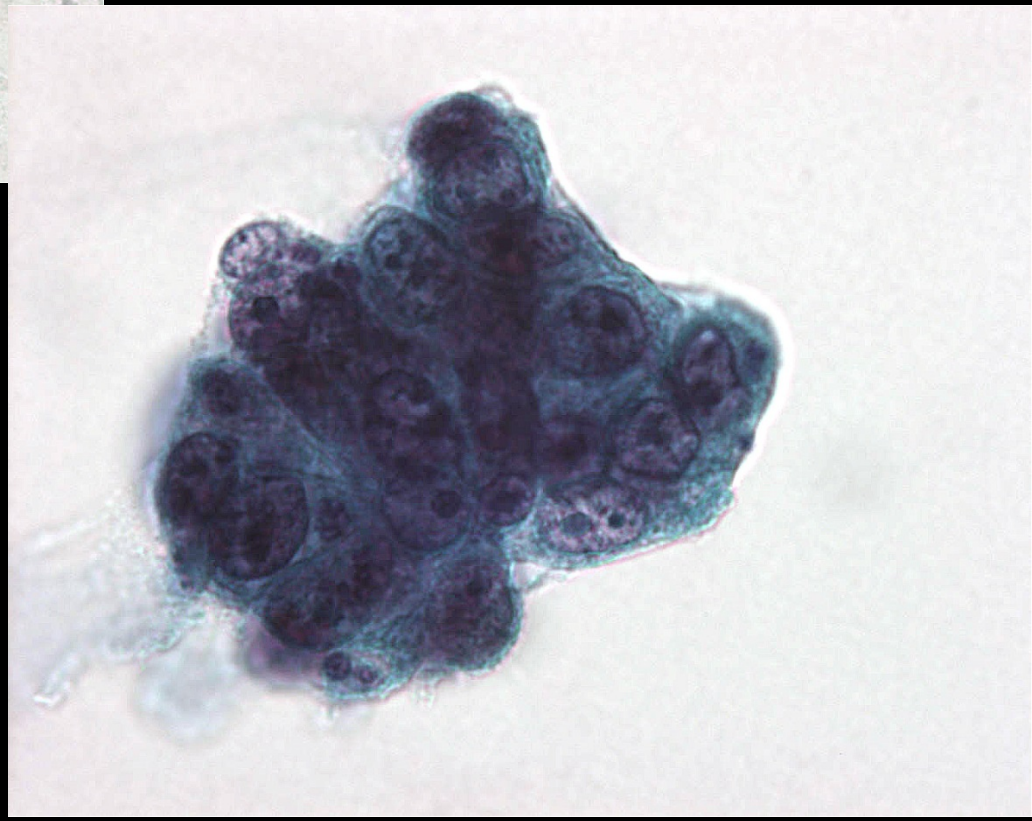
# What is your attitude?

- 1: Antibiotherapy after sputum culture
- 2. Perform a bronchoscopy
- 3. Perform a CT scanner with IV contrast
- 4. Do a PET-CT









# Case 3: Clinical History

- 35-year old woman
- Chronic cough and repeated lung infections
- Fever
- Chest X-ray


10 cm

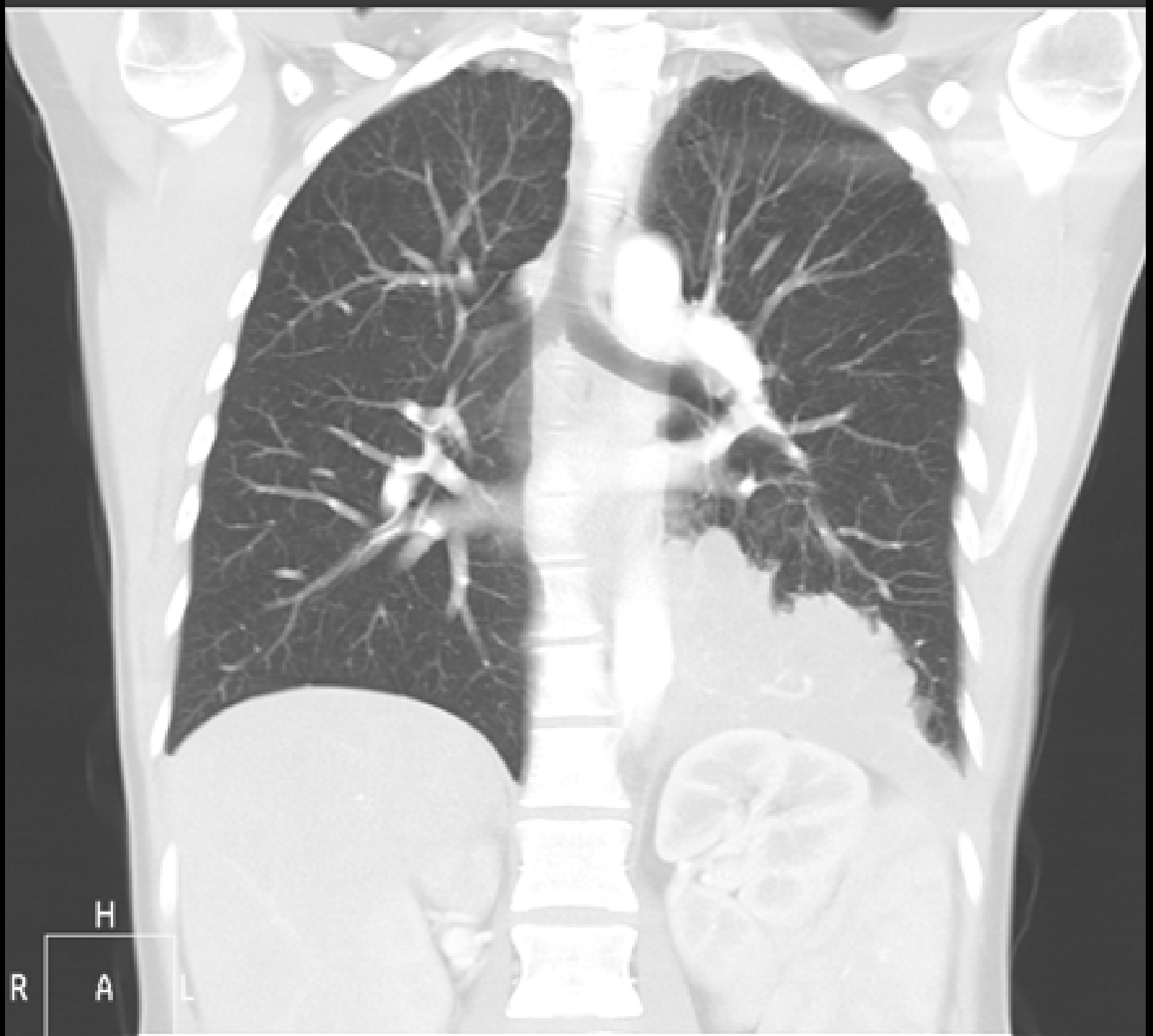
# What is your diagnosis?

- Make a proposal

# Follow-up

- No answer to large spectre antibiotherapy

- What is your next diagnostic test?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# What is your diagnosis?

- 1. Lung  abscess
- 2. Extra-pulmonary sequestration
- 3. Intra-pulmonary sequestration
- 4. Surinfected lung tumor

# Intra-pulmonary sequestration

## Intralobar sequestration [edit]

- The intralobar variety accounts for 75 percent of all sequestrations.
- Usually presents in adolescence or adulthood as recurrent pneumonias.
- The lung tissue lies within the same visceral pleura as the lobe in which it occurs.
- Males and females are equally affected with ILS.
- In ILS, the arterial supply usually is derived from the lower thoracic or upper abdominal aorta.
- Venous drainage is usually to the left atrium via pulmonary veins establishing a left to right shunt.
- Abnormal connections to the vena cava, azygous vein, or right atrium may occur.
- Two thirds of the time, the sequestration is located in the paravertebral gutter in the posterior segment of the left lower lobe.
- Unlike extralobar sequestration, it is rarely associated with other developmental abnormalities.
- Patients present with signs and symptoms of pulmonary infection of a lower lobe mass.
- It is believed that sequestrations become infected when bacteria migrate through the Pores of Kohn or if the sequestration is incomplete.

# Case 4: Clinical History

- Middle-age woman
- Long-standing cough
- Chest X-ray
- CT


Lardinois Nadine


10 Jan 2005 09:41:16.0
120kV, 230mAs
SC 321.0 mm
SW 5.50 mm
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120kV, 230mA
SC 321.0 m
SW 5.50 m
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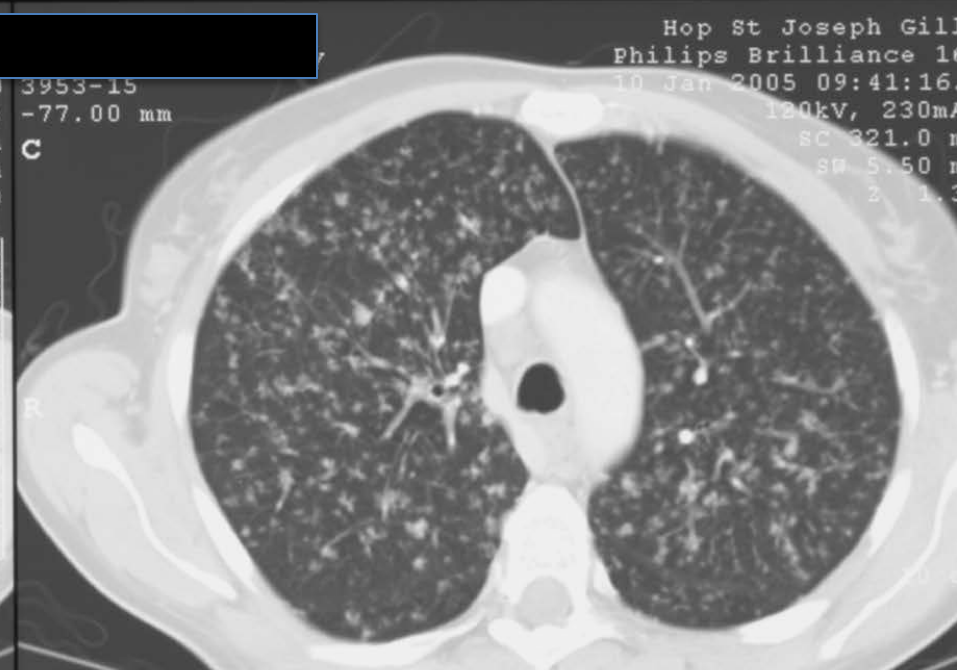
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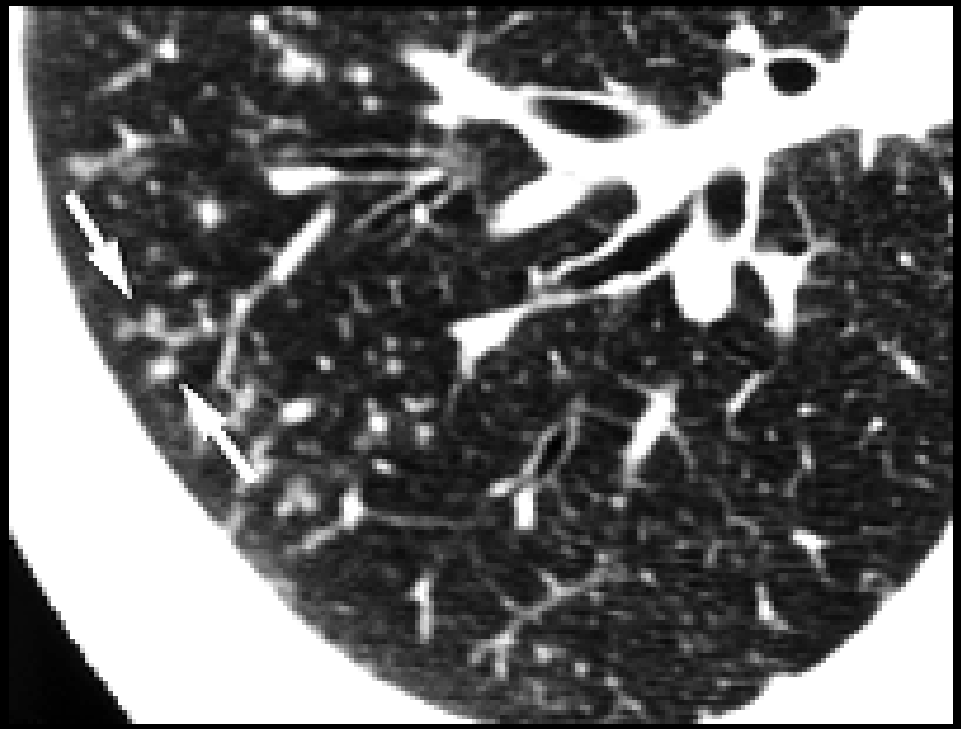

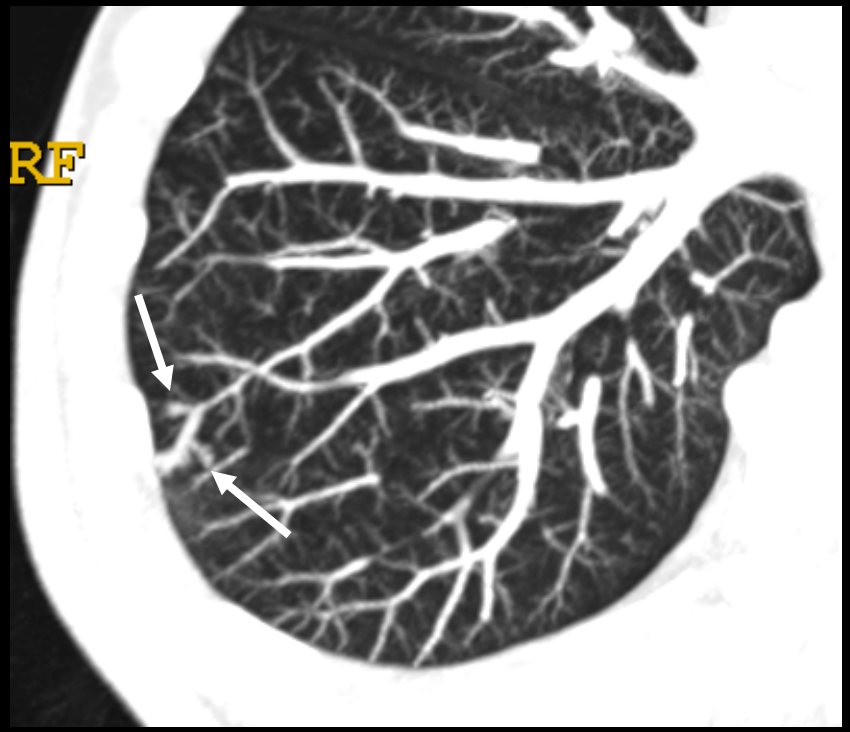
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# The following statement

- The tree-in bud sign is highly specific for mycobacterial infection

- 1. True

- 2. False

# Tree-in-bud pattern

- Peripheral airway disease
  - Infection
    - Bacterial
      - *Mycobacterium tuberculosis*
      - *M avium-intracellulare* complex
      - *Staphylococcus aureus*
      - *Haemophilus influenzae*
    - Fungal
      - *Aspergillus*
    - Viral
      - Cytomegalovirus
      - Respiratory syncytial virus
  - Congenital disorders
    - Cystic fibrosis
    - Kartagener syndrome
  - Idiopathic disorders
    - Obliterative bronchiolitis
    - Diffuse panbronchiolitis
  - Aspiration
  - Inhalation
    - Toxic fumes and gases
  - Immunologic disorders
    - Allergic bronchopulmonary aspergillosis
  - Connective tissue disorders
    - Rheumatoid arthritis
    - Sjögren syndrome
- Peripheral pulmonary vascular disease
  - Neoplasms
    - Gastric cancer
    - Breast cancer
    - Ewing sarcoma
    - Renal cancer

Previous Article

**May-June 2005**
Volume 25, Issue 3

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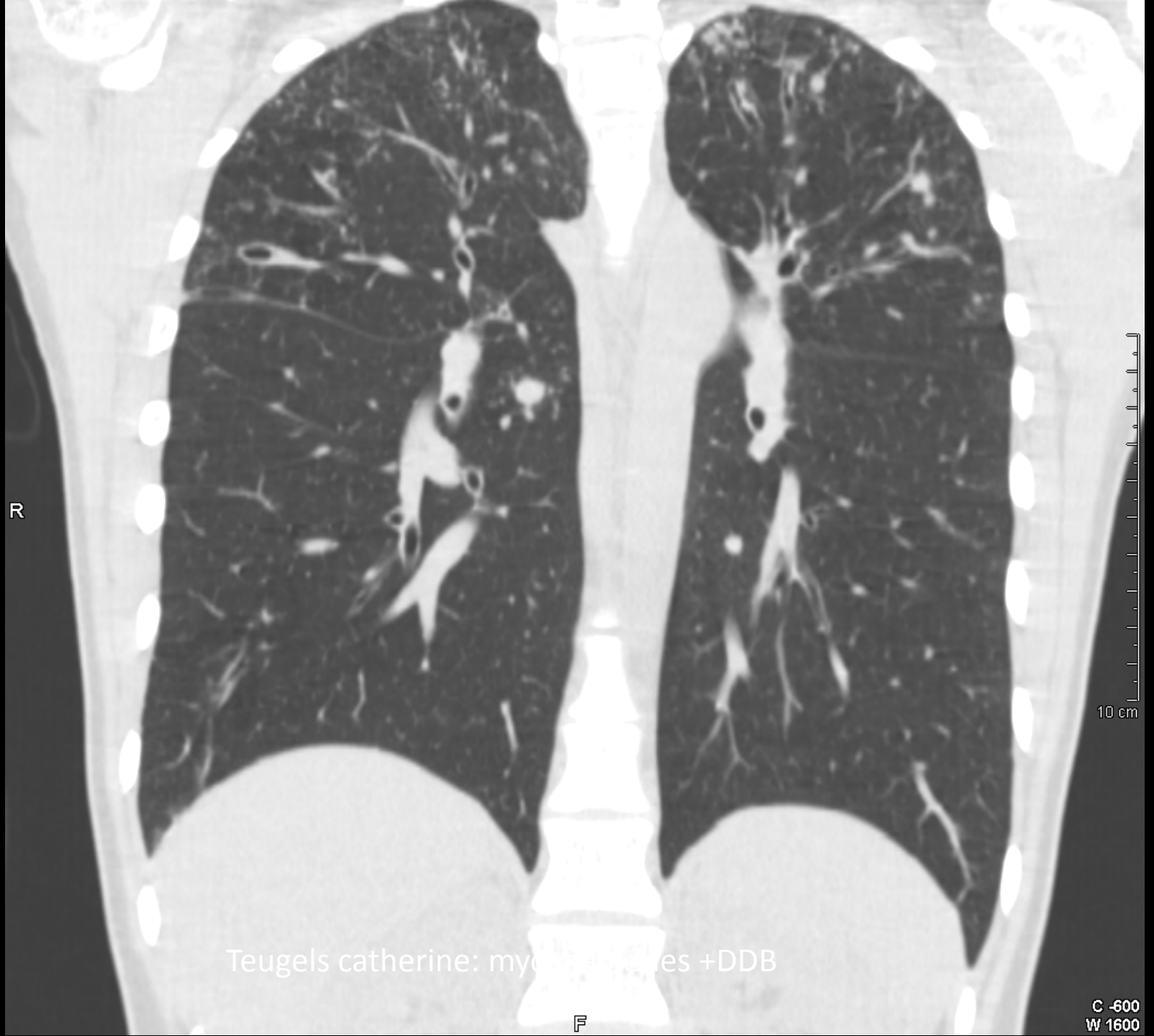
## Tree-in-Bud Pattern at Thin-Section CT of the Lungs: Radiologic-Pathologic Overview

**Santiago Enrique Rossi, MD, , Tomas Franquet, MD, , Mariano Volpacchio, MD, , Ana Giménez, MD, and , Gabriel Aguilar, MD**

[1]From the Department of Radiology, Centro de Diagnostico Dr Enrique Rossi, Arenales 2777, CP 1425, Buenos Aires, Argentina (S.E.R., M.V., G.A.); and the Department of Radiology, Hospital de Sant Pau, Universidad Autónoma de Barcelona, Barcelona, Spain (T.F., A.G.).
Recipient of a Certificate of Merit award for an education exhibit at the 2003 RSNA Scientific Assembly. Received May 26, 2004; revision requested August 26 and received November 29; accepted December 6. All authors have no financial relationships to disclose.

