

# Diagnostics from a radiological perspective

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# Overview

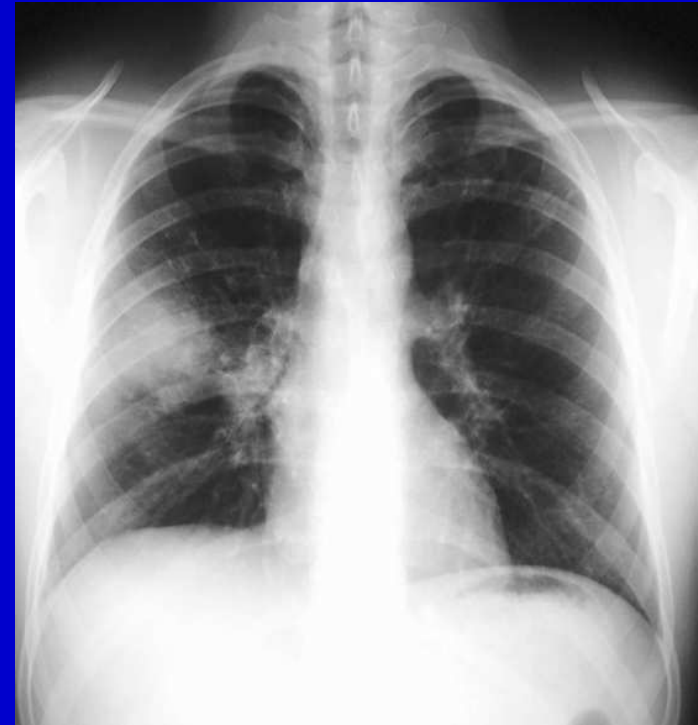
- Radiological options
- CT findings in:
  - Invasive fungal infections (IFI)
  - Candidiasis
  - Pneumocystis pneumonia
  - Aspergillosis (other than invasive)
- Discussion

# Radiological options

- CXR
- MRI
- PET
- CT

# Radiological options

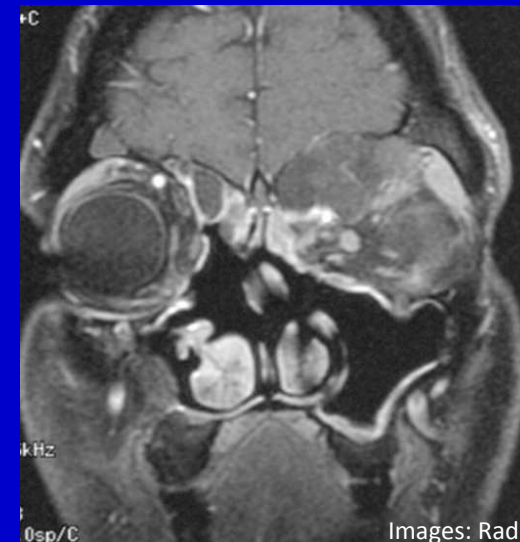
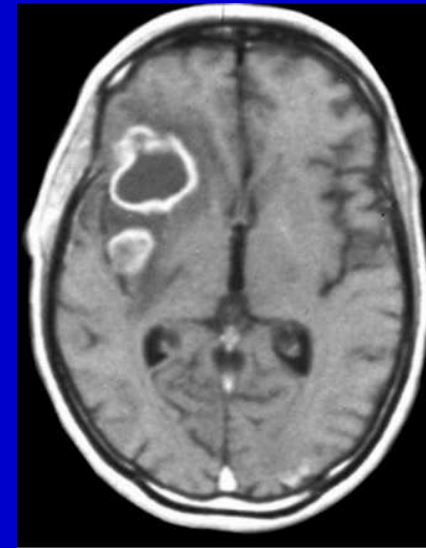
- CXR
  - Cheap and available
  - Often nonspecific
  - May be false negative
- MRI
- PET
- CT



Acta Radiol 2002 43:292-8

# Radiological options

- CXR
- MRI
  - Excellent for other areas
- PET
- CT



Images: Radiopaedia.org

# Radiological options

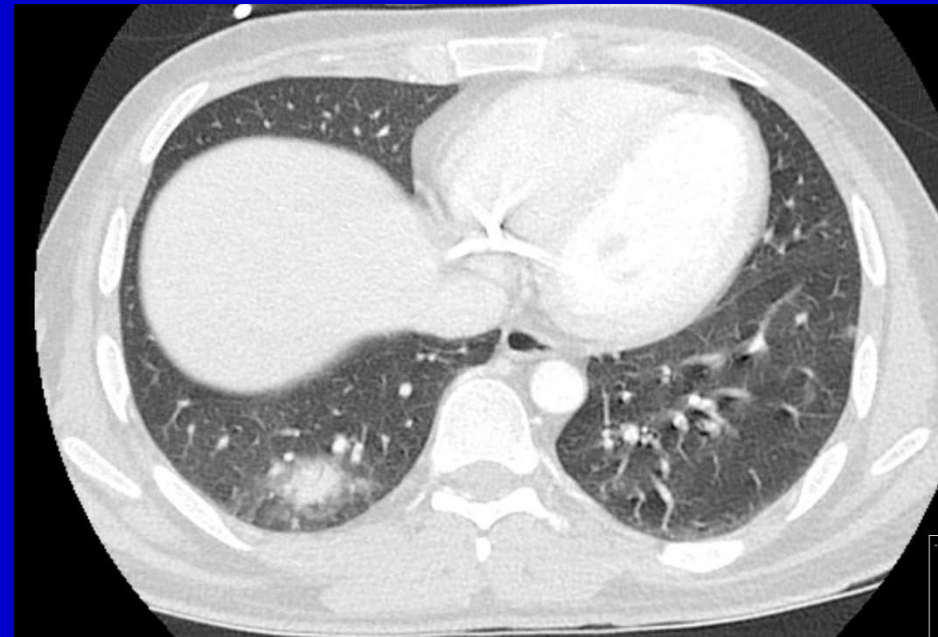
- CXR
- MRI
- PET (+FDG)
  - Cost, availability
  - Non-specific
  - Treatment surveillance?
- CT



Images: Radiopaedia.org

# Radiological options

- CXR
- MRI
- PET
- CT
  - Well documented
  - Available
  - Quick



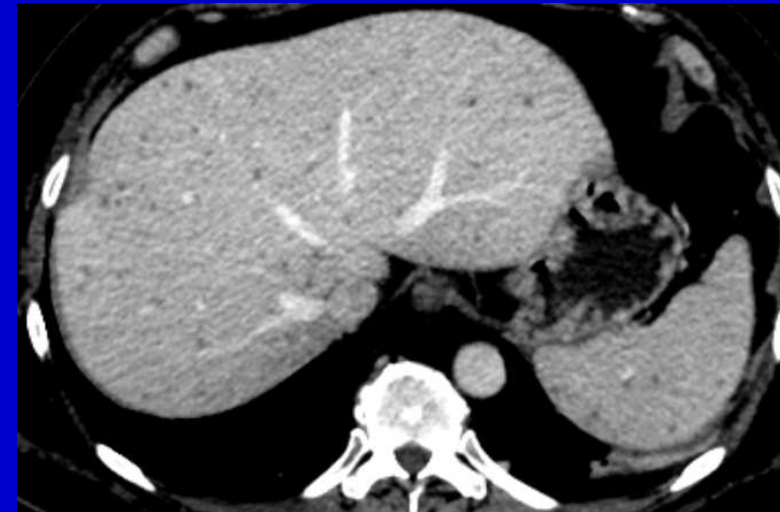
# CT –considerations

- Intravenous contrast

other differential dx ?

other sites of infection ?

Renal function, allergy ?