DOI: http://dx.doi.org/10.1148/rg.253045115

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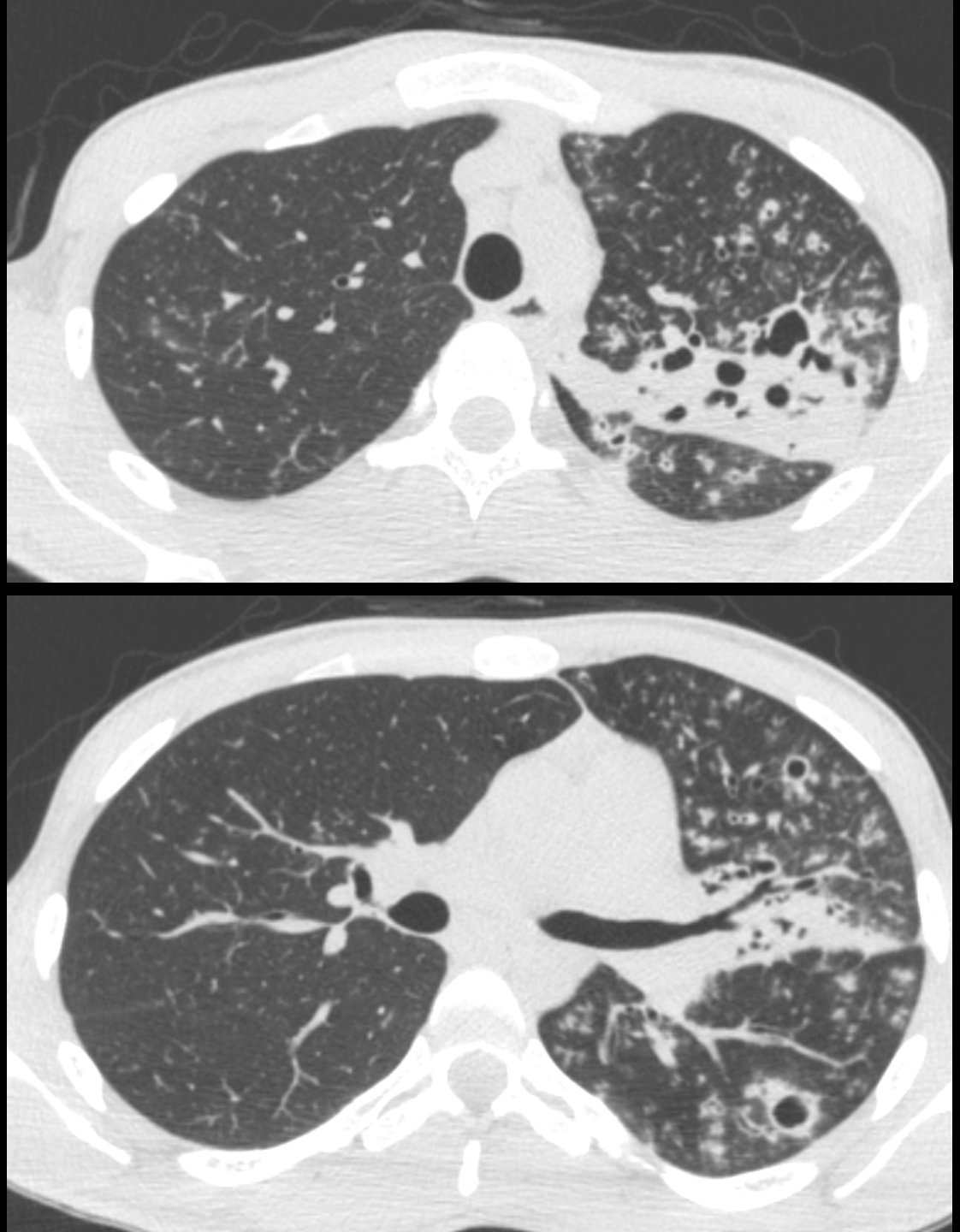
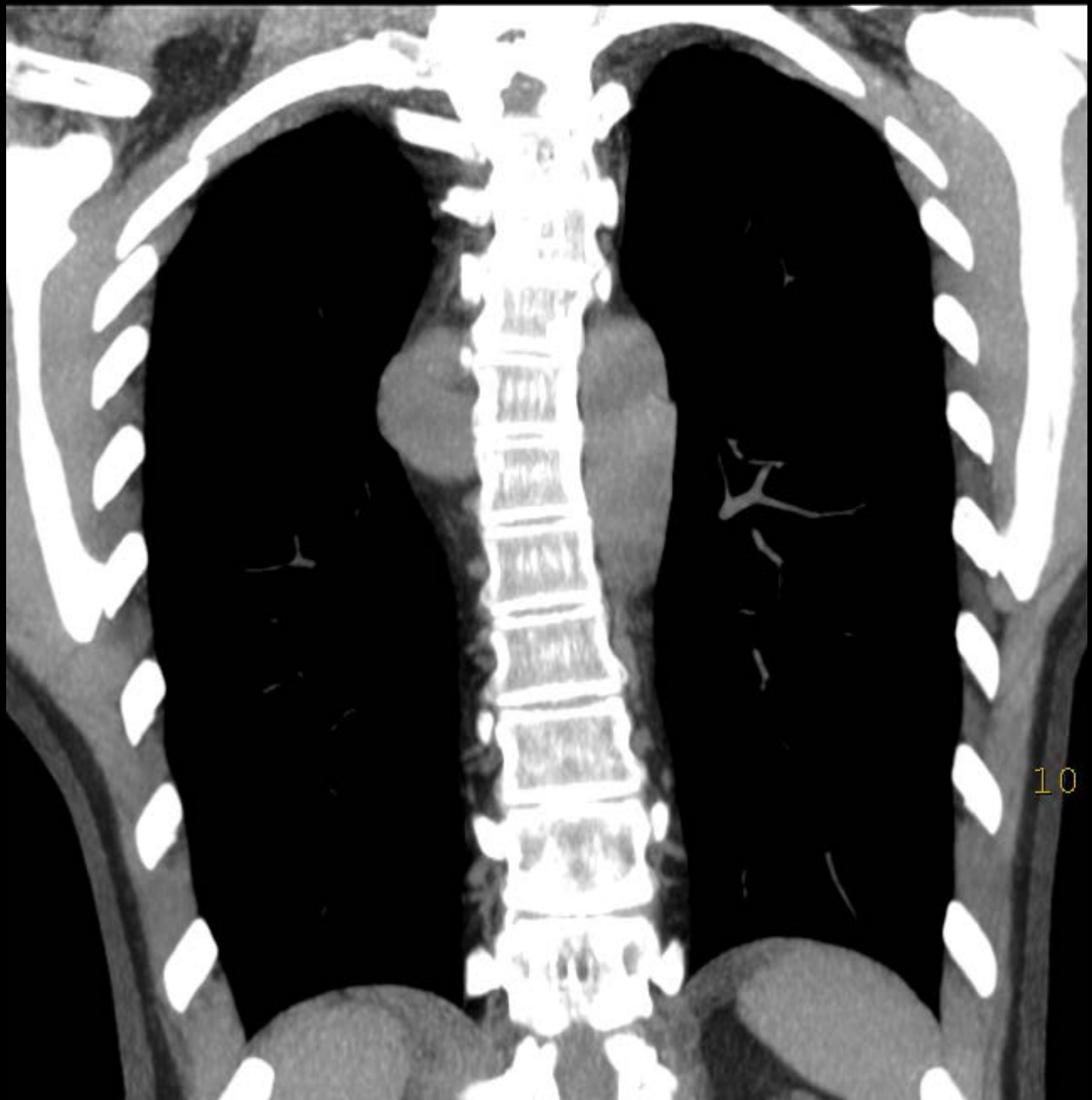
10 cm



# Case 5: Clinical history

- 45-year-old italian woman
- Chronic glomerular disease → renal graft in 1985
- In 1987: tubo-ovarian abcess
- March 2005: fall → chest X-ray
- Left rib fracture +…..
- Clinical examination:negative
- MDCT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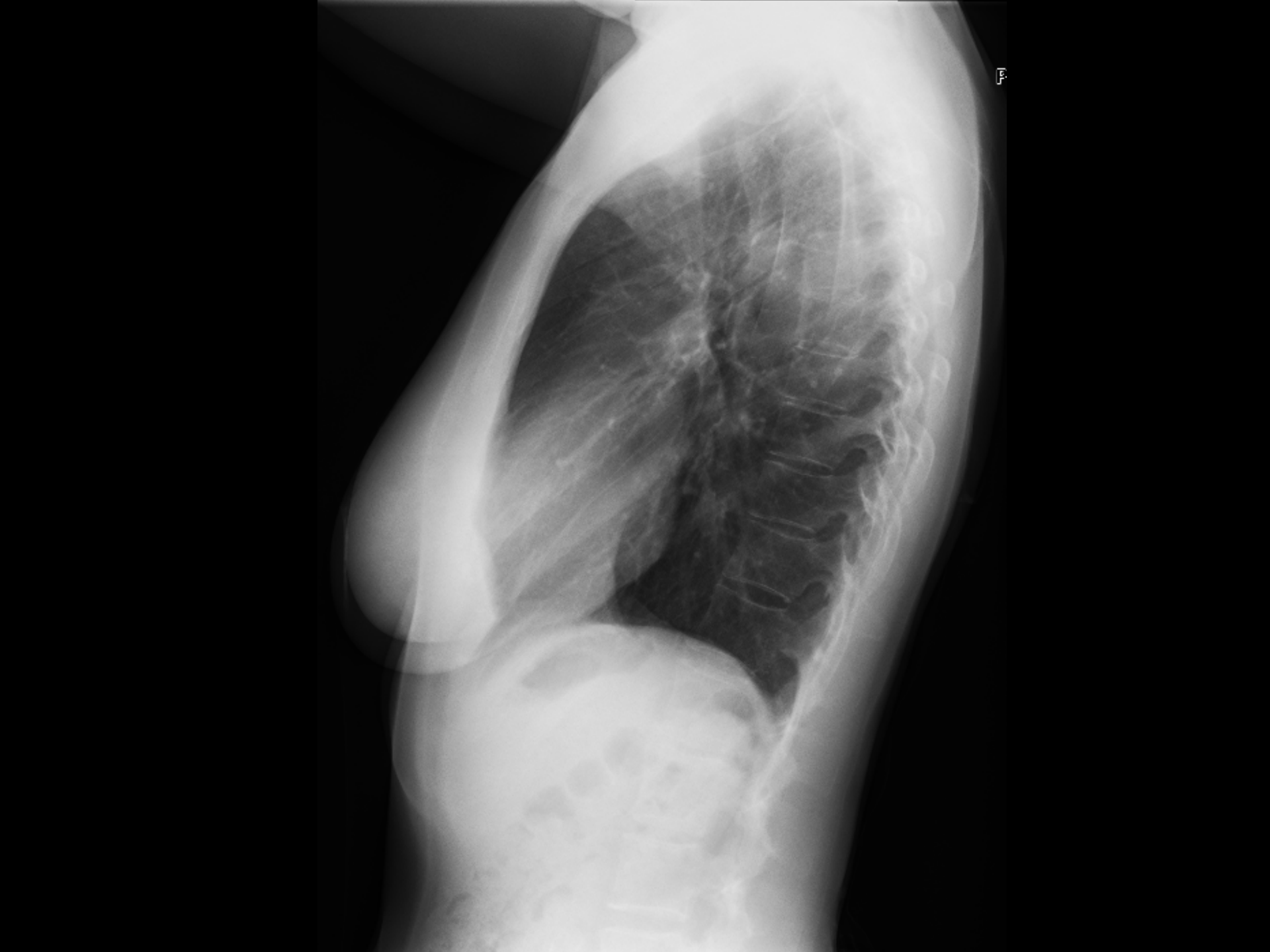