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# CT findings 1: Macronodules

- "ovoid, >1cm masses"
- singular or multiple
- 94,5% of patients with invasive pulmonary aspergillosis present with macronodules



[Clin Infect Dis. 2007 Feb 1;44\(3\):373-9.](#)

# CT findings 2: Halo sign (HS)

- Nodule or mass surrounded by ground-glass-opacity (GGO)
- Trombosis
- -> ischemic necrosis
- -> hemorrhage

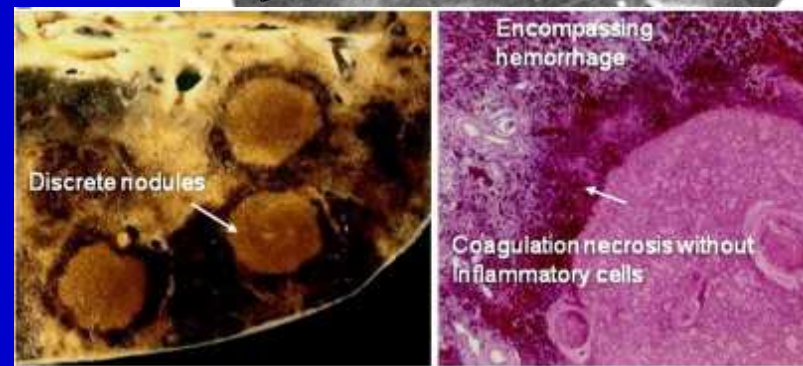
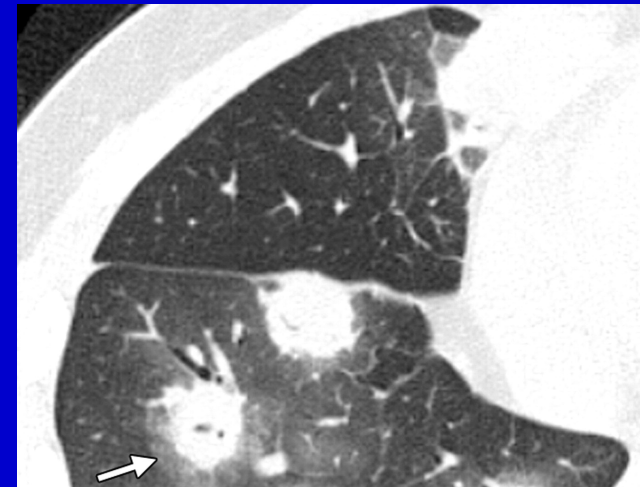


Image: Fleischner Society: Glossary of Terms for Thoracic Imaging  
And [Clin Infect Dis. May 1, 2011; 52\(9\): 1144-1155](#)

n=111	Fungal (n=21)	Bacterial (n=26)	RSV (N=30)	CMV (n=22)
macro- nodules	13	5	3	3
halo sign	10	2	3	1
ground glass opacity	1	3	4	7
consoli- dation	11	18	10	7

AJR 2005: 185:608-615

# Halo sign

- Varying incidence reported (27-96%)
- decrease over time

Caillot et al (2001)	Day 0	Day 3	Day 7	Day 14
Incidence	96%	68%	22%	19%
Brodoefel et al (2006)	Day 1	Day 4	Day 8	Day 16
Incidence	88%	63%	37%	18%

[J Clin Oncol. 2001 19\(1\):253-9](#)

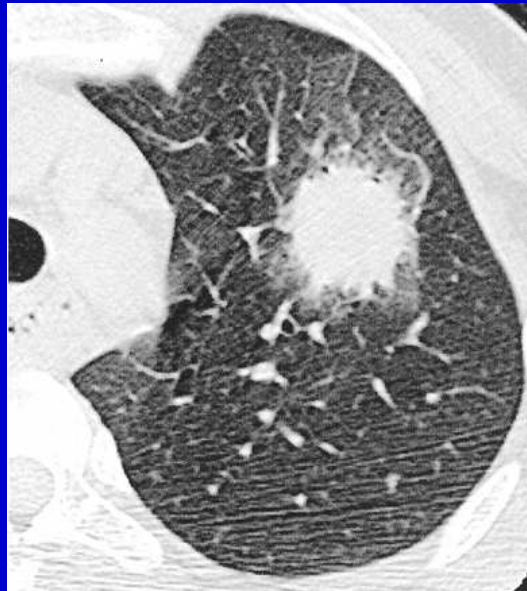
[Am J Roentgenol 2006 187:404-13](#)