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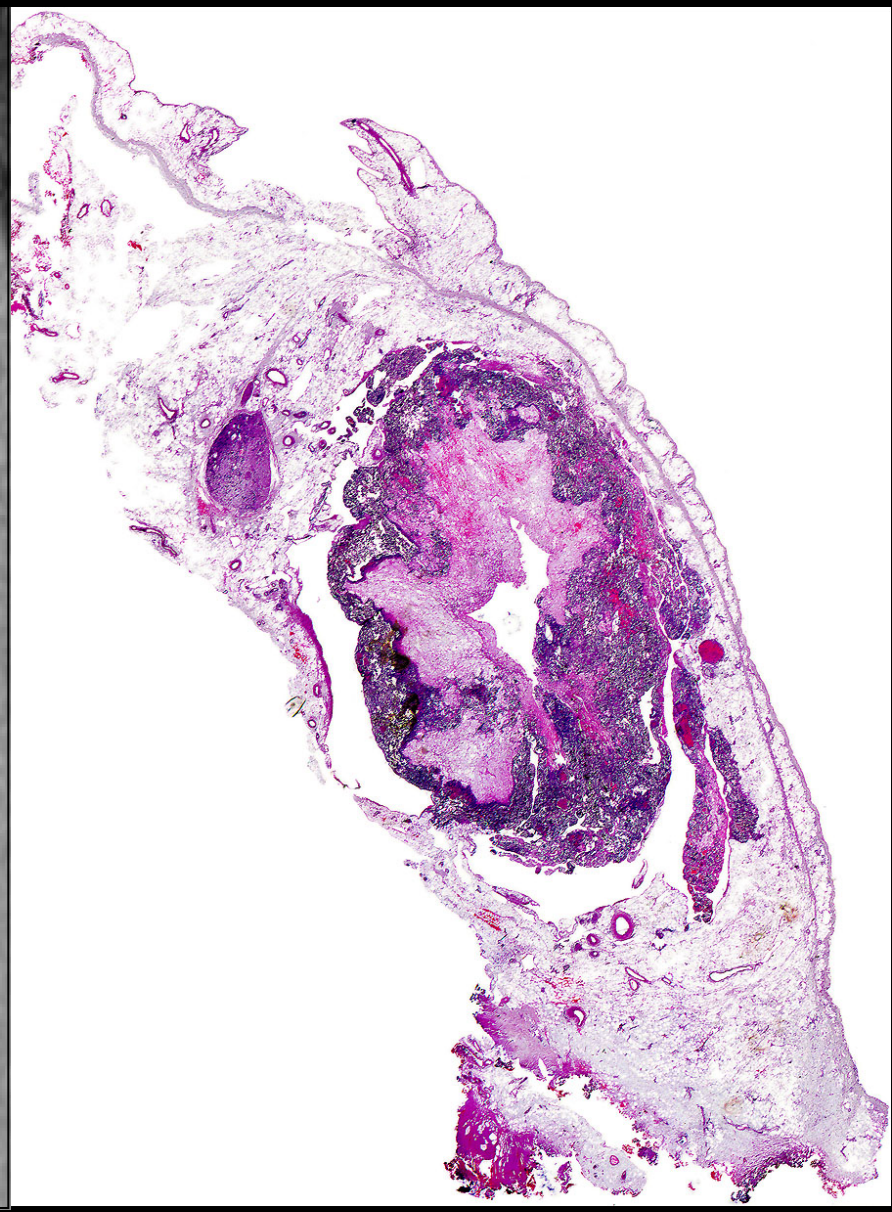
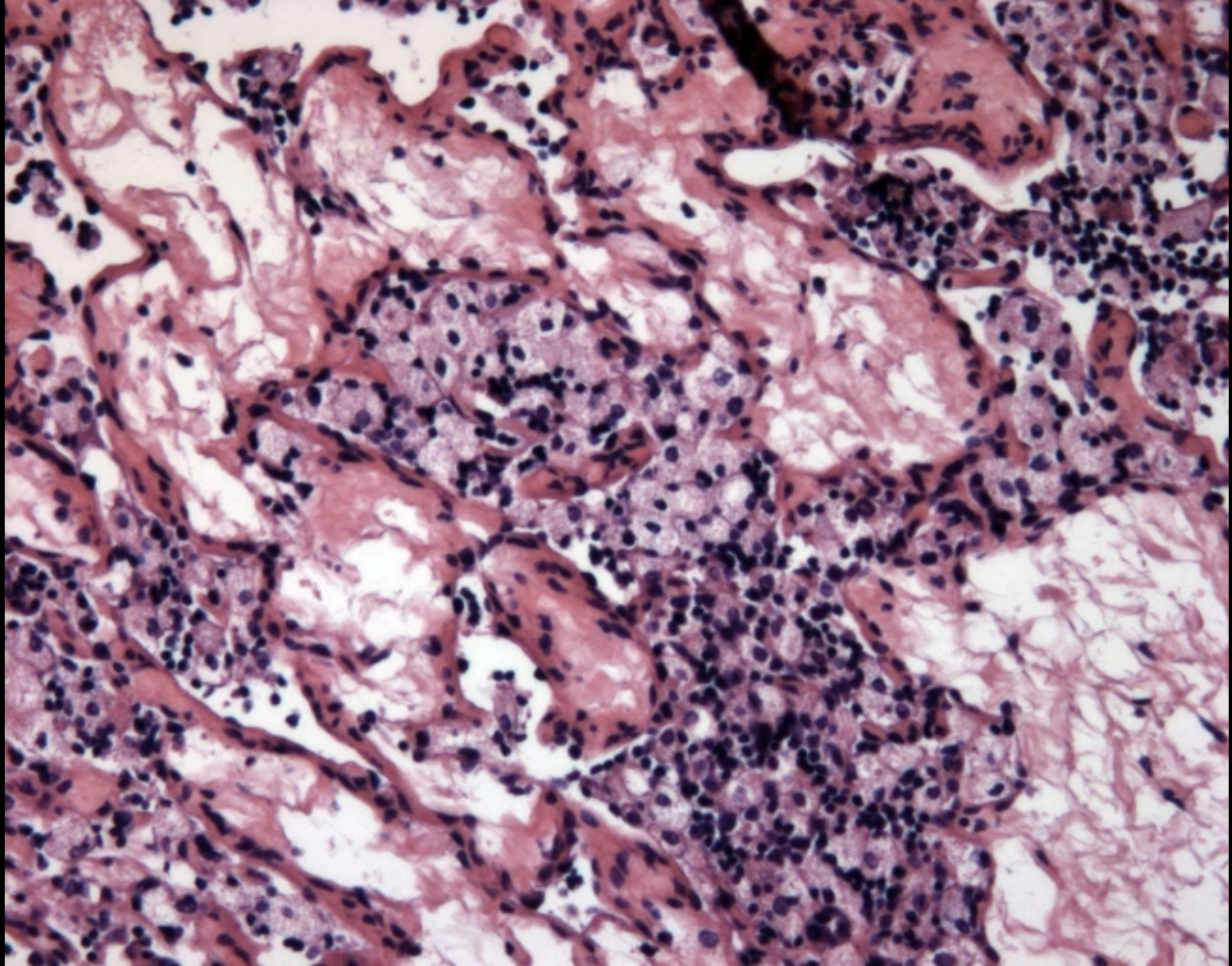
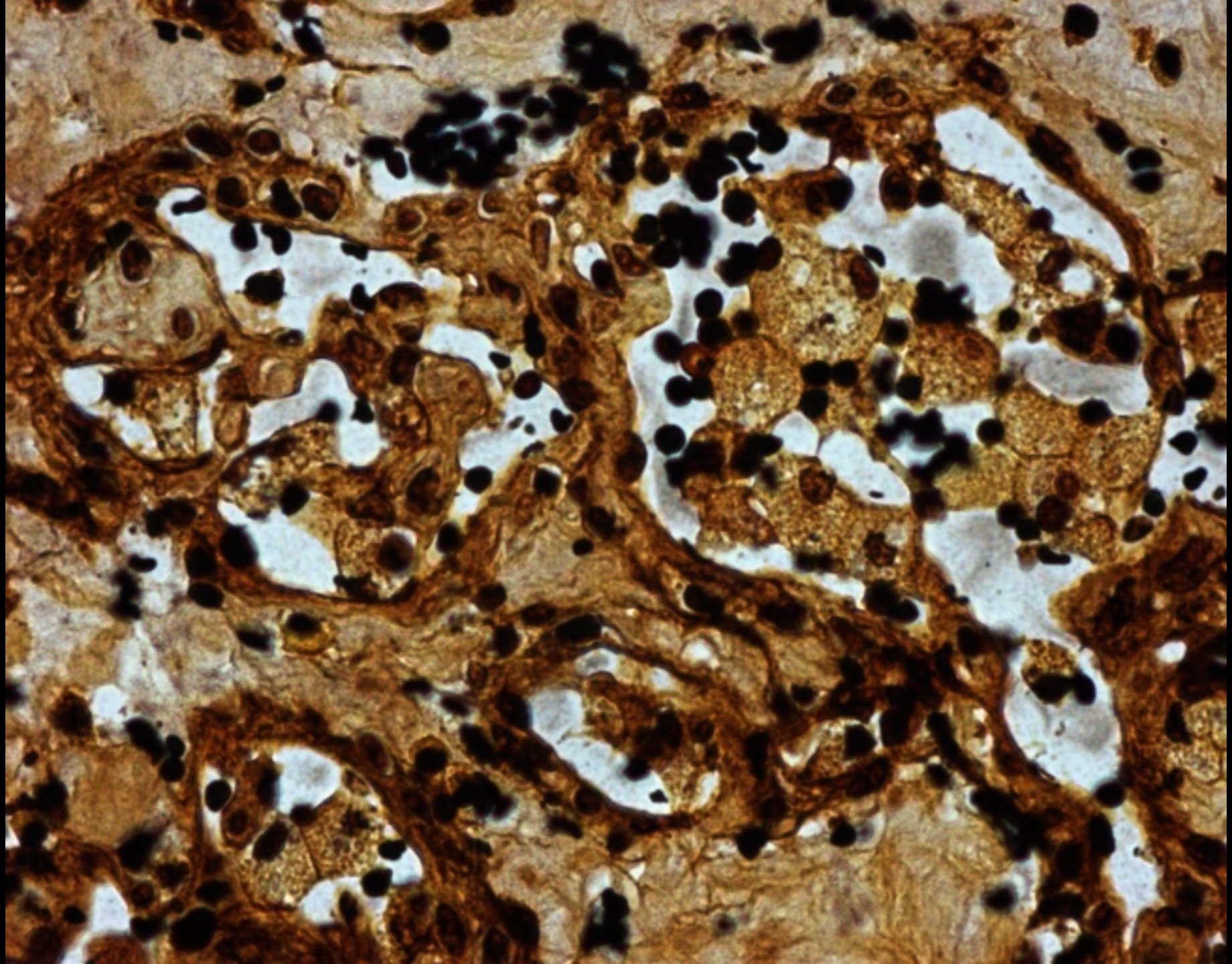


# What is your diagnosis?

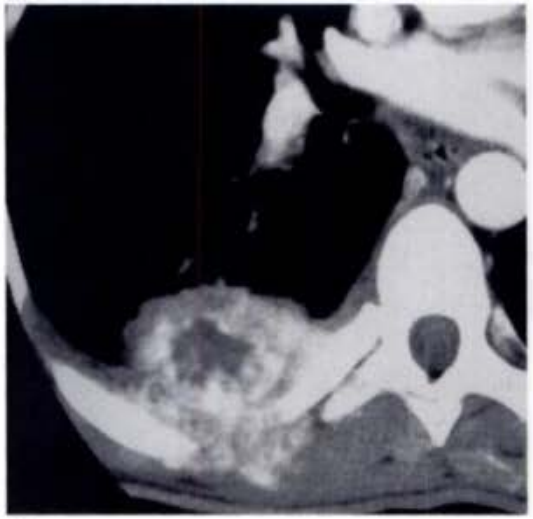
- Make a proposal





Coche E et al. AJR 1995; 165:56-58

A



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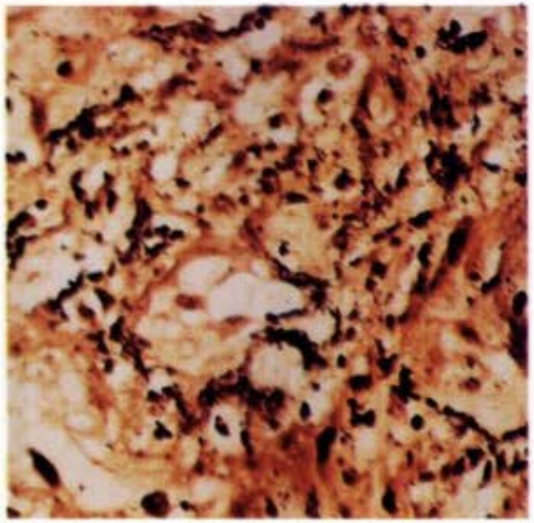


E

Fig. 1.—26-year-old woman with AIDS who had pain in right hemithorax, low-grade fever, and weight loss.

*A*, Chest radiograph shows right-sided thoracic mass with contiguous rib erosion.

*B*, Chest CT scan after dynamic injection of contrast material shows mass in lower right portion of thorax that appears hypervascular with heterogeneous enhancement and central hypodense area. Small pleural effusion is present, and mass is seen to involve intercostal space and posterior thoracic wall.

*C*, CT scan of 1.5-mm collimation at bone window setting did not show any calcification within mass. Note bronchus arriving into parenchymatous mass.

*D*, T1-weighted spin-echo MR image obtained after injection of contrast material shows that mass involves sixth right dorsal foramen (*arrow*) without any epidural involvement.

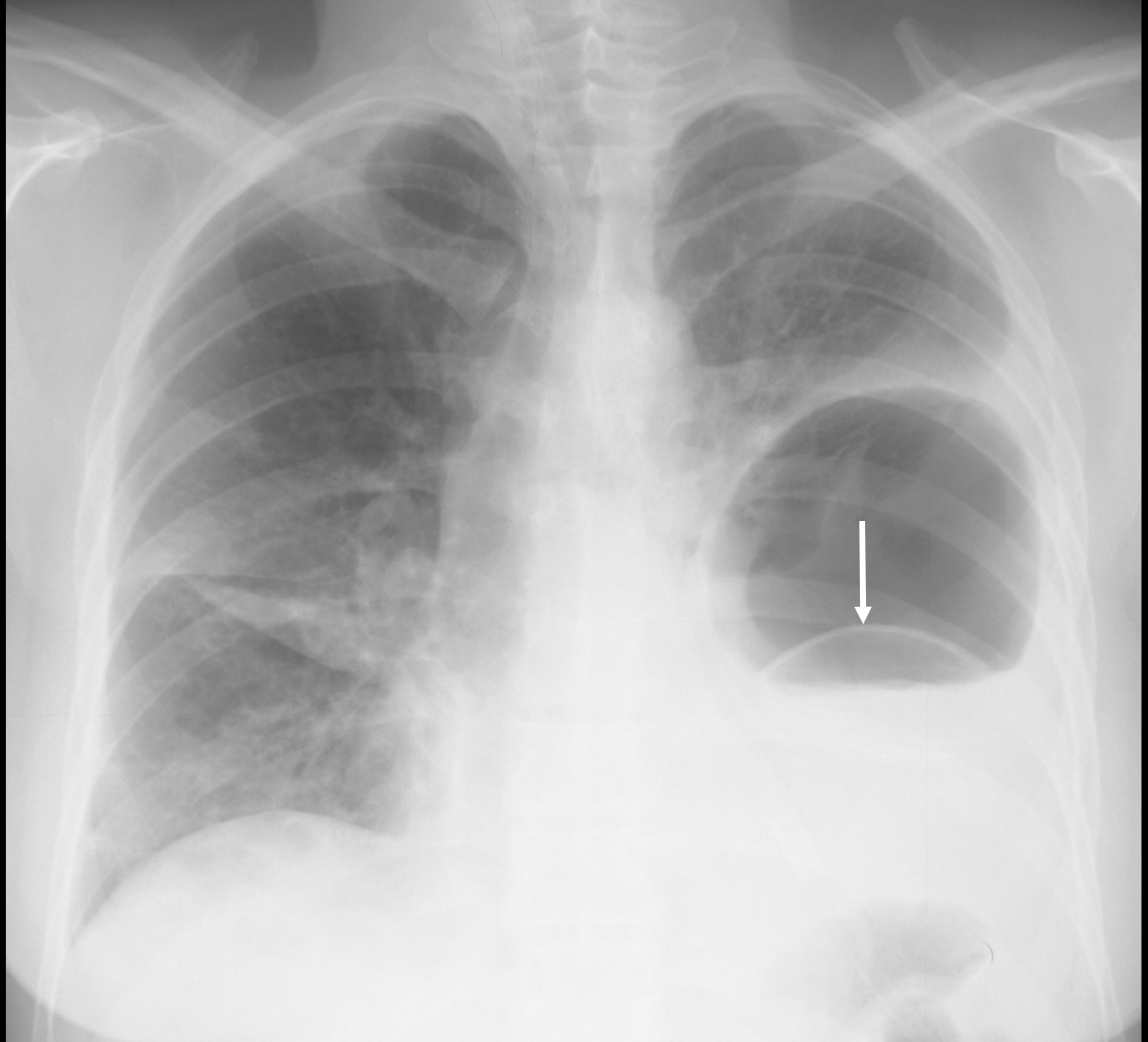
*E*, Photomicrograph of bacillary angiomatosis lesion reveals clusters of bacilli in interstitium (Warthin-Starry stain, original magnification ×200).

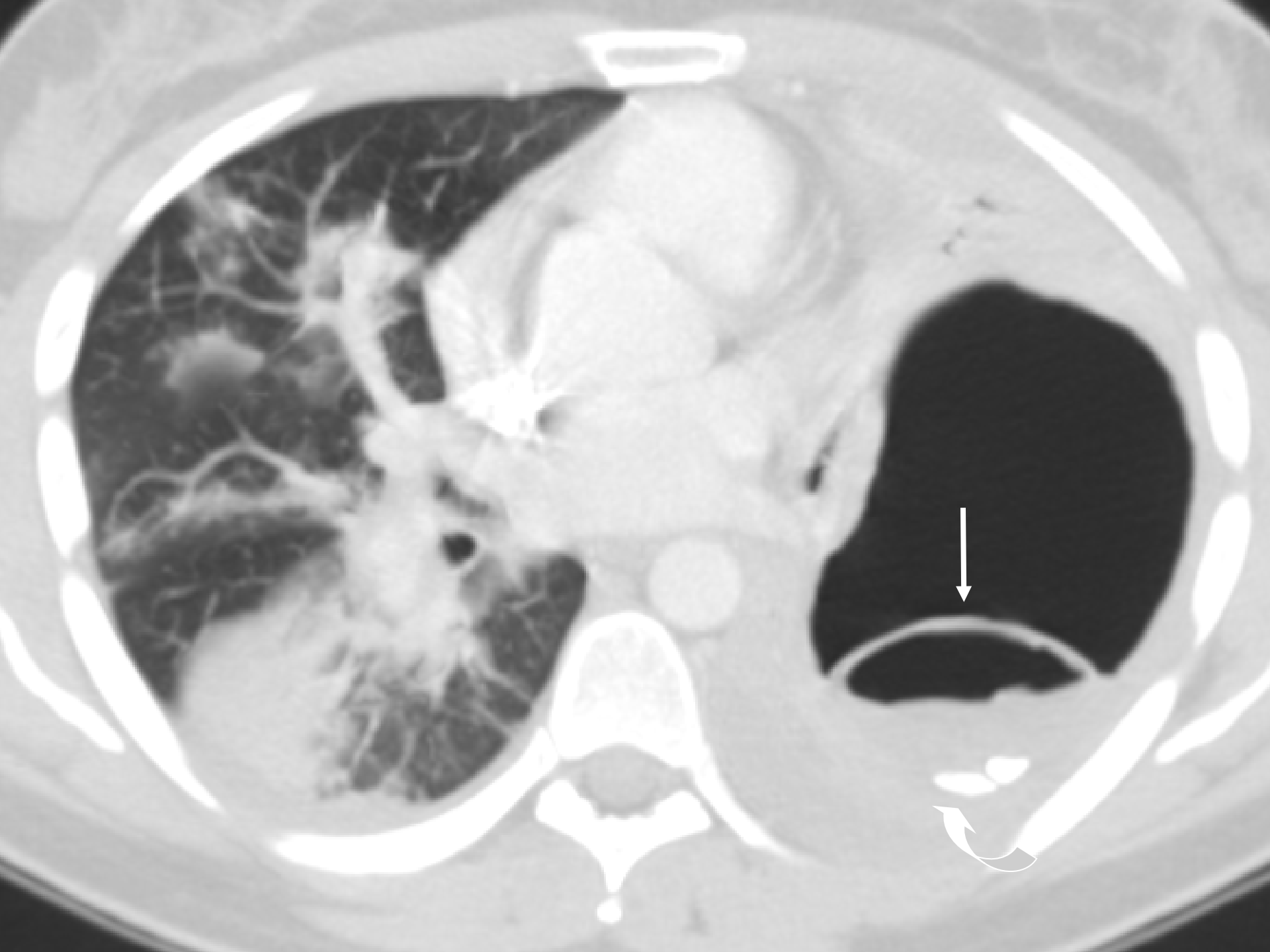
# Bacillary angiomatosis

- Rochalimaea Henselae and Quintana
- Catch-scratch disease
- Skin involvement: erythematous nodules
- Soft tissue, bone, lymphnodes, liver (hepatic peliosis, spleen, CNS, lungs
- Diagnosis: 16s ribosomial DNA, Whartin-Starry silver stain
- Treatment: Erythromycin

# Case 6: Clinical History

- 32-year old woman, caucasian
- Sudden expectoration of moderate amount of blood tinged liquid
- Left-sided chest-pain and fever
- 2-month history of a non-productive cough
- **Blood sample:**
- increased white blood cell count with a left shift and no eosinophilia

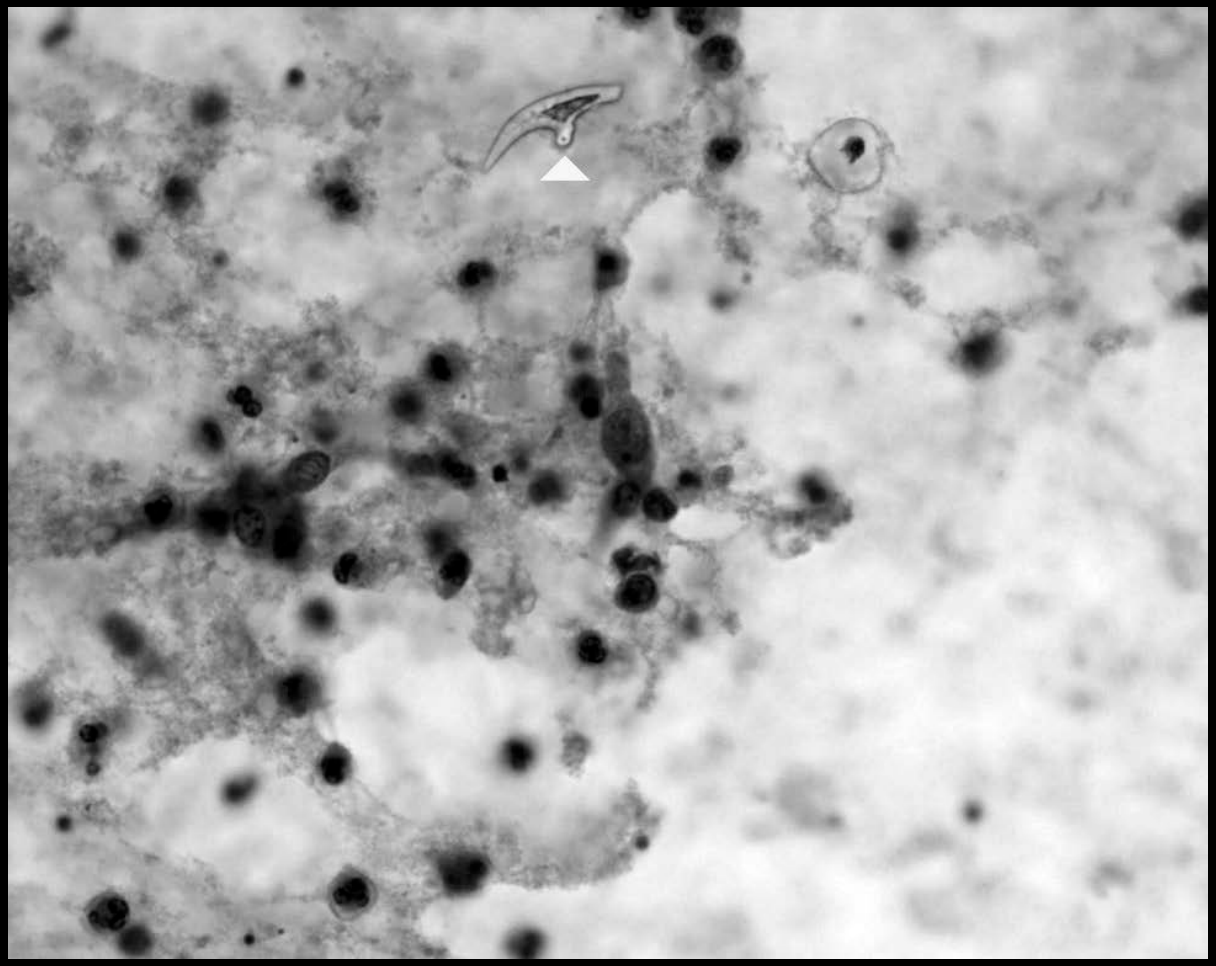




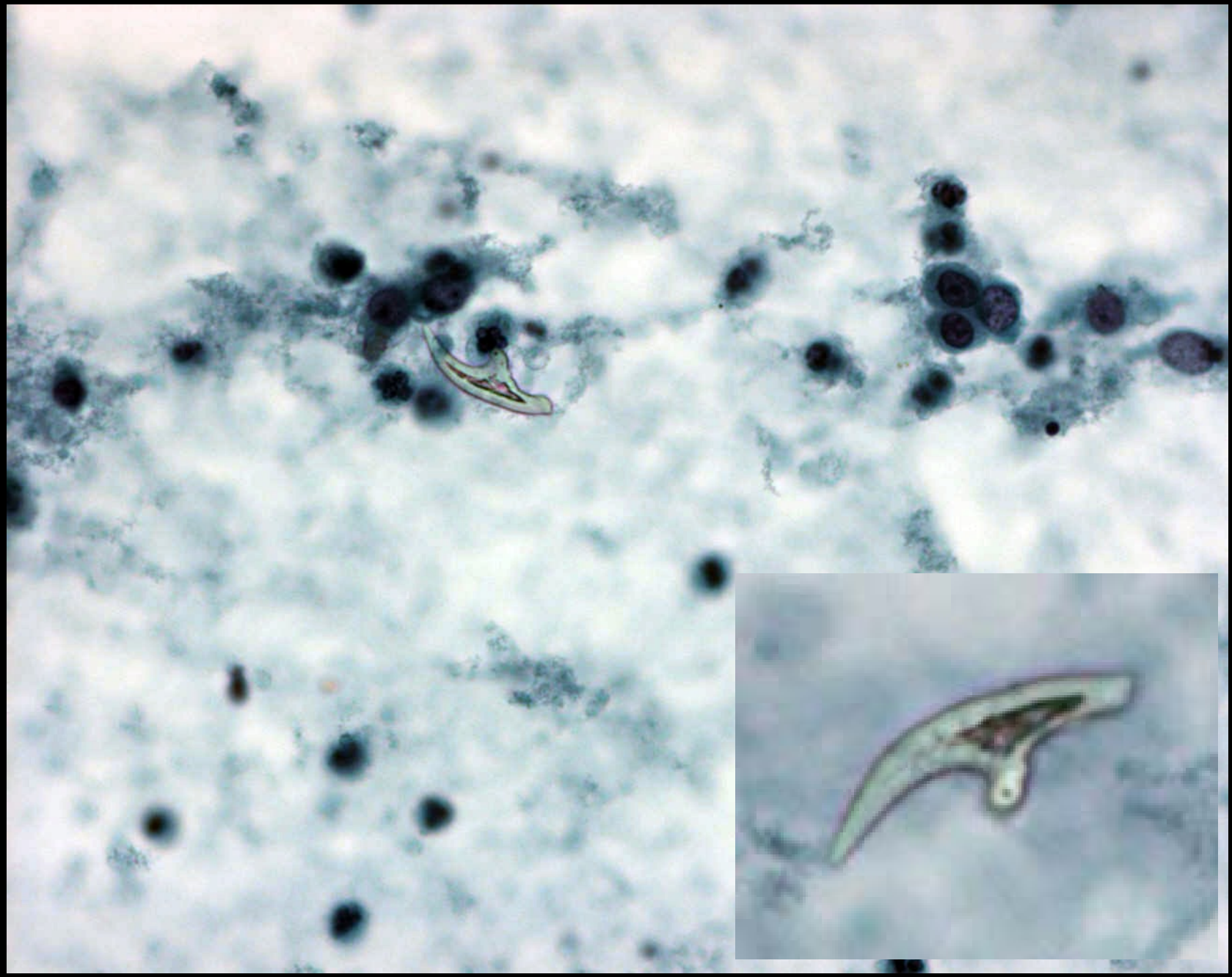
# What is your diagnosis?

- 1. Invasive Aspergillosis
- 2. Bronchogenic carcinoma
- 3. Echinococcal cyst
- 4. Tuberculosis
- 5. None of the above

# Pathology Specimen: BAL



- Polymorphous inflammatory infiltrate and a few hooklets
- HYDATID CYST

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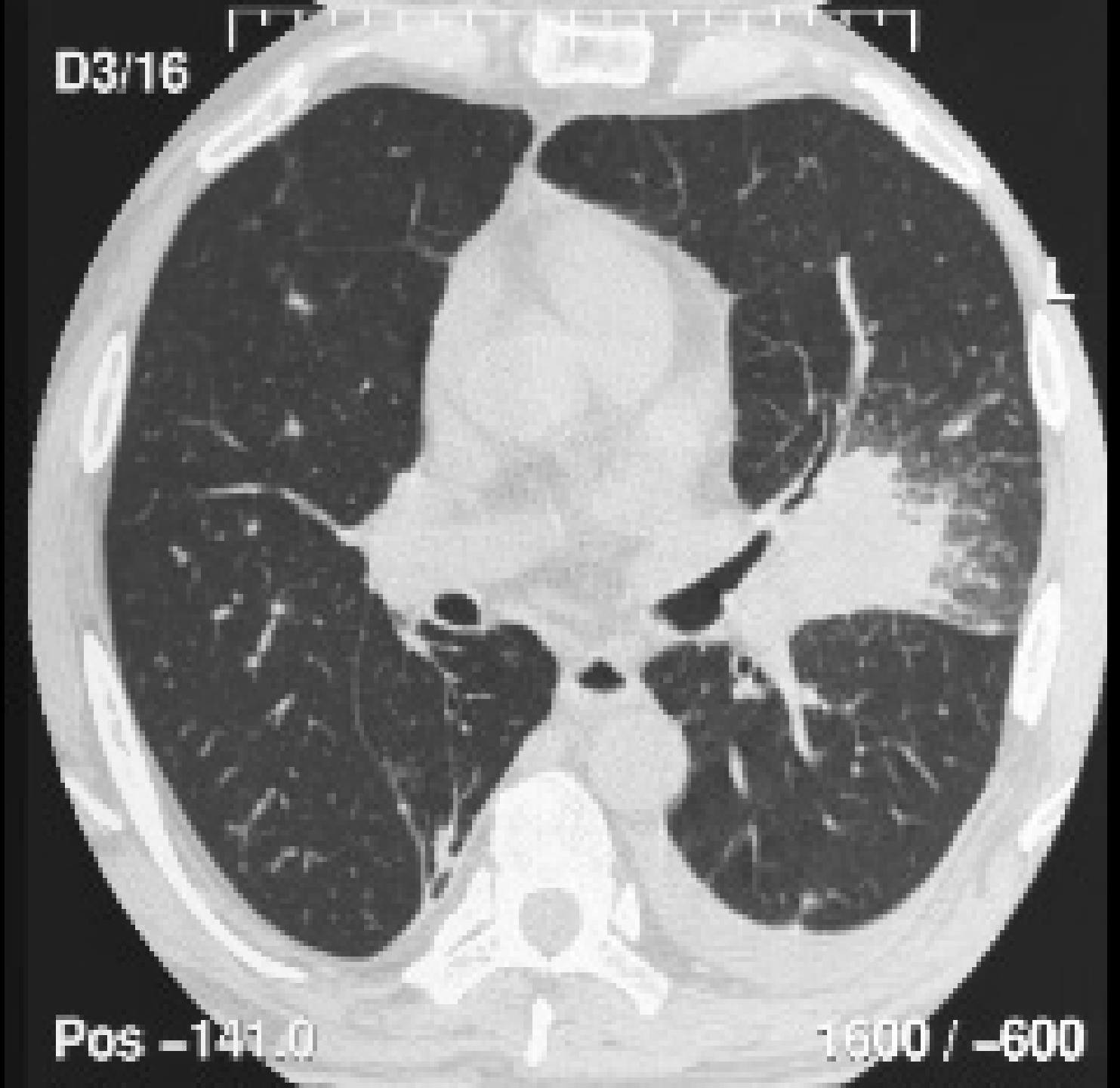
# Case 7: Clinical History

- 69-year-old man with acute myeloid leukemia
- Fever and progressive dyspnea
- Chemotherapy
- Aplasia, pancytopenia

# What is your attitude?

- 1. Repeat a chest X-ray in one week
- 2. Perform a thin-section chest MDCT
- 3. Perform a chest MDCT with iv contrast
- 4. Recommend a BAL
- 5. Do nothing and reassure the doctor and the patient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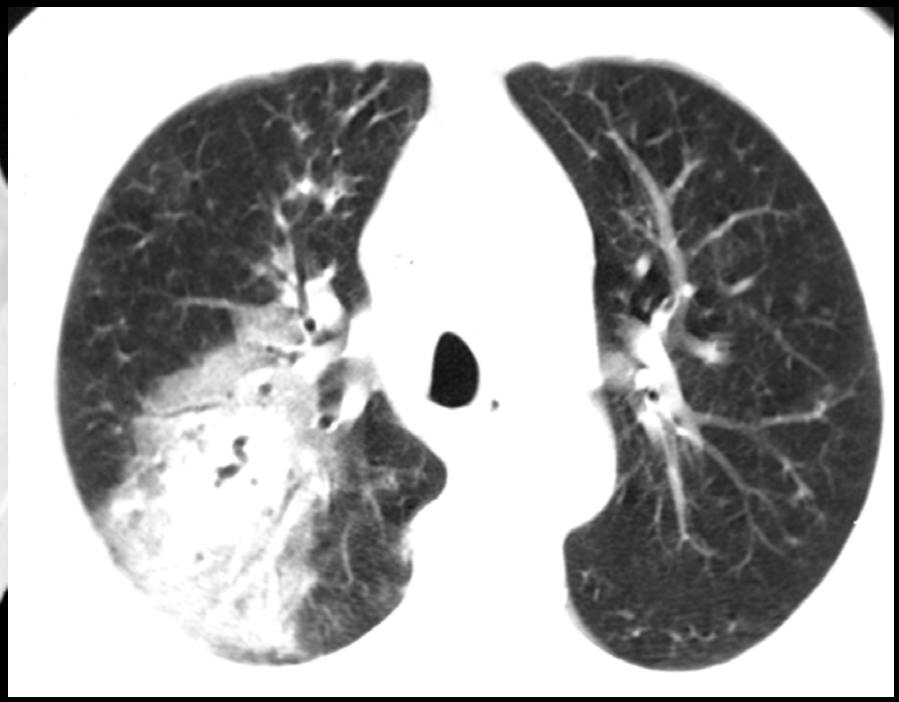
# The CT “halo” sign



- Refers to a zone of ground-glass attenuation surrounding a nodule or mass on CT images

Pinto P. The CT halo Sign. Radiology (2004); 230:109-110

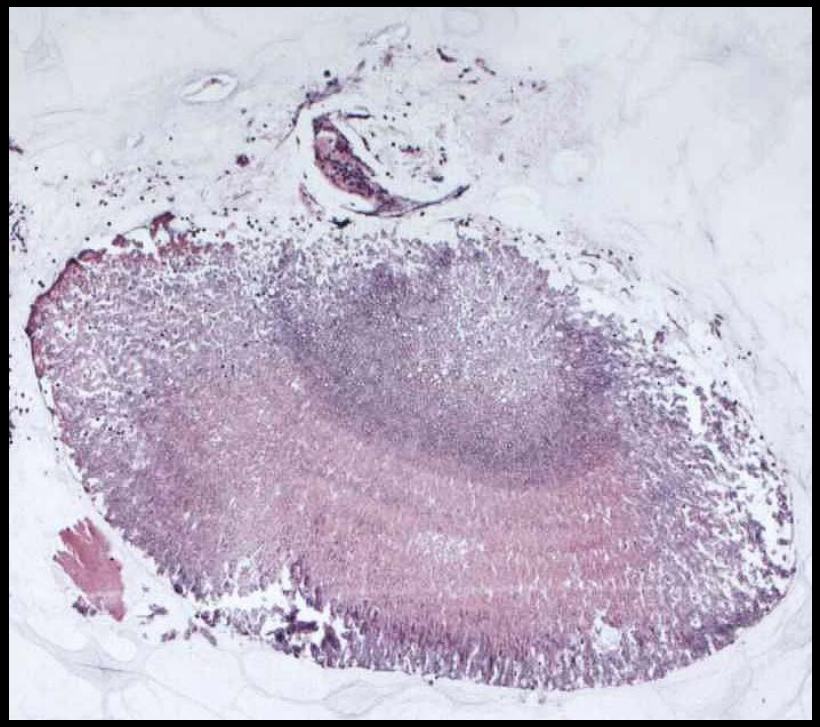
# CT Halo sign

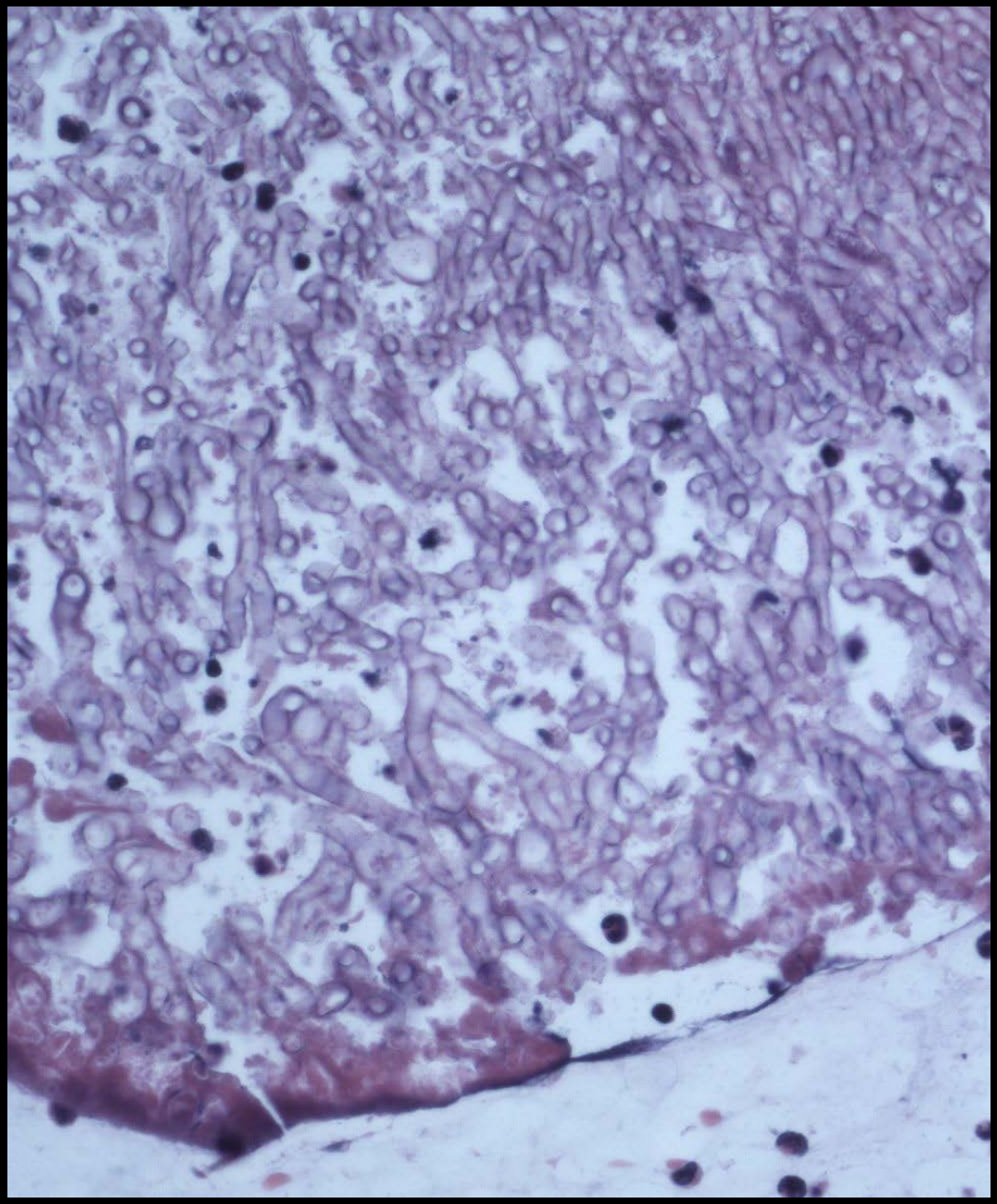
- Frequently high in the early stages of angio-invasive aspergillosis
- Sensitivity: 72 % and specificity: 100 %
- Metastases: angiosarcoma, choriocarcinoma, osteosarcoma…
- Wegener's granulomatosis, BO, COP, Tbc, virus, candida and other mycoses…

Pinto P. The CT halo Sign. Radiology (2004); 230:109-110
Blum U et al. Invasive pulmonary aspergillosis: MR, CT and plain radiographic findings and their contribution for early diagnosis. Chest (1994);106:1156-61

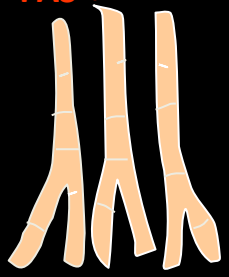
# Which test do you recommend to confirm your diagnosis?