# Development over time in IPA



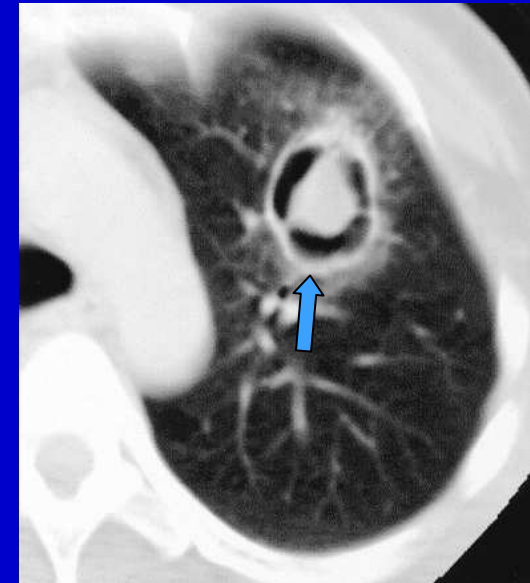
Day 0



Day 4



Day 7



Air crescent sign

[J Clin Oncol.](#) 2001 Jan 1;19(1):253-9



# Development over time in IPA

	Day 0	Day 3	Day 7	Day 14
Halo sign	24/24 100%	8/13 68%	4/18 22%	3/16 19%
Non-specific	-	4/13 31%	9/18 50%	3/16 18%
Air crescent	-	1/11 8%	5/18 28%	10/16 63%

[J Clin Oncol.](#) 2001 Jan 1;19(1):253-9

# Halo sign-differential dx

- **Fungal infections** Invasive aspergillosis Mucormycosis Pulmonary candidiasis Cryptococcosis Coccidioidomycosis Phaeohyphomycosis
- **Viral infections** Herpes simplex virus Varicella-zoster virus Respiratory syncytial virus Cytomegalovirus Myxovirus (including Influenza A)
- **Bacterial infections** *Coxiella burnetii* *Chlamydia psittaci* *Actinomyces* species Bacterial pneumonia Slow-resolving pneumonia Septic emboli
- **Mycobacterial infections** *Mycobacterium tuberculosis* *Mycobacterium avium-intracellulare*
- **Parasitic infections** *Schistosoma (haematobium, mansoni)* *Paragonimus westermani* Hydatid disease *Toxocara canis* *Ascaris suum*
- **Systemic diseases** Wegener granulomatosis Sarcoidosis Amyloidosis
- **Neoplastic diseases** Primary Bronchoalveolar carcinoma Squamous cell carcinoma Adenocarcinoma Mucinous cystadenocarcinoma Kaposi sarcoma Angiosarcoma Lymphoma Metastatic lesions Angiosarcoma Choriocarcinoma Osteosarcoma Melanoma Gastrointestinal tract/pancreatic cancer Renal cell carcinoma Lymphoma
- **Various pulmonary diseases** Cryptogenic organizing pneumonia Eosinophilic pneumonia Idiopathic hypereosinophilic syndrome Hypersensitivity pneumonia Iatrogenic injuries: pulmonary artery catheterization or transbronchial biopsy (especially in lung transplants)
- **Other** Endometriosis



# CT appearance of IFI in non-haematological patients

- Subgroups of patients IFI have lower incidence of halo sign
  - Solid organ transplant
  - AIDS
  - High dose steroids
- 25% (vs 61%) have halo
- 83 ICU pts with IPA: only 5% specific findings