- 1.Haemoculture
- 2. A percutaneous biopsy
- 3. Searching for anti-aspergillus antibodies
- 4. Dosage of Galactomannan antigen
- 5. Searching for PCR





5-9 µm
HE +
G +++
PAS +



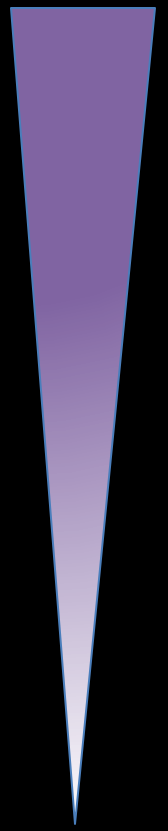
Aspergillus spp.

# Aspergillosis

- > 300 species: A. fumigatus+++
- Ubiquitous in the envirronment
  - Soil, water, decaying organic material, colonisation of the nasal mucosa
- Pathogenesis is complex and incompletely understood
- Pulmonary involvement is varied and largely dependent of the patient's underlying pulmonary and immune status
- Early diagnosis is crucial in some  clinical situations

# Spectrum of pulmonary aspergillosis

- Angio-invasive aspergillosis
- Airway-invasive aspergillosis
- Semi-invasive Asp. (chronic necrotizing)
- Hypersensitivity reaction (ABPA, Loeffler-like syndrome, EAA)
- Saprophytic Asp. (aspergilloma)



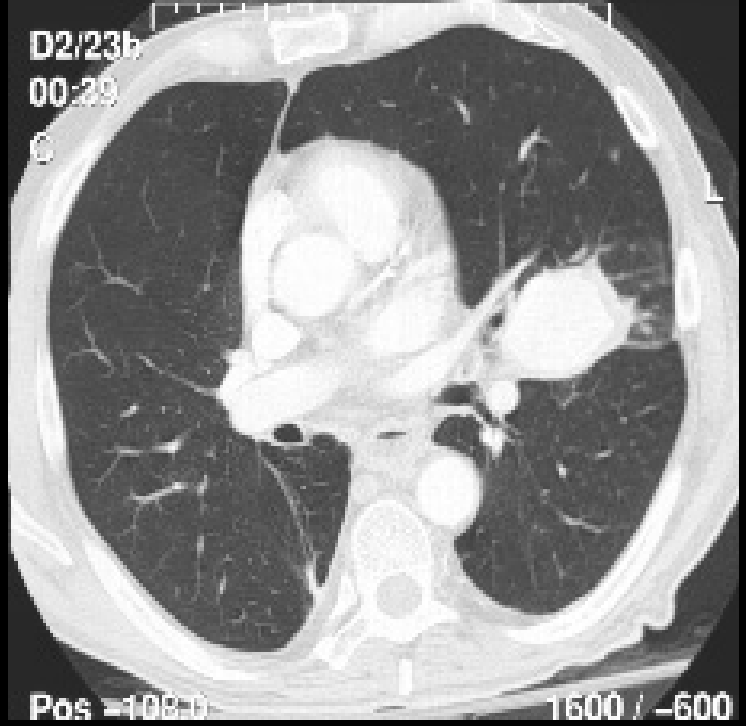
Franquet T et al. Radiographics 2001;21:825-837

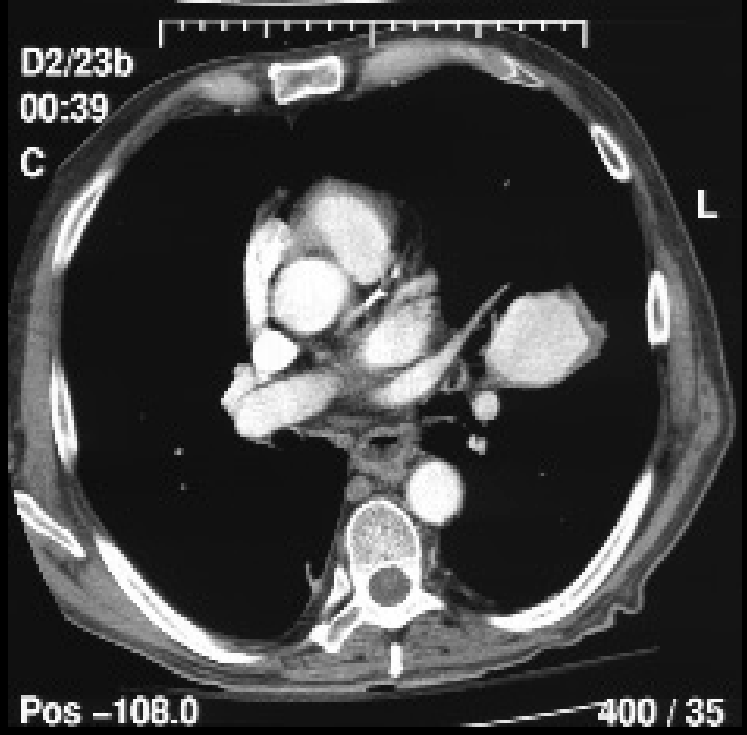
# Clinical Evolution

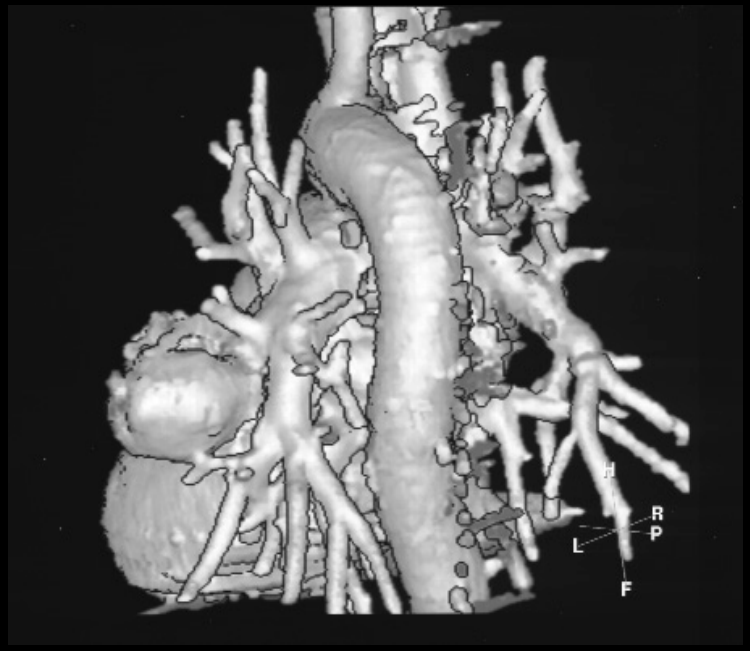
- The patient received Amphotericine B IV (Fungizone ®), Itraconazole PO (Sporanox ®)
- Few days later: massive haemoptysis (300 mL)
- Chest X-ray

# What is your attitude?

- 1. Repeat a chest MDCT without IV contrast
- 2. Perform an angio CT of the pulmonary arteries
- 3. Perform a dynamic CT of the thoracic aorta and its side branches
- 4. Perform a chest MDCT with opacification of aorta and pulmonary arteries

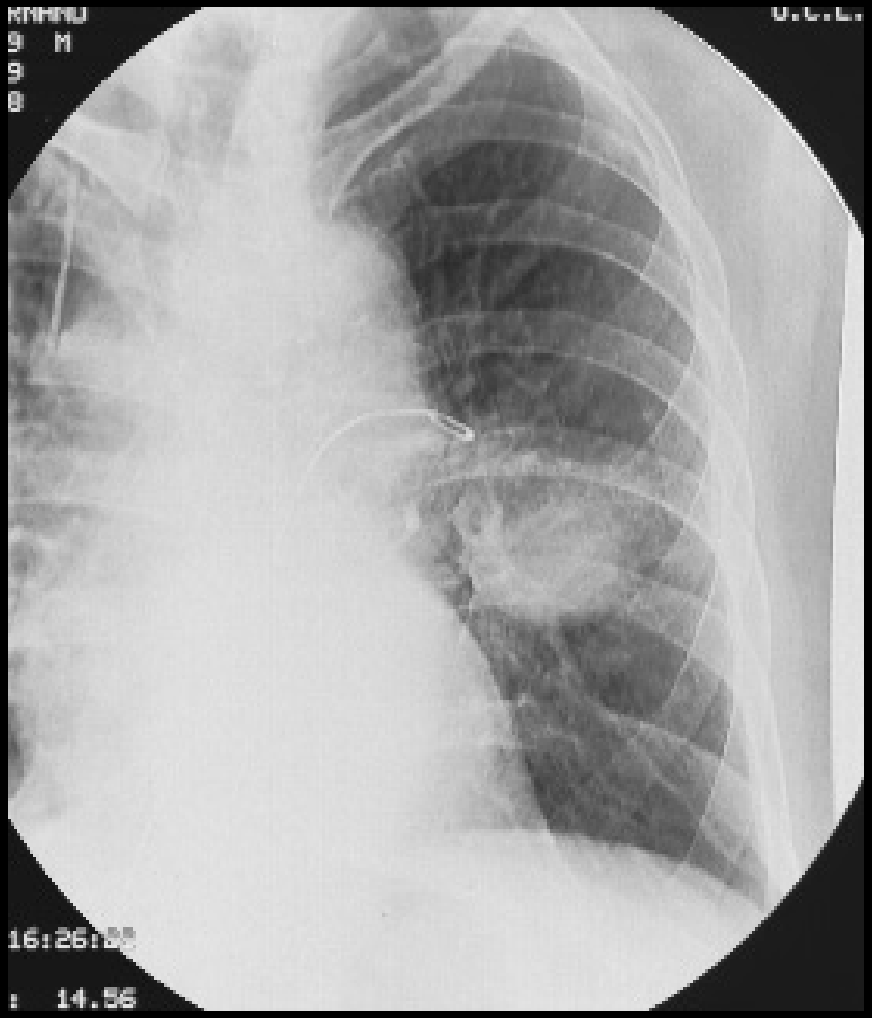


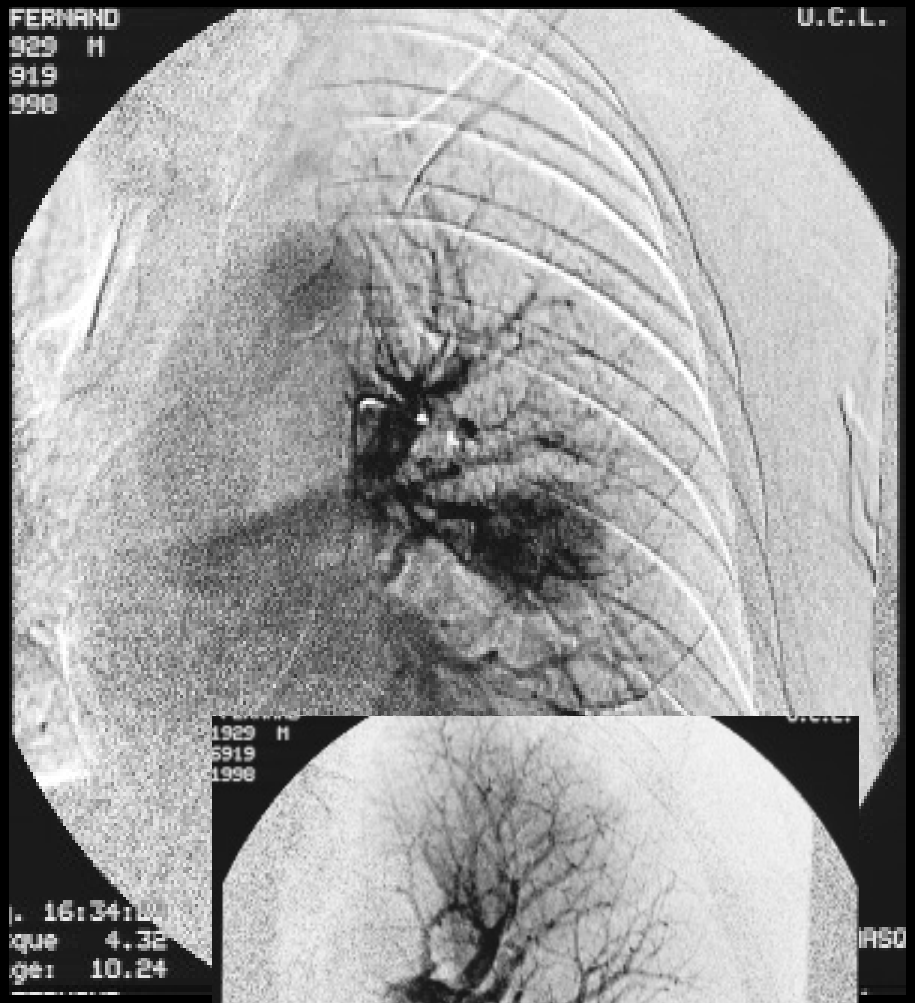



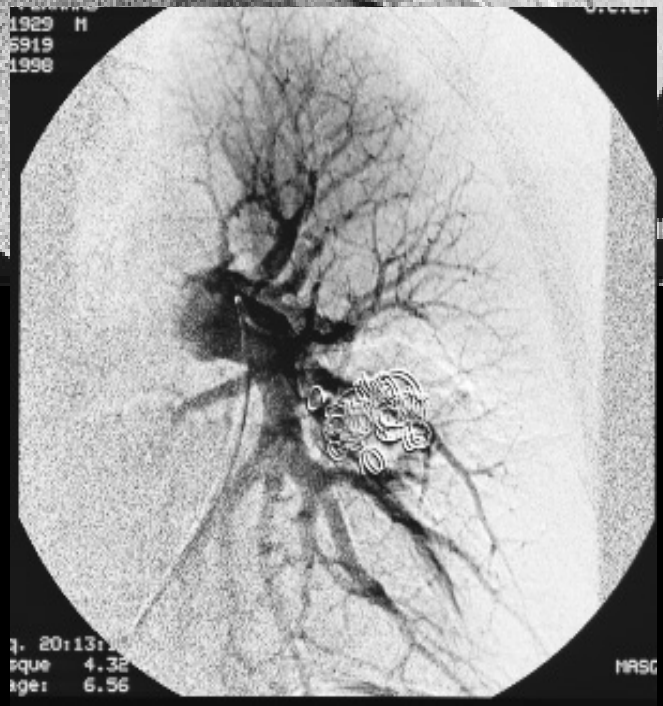




# Pseudoneurysm of the inferior lingular artery

Mody GN, Lau CL, Bhalla S, Picus D, Ritter J, Mc Cardle T, Patterson GA. Mycotic pulmonary artery pseudoaneurysm. J Thorac Imaging (2005); 20(4):310-2





Treatment: Selective catheterisation and coils embolization

Courtesy Dr C Beigelman
CHU Lausanne, Switzeland

Sonnet et al. Direct detection of angioinvasive aspergillosis in immunosuppressed patients: preliminary results with high resolution 16-MDCT angiography. AJR (2005);185-746-751

**Regenerative phase +++**
**Risk of massive haemoptysis +++**

When PMN > 500/mm3

Courtesy Dr C Beigelman
CHU Lausanne, Switzeland

# Case 8: Clinical History

- 73-year old man, dyspnea
- Chest radiograph

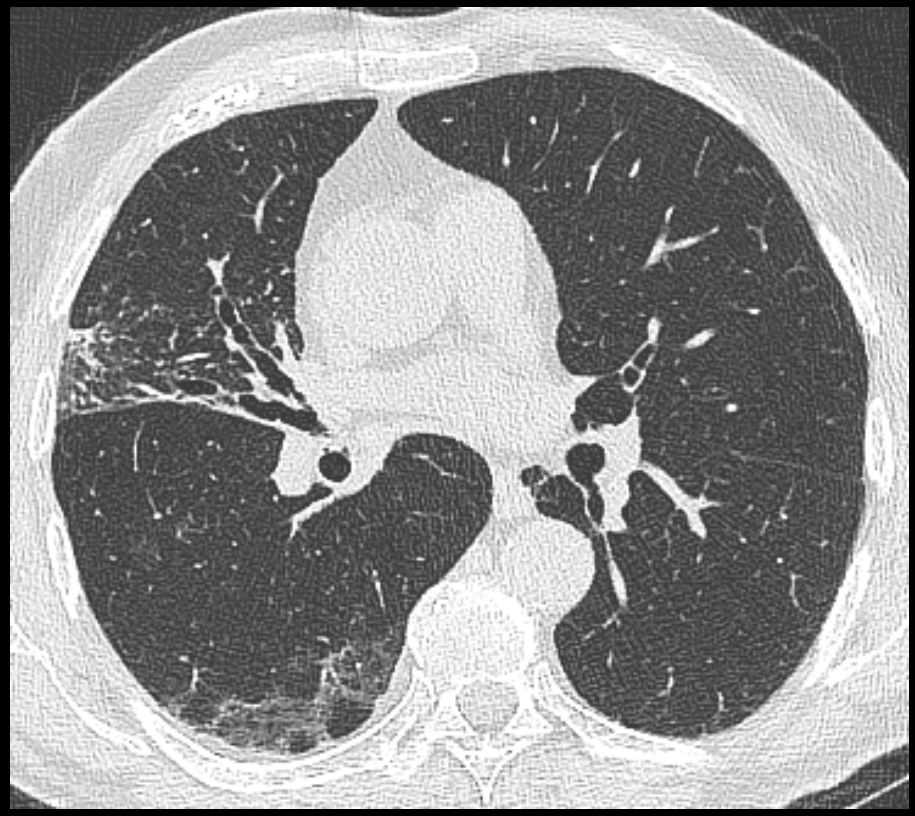

# Computed Tomography

# What is your diagnosis?

- Make a proposal

# Main CT findings in ABPA

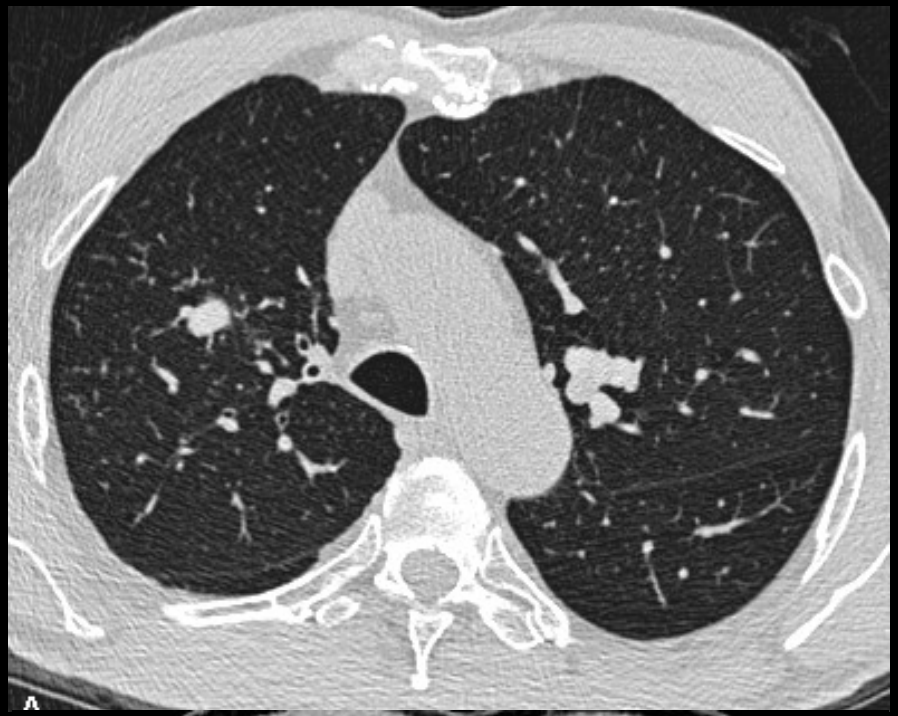
- Homogeneous finger-in-glove areas of increased opacity or calcified (30%)
- Segmental and subsegmental bronchiectasis usually involved
- Isolated lobar or segmental atelectasis
- Abnormalities can migrate

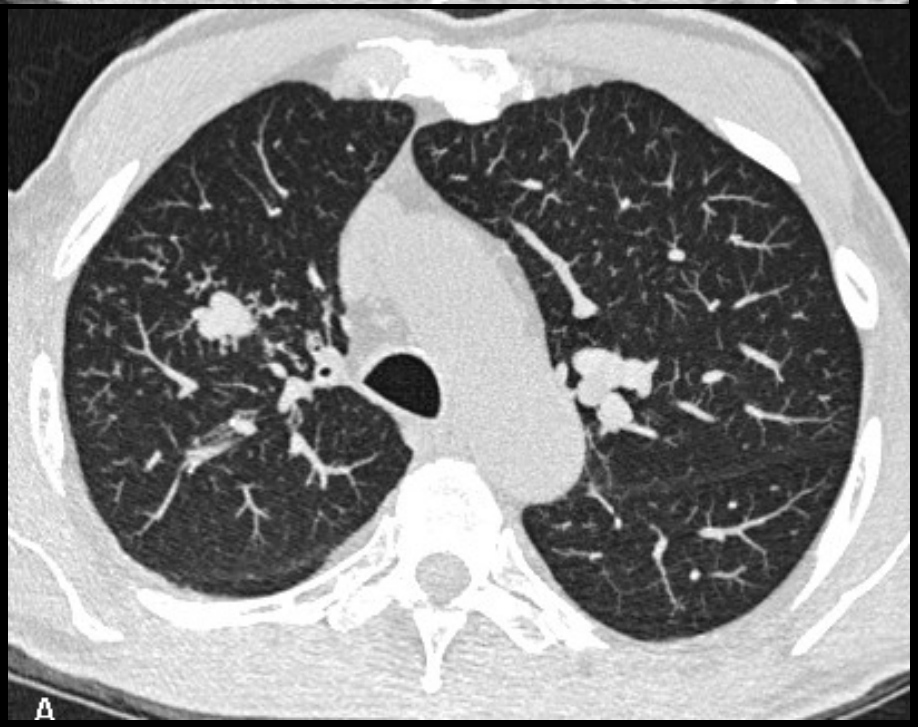



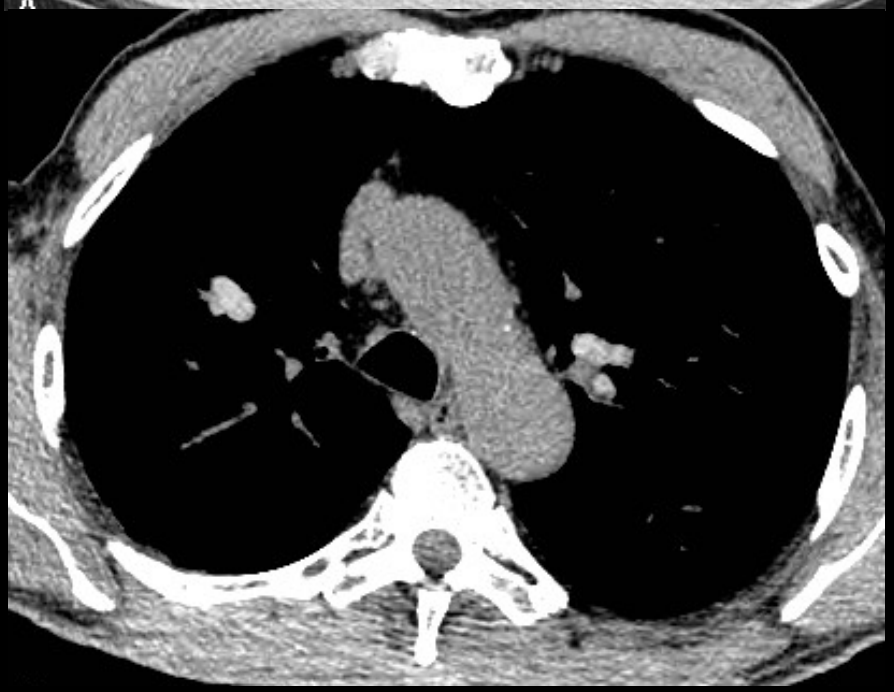
After corticosteroid treatment

# Case 9: Clinical History

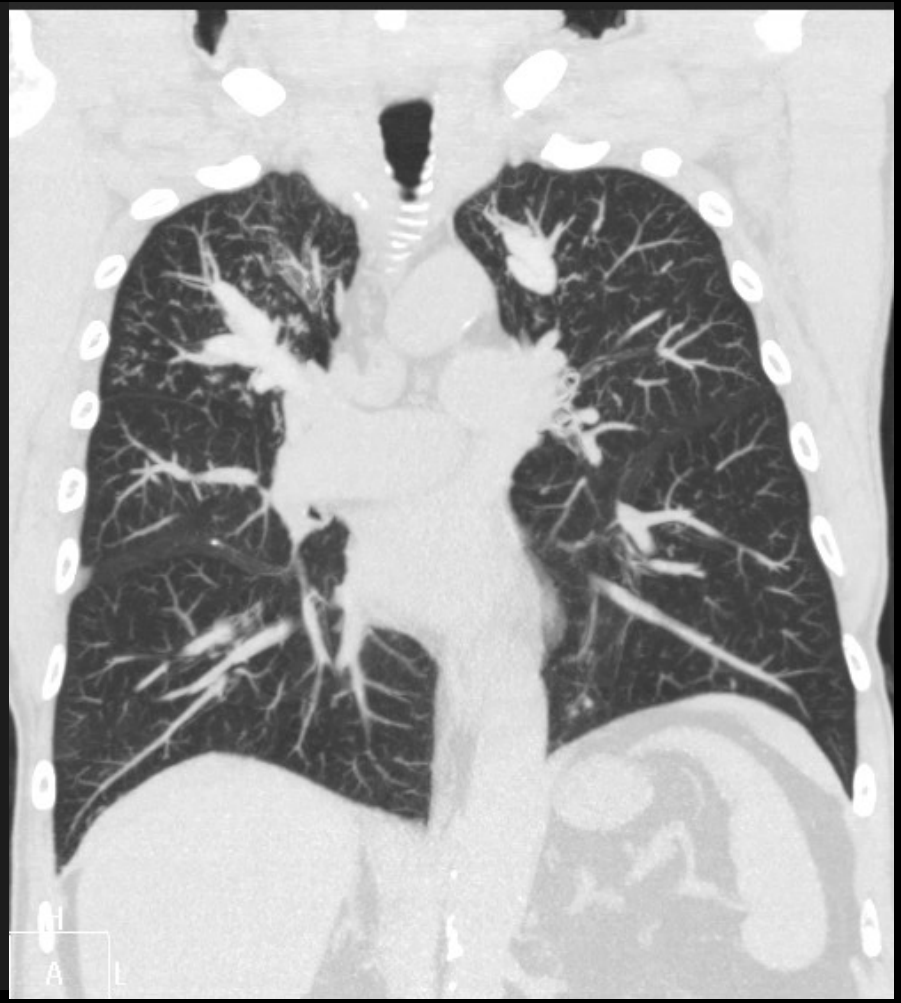
- Middle-aged man
- Recurrent wheezing
- Malaise with low-grade fever
- Cough and sputum production
- History of recurrent pneumonia
- Long-standing asthma







# Multiplanar reformattions



Courtesy G.Ferretti, Grenoble, France

# Criteria for ABPA

Table 1 Diagnostic criteria of ABPA.

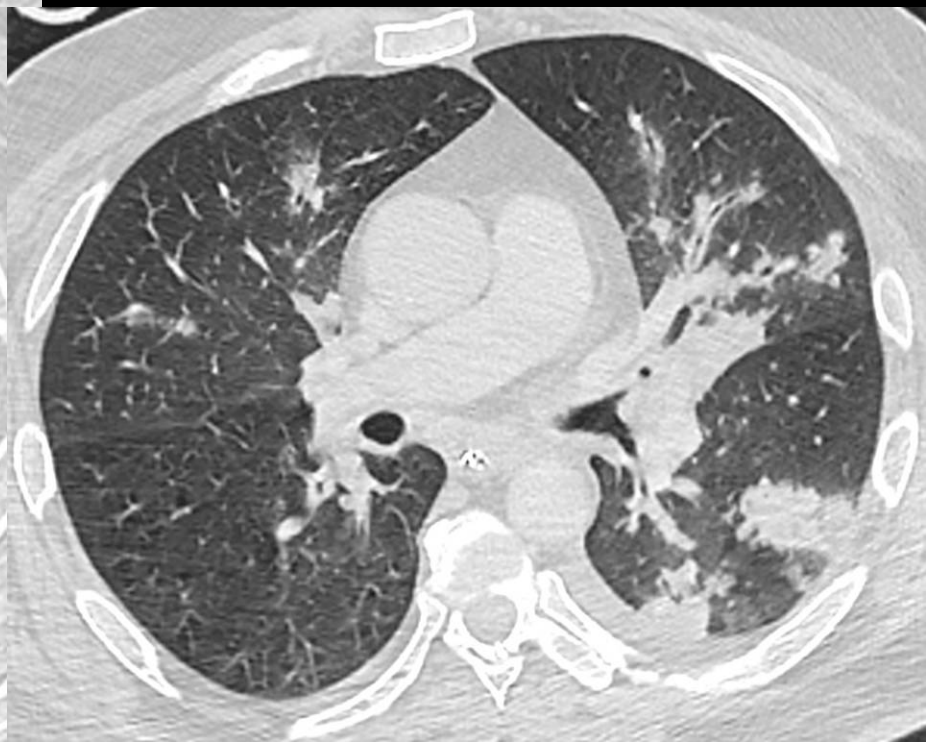
| Criteria | Essential for ABPA diagnosis? |
|---|---|
| Asthma | Yes |
| Total IgE >1000 ng/mL (417 kU/L) | Yes |
| Elevated serum IgE and/or IgG to *A. fumigatus* | Yes |
| Immediate cutaneous reactivity to *Aspergillus* species or *A. fumigatus* | Yes |
| Central bronchiectasis (inner two-thirds of axial lung parenchyma) | Yes to diagnose ABPA-central bronchiectasis<br>If first four criteria have been met, diagnosis is ABPA seropositive (ABPA-s) |
| Infiltrates seen on chest radiograph | No |
| Peripheral eosinophilia > 500 $mm^3$ | No |
| Precipitating antibodies to *A. fumigatus* | No |

Adapted from Greenberger, P. A. 2002. Allergic bronchopulmonary aspergillosis. *J Allergy Clin Immunol*. 110(5): 685–92 (31).

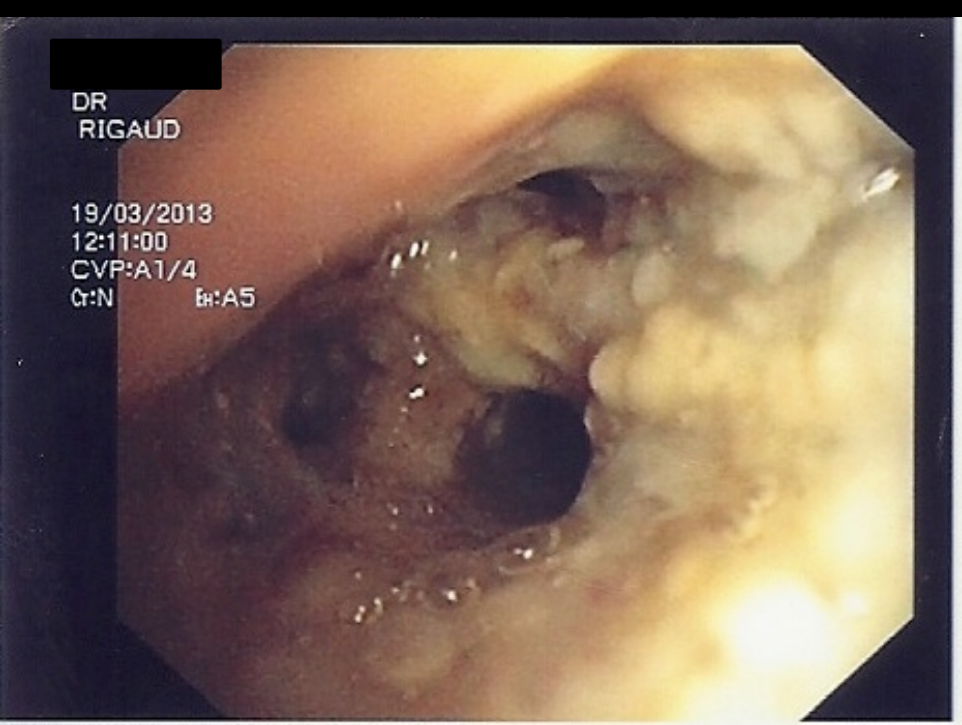
# Case 10: Clinical History

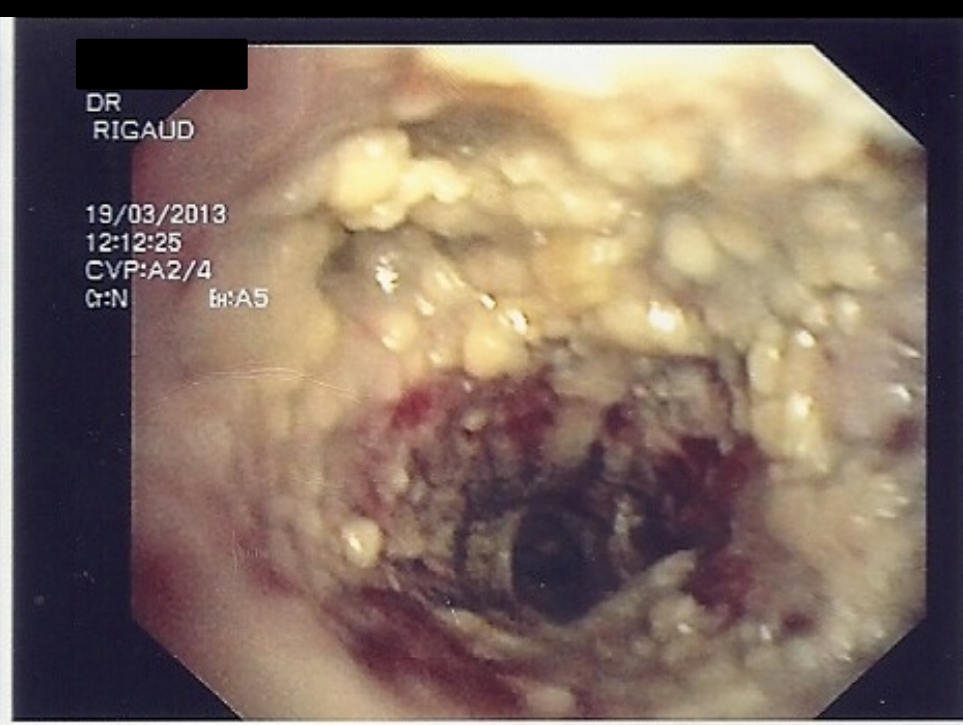
- 62 yo man
- Immunocompetent
- Recent fatigue weigh loss anorexia
- Fever
- Cough
- Acute respiratory distress… ICU



Courtesy Prof. Gilbert Ferretti, CHU Grenoble, France


[redacted]
DR
RIGAUD
19/03/2013
12:11:00
CVP:A1/4
Cr:N
Bn:A5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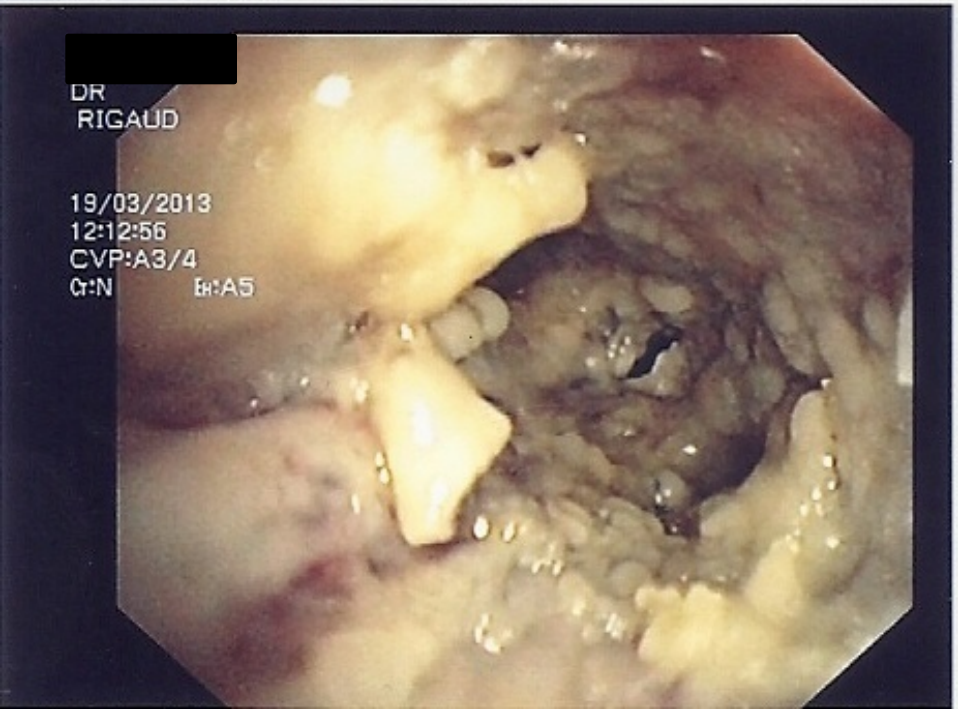
Cr:N
Bn:A5