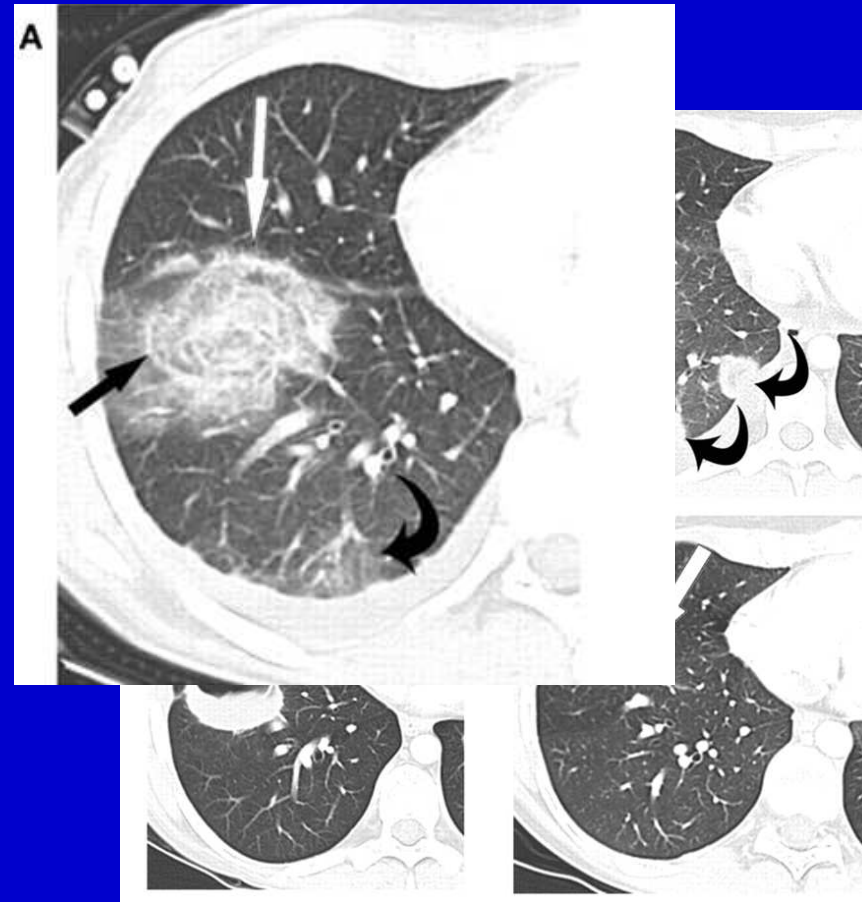
[Clin Infect Dis.](#) 2007 Feb 1;44(3):373-9

Critical Care 2006 10:R31.



## CT findings 3: Reversed Halo Sign

- Focal area of GGO surrounded by consolidating ring
- Initially described in COP
- Rare early sign in IFI
- Significantly more common in zygomycosis



Clin Inf Diseases 2008;46;1733-7

# Overview

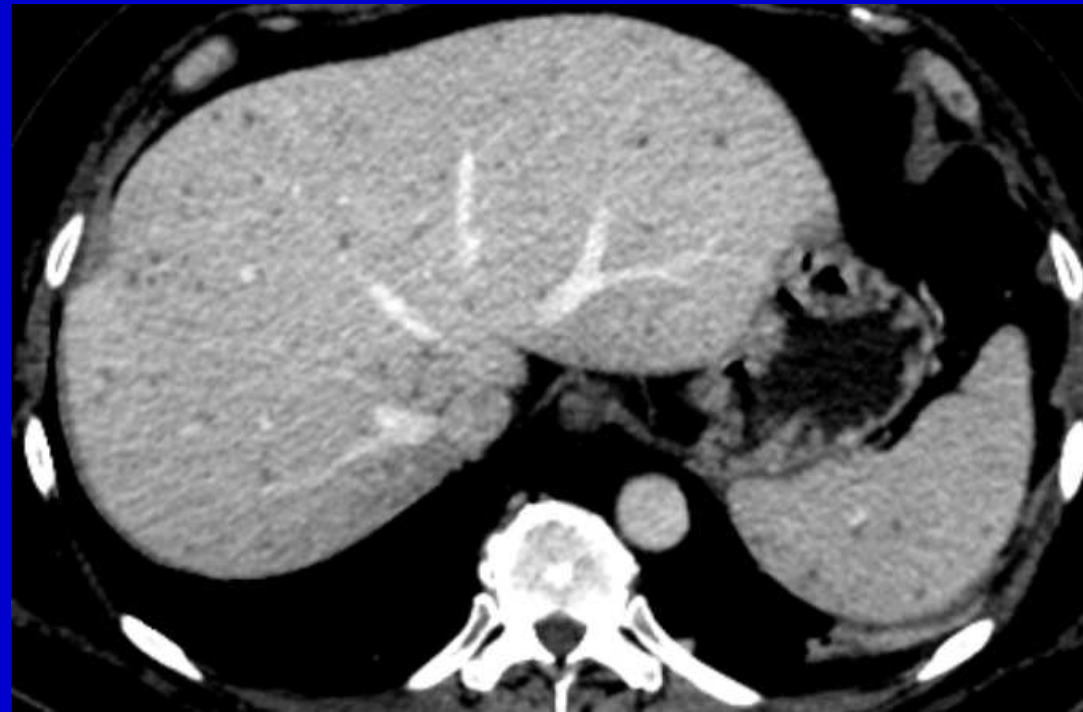
- Radiological options
- CT findings in immunocompromised hosts
  - IFI in neutropenic patients
  - Candidiasis and pneumocystis pneumonia
- CT findings in immunocompetent hosts
- Discussion