[redacted]
DR
RIGAUD
19/03/2013
12:12:56
CVP:A3/4
Cr:N
Bn:A5


[redacted]
DR
RIGAUD
19/03/2013
12:20:50
CVP:A4/4
Cr:N
Bn:A5

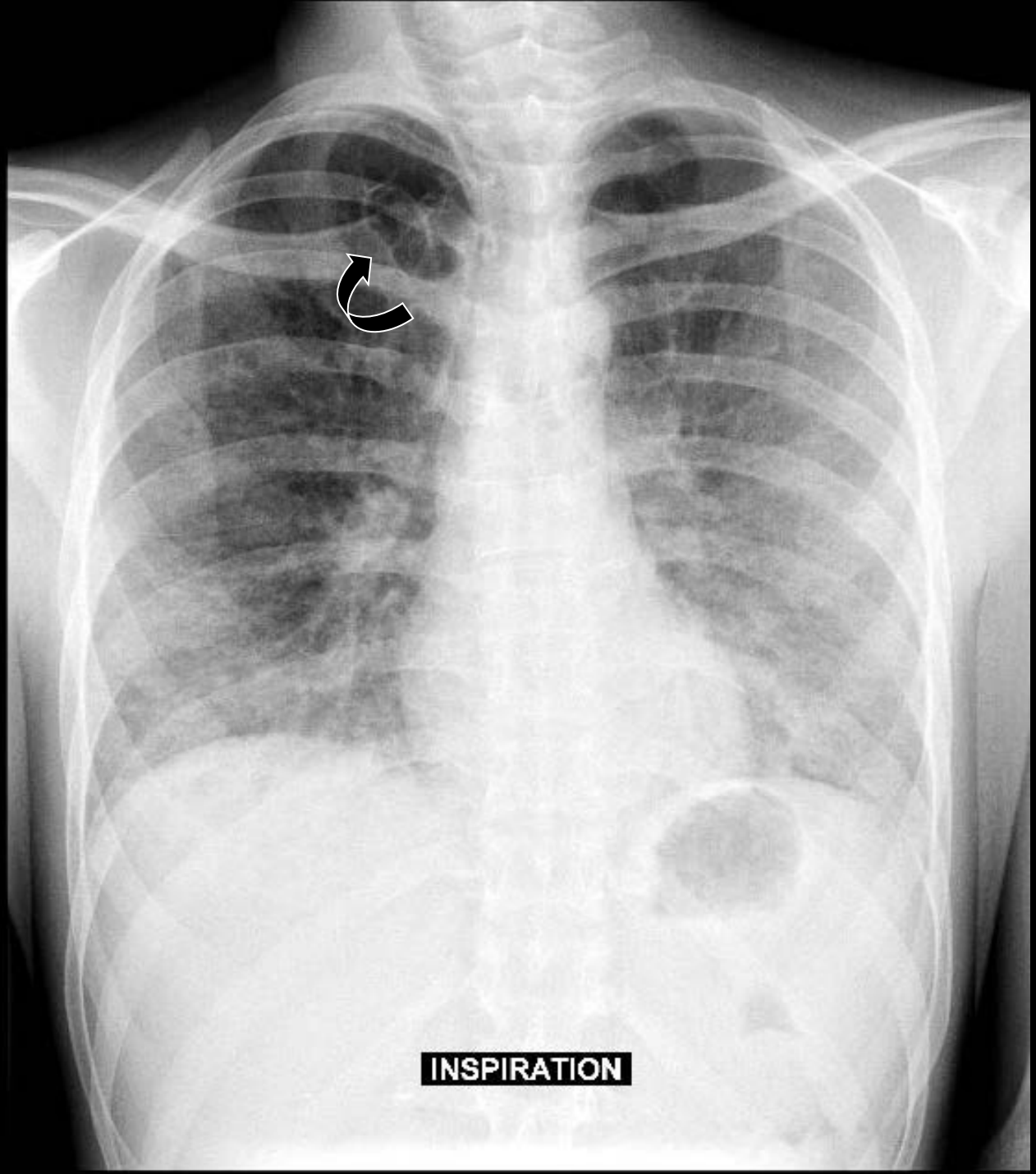
# Suggest a Diagnosis

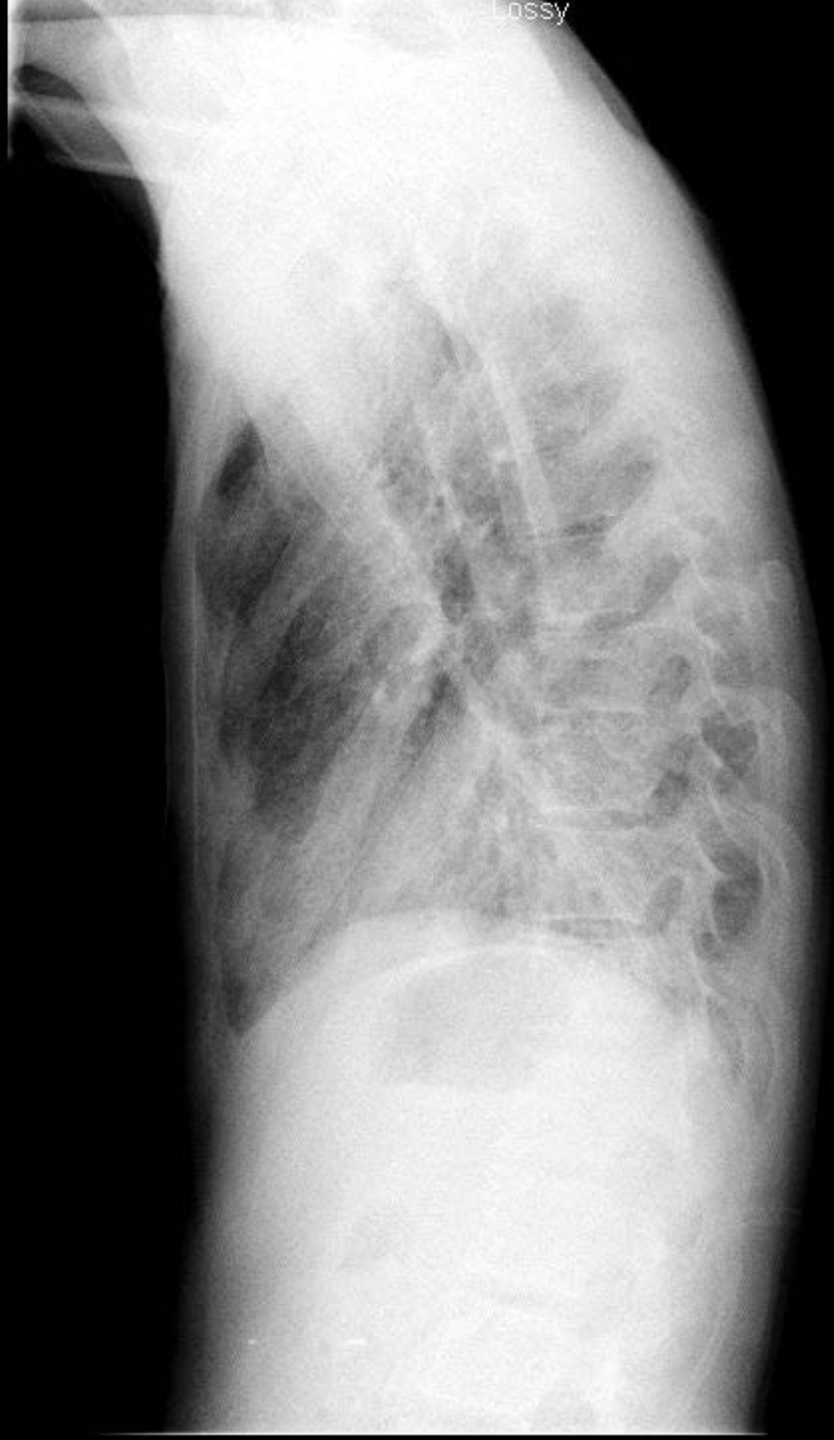
# Which statement is false for aspergillus tracheobronchitis?

- 1. Predilection for patients with lung or heart transplantation
- 2. May coexist with other of aspergillus-related pulmonary diseases
- 3. Chest CT may show atelectasis, airways thickening, ground glass opacities
- 4. Administration of systemic antifungal agents (Voriconazole, V-Fend ®) is recommended and is usually successful

# Case 11: Clinical History

- 27-year old man
- Acute dyspnea with cough
- No fever
- HIV positive
- CRP: 5.9 mg/dL (Nl<1 mg/dL)
- No leucocytosis (6.5 $10^3$/µL, Nl: 4,00-10,00 $10^3$/µL)
- T CD4:142 cells/µL


INSPIRATION


Lossy

# What is the most likely diagnosis?

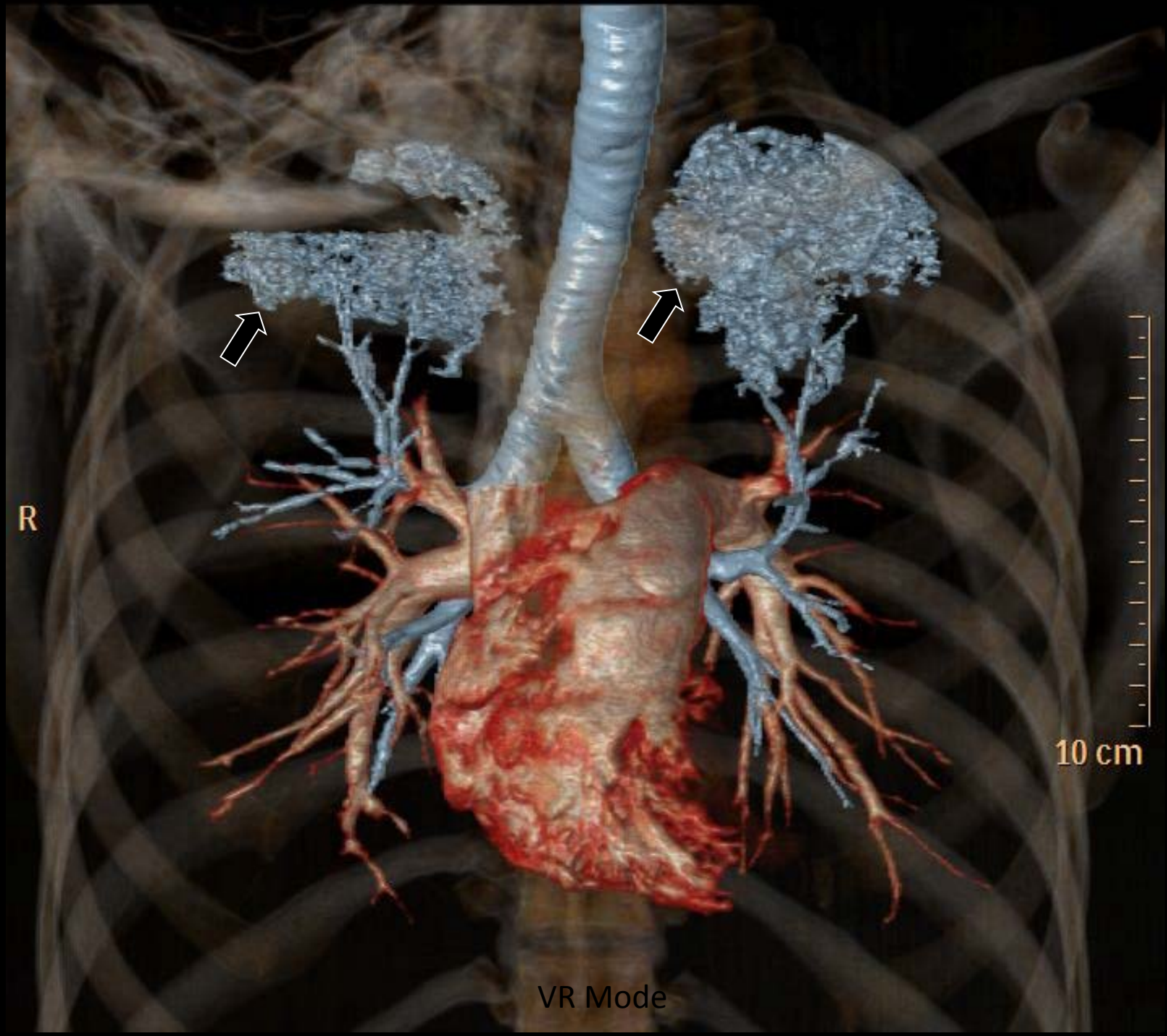
- 1. Gram positive Pneumonia
- 2. Viral pneumonia
- 3. Pneumonia pneumocystis Jirovicii
- 4. Mycotic Infection

# What is your next diagnostic test?

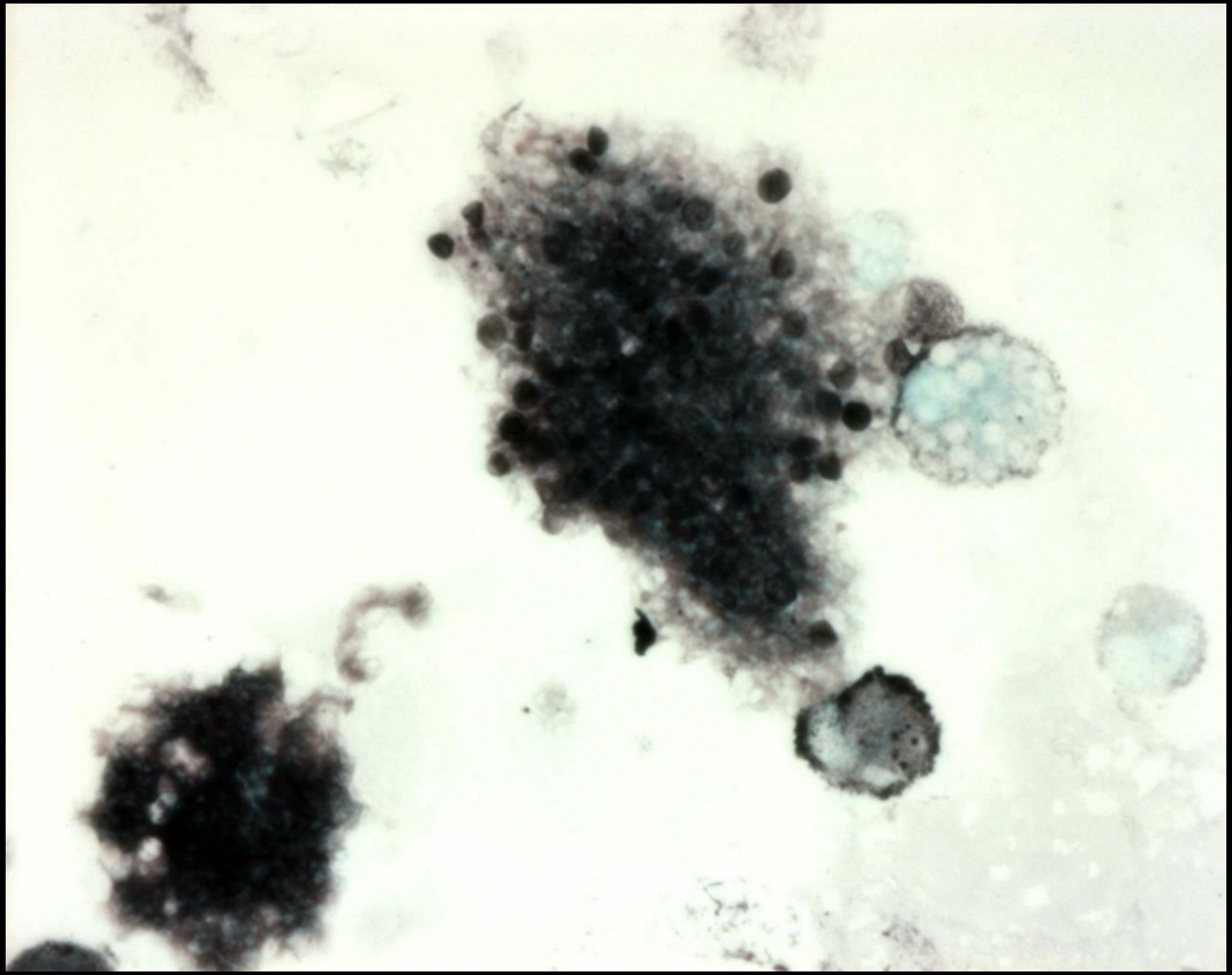
- 1. Alveolar lavage
- 2. CT with IV contrast
- 3. High resolution CT
- 4. repeat a chest X-ray in 2-3 days


MPR-Average mode


MPR-Average mode




VR Mode

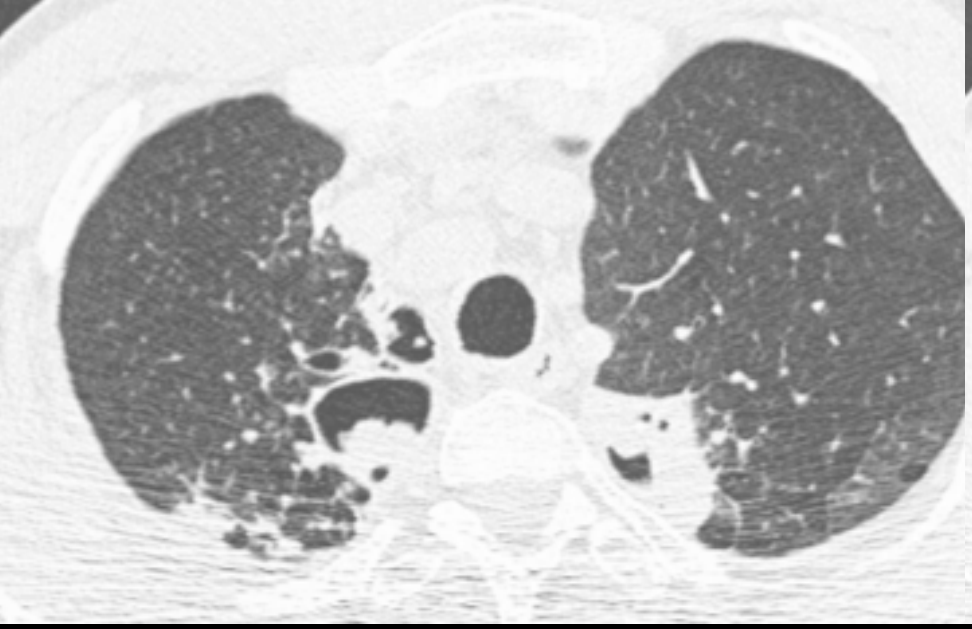


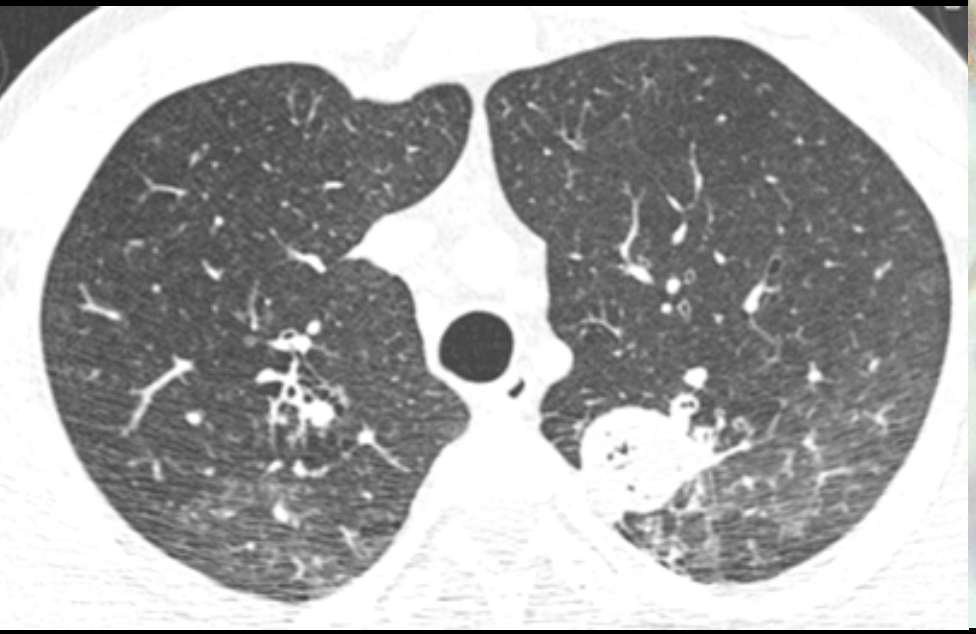
# Final diagnosis

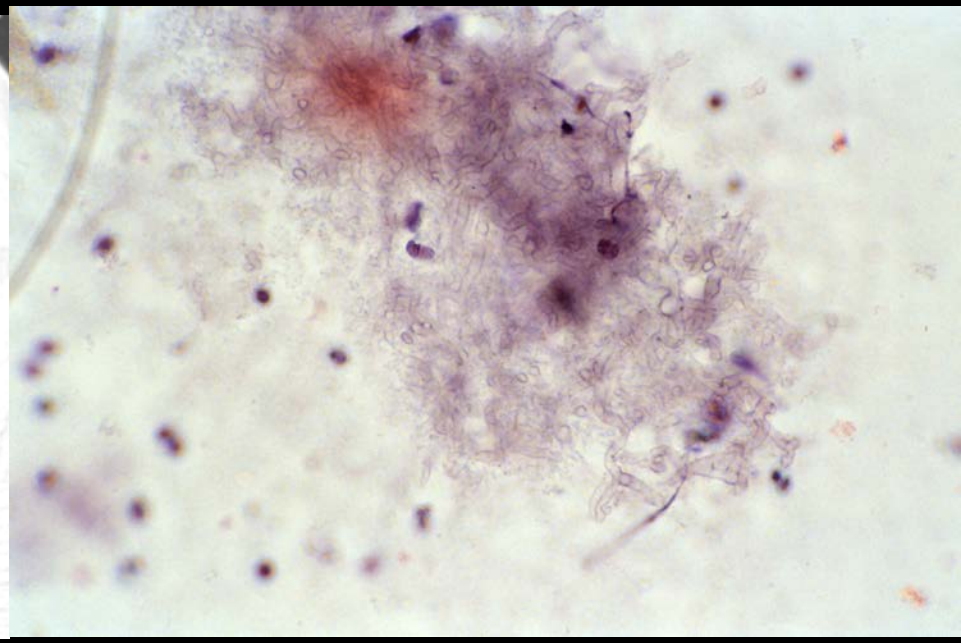
- Acute pneumonia caused by pneumocystis Jiroveci
- Upper lobe cavities was caused by early emphysema as described in HIV patients or by pneumocystis infection. The exact nature was not proven
- No germs causing cavitation found in blood cultures and sputum analysis (tuberculosis, aspergillus, mycosis…)
- The patient died 1 month after his admission

# Case 12: Clinical History

- 31-year-old man
- From south America
- No symptoms
- Blood sample within normal limits
- Chest X-ray
- Chest CT



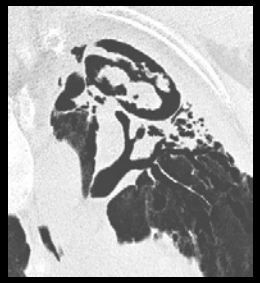




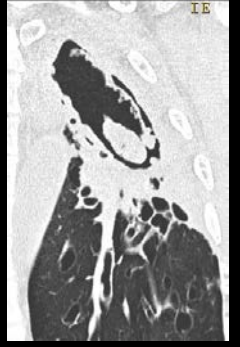
# The fungus ball

- Is characterized by Aspergillus infection without tissue invasion
- Colonization of pulmonary cavities usually located in the upper lobes
- Most common cavities
  - Tuberculosis
  - Sarcoïdosis
  - Bronchiectasis, bullae, pulmonary abcess…

Franquet T et al. Radiographics 2001;21:825-837



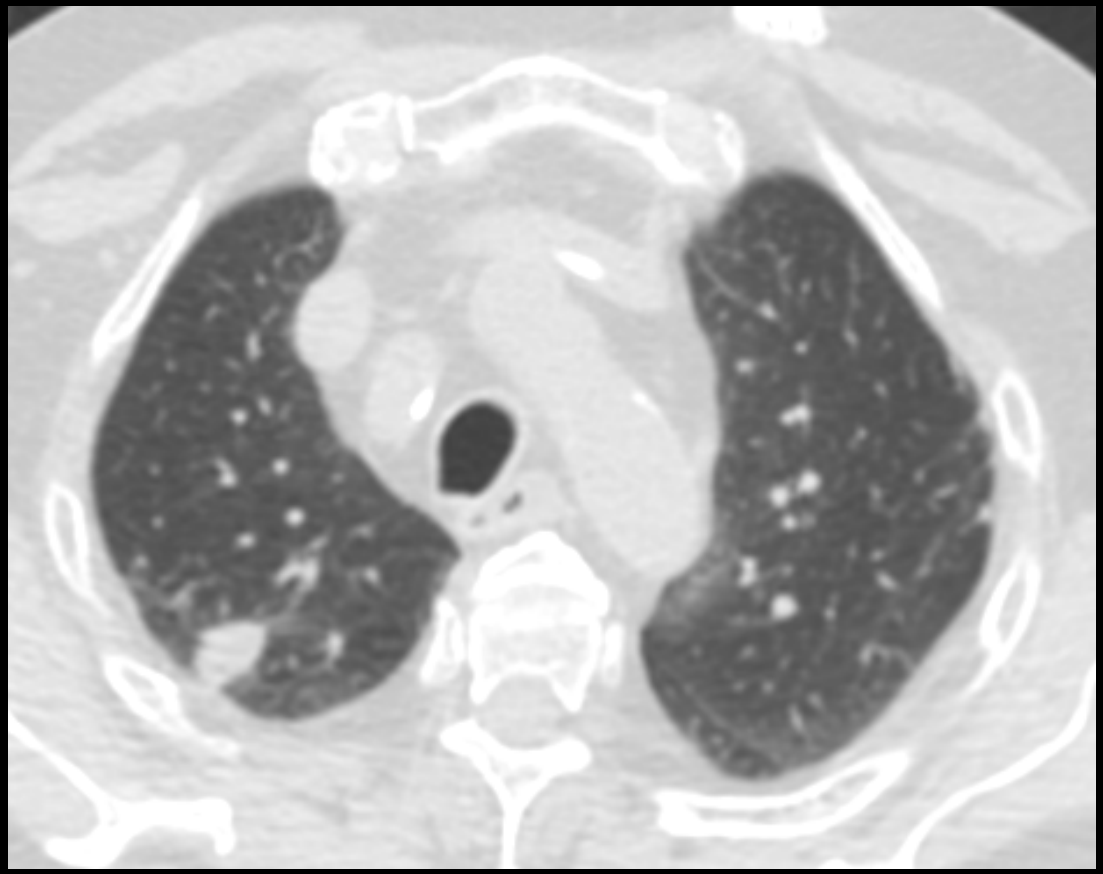
# Which statement is false?



- 1. The most common symptom from aspergilloma is haemoptysis
- 2. The source of bleeding may arise from bronchial arteries
- 3. The source of bleeding may arise from communications between pulmonary and bronchial arteries
- 4. Localised pleural thickening may occasionally be apparent
- 5. Systemic antifungal therapy is usually successful

# Case 13: Clinical History

- 78-year old male
- Colon adenocarcinoma 4 years ago
- Treatment: Avastin
- Numerous hepatic metastases
- CT and PET-CT
- No diabetus
- Previous PE



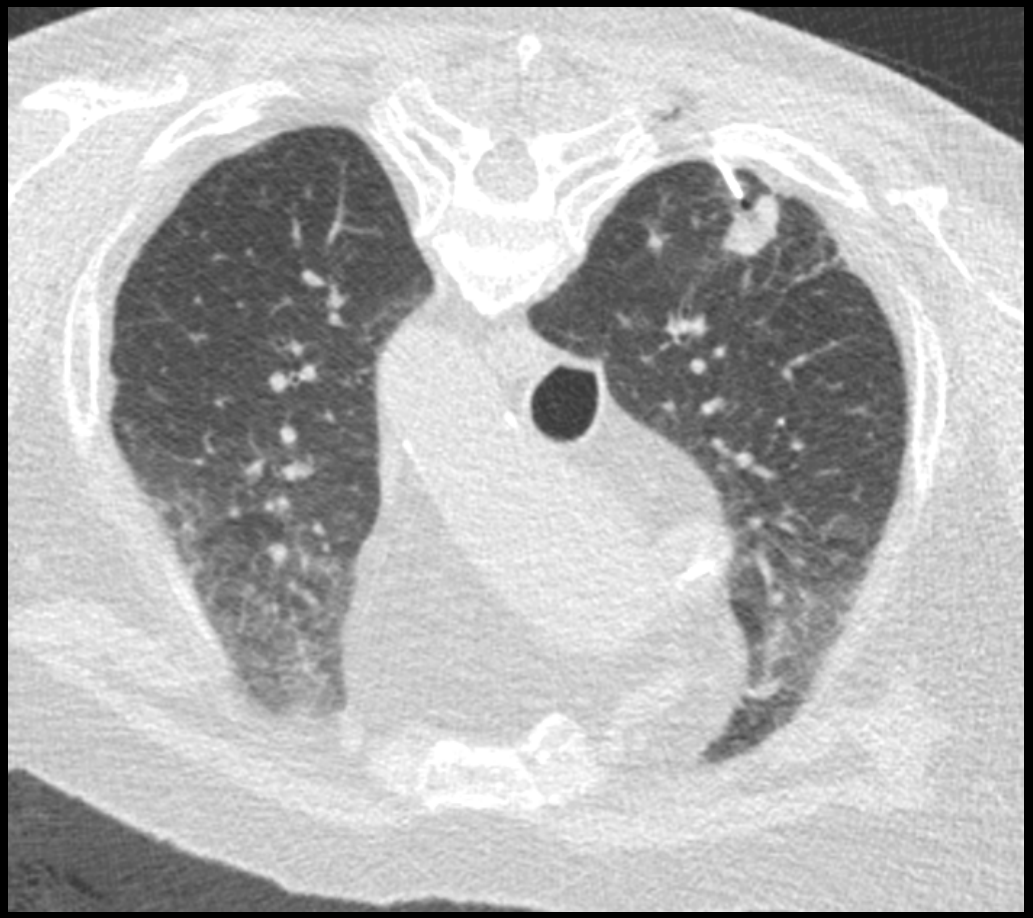
CT

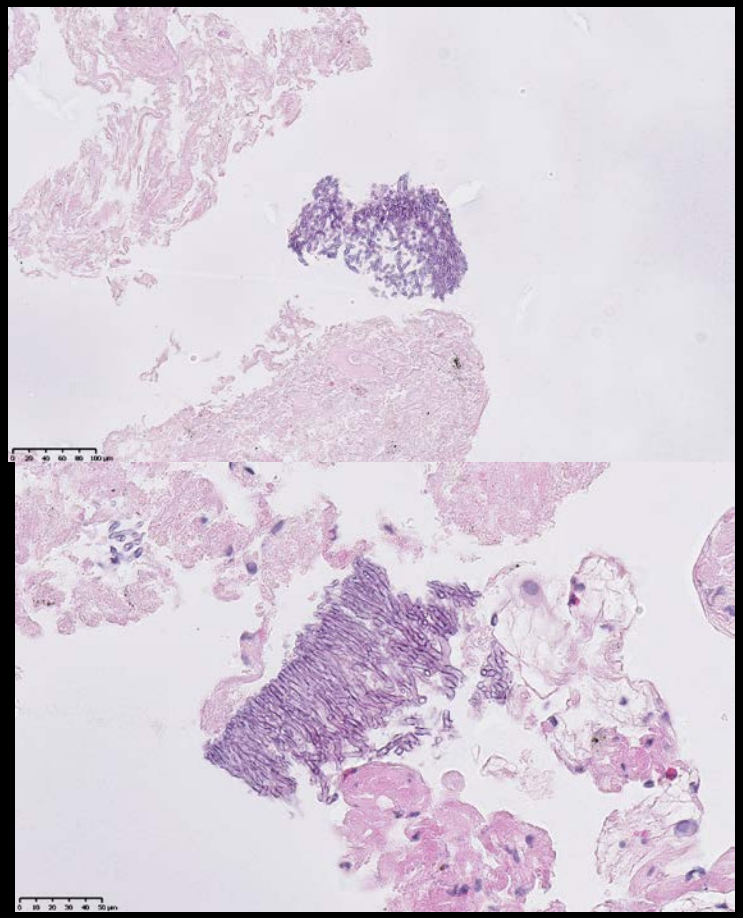
PET-CT

# What is your first diagnosis?

- 1. Colon carcinoma metastasis
- 2. Primary lung cancer
- 3. Chronic Aspergilloma
- 4. Tuberculoma
- 5. I do not know

# CT guided transthoracic biopsy





Histologic appearance from the right upper lobe biopsy demonstrates dichotomously branching hyphae, compatible with Aspergillus.

# Infectious pseudotumor of the lung

- Several pulmonary infectious diseases occasionnaly cause inflammatory lesions ressembling pulmonary carcinoma
  - Tuberculoma
  - Aspergilloma
  - Pulmonary actinomycosis
  - Coccidioidoma
- 3 related cases PET + (SUV: 3,1-8,3g/mL)

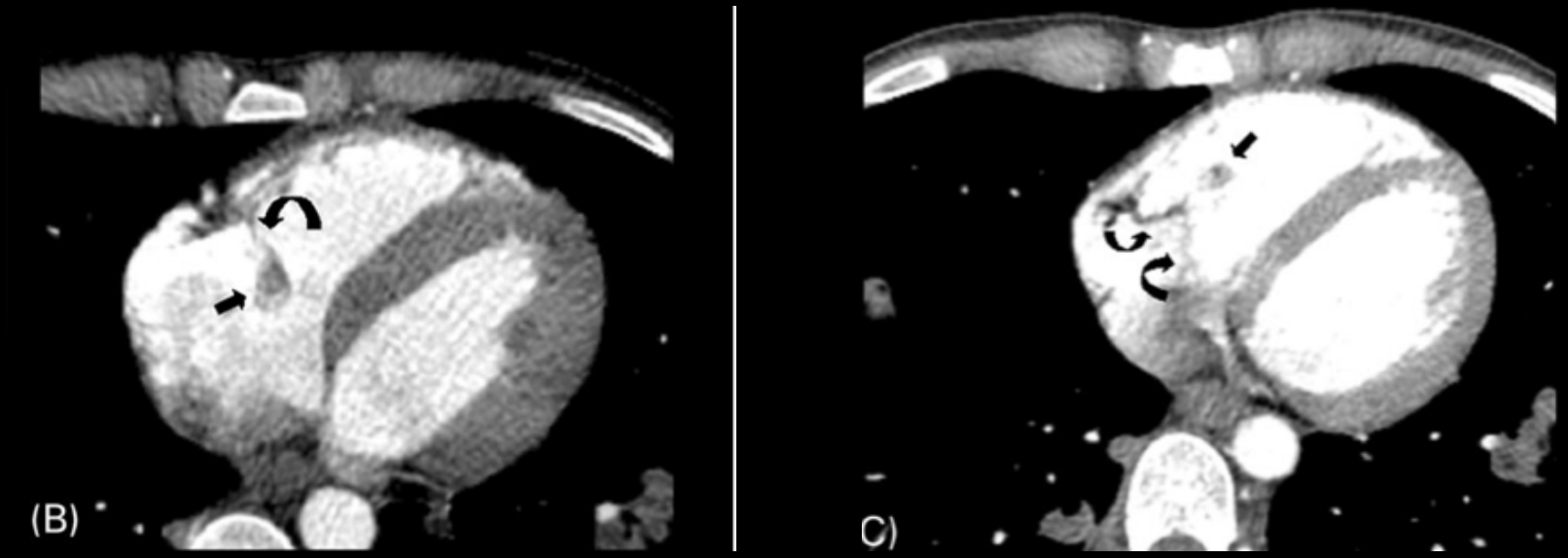
Baxter C, et al. Pulmonary aspergillosis: an alternative diagnosis to lung cancer after positive $^{18}$F FDG positron Emission tomography. Thorax (2011);66:638-640

# Case 14: Clinical History

- 27-year old woman
- Intravenous drug addict
- Treatment of a tricuspid valve endocarditis
- Clinical examination: normal cardiopulmonary auscultation
- Multiple sites of injections on both arms
- Septic arthritis of the knee
- Blood culture: staphylococcus aureus

# Chest CT

# ECG-GATED CT




E. Coche, E Mauel, C Beauloye, A Pasquet. Tricuspid valve endocarditis and septic emboli illustrated by ECG-gated multi-slice CT of the chest. Eur Heart J. Eur Heart J. 2006 Jan;27(1):20. Epub 2005 Nov 24.

# CARDIAC ULTRASOUND