# Overview

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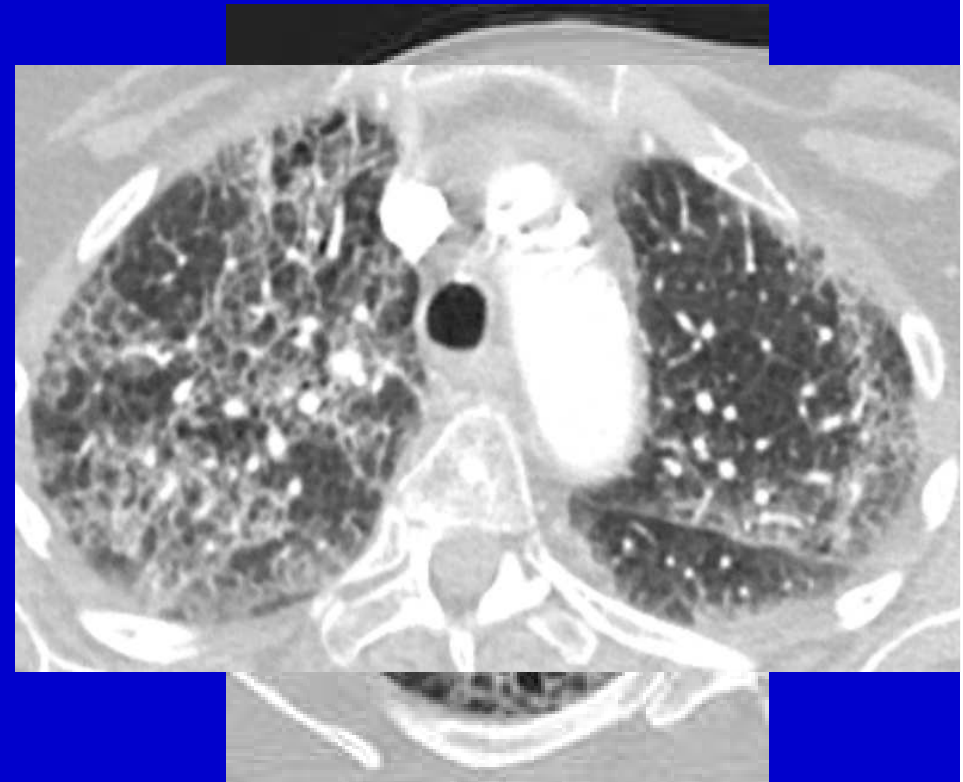
# Pulmonary candidiasis

- Lobar consolidation
- Miliar/nodular (rarely w/halo)
- Lung abscesses
- Other organs?



# Pneumocystis pneumonia

- Dominant:
  - GGO, perihilar and mid
  - Septal thickening (crazy paving)
  - Pneumatocoles (30%)
- Pleural effusions rare (<5%)
- Can be less typical when treated with prophylaxis



[Eur Radiol.](#) 2003 May;13(5):1179-84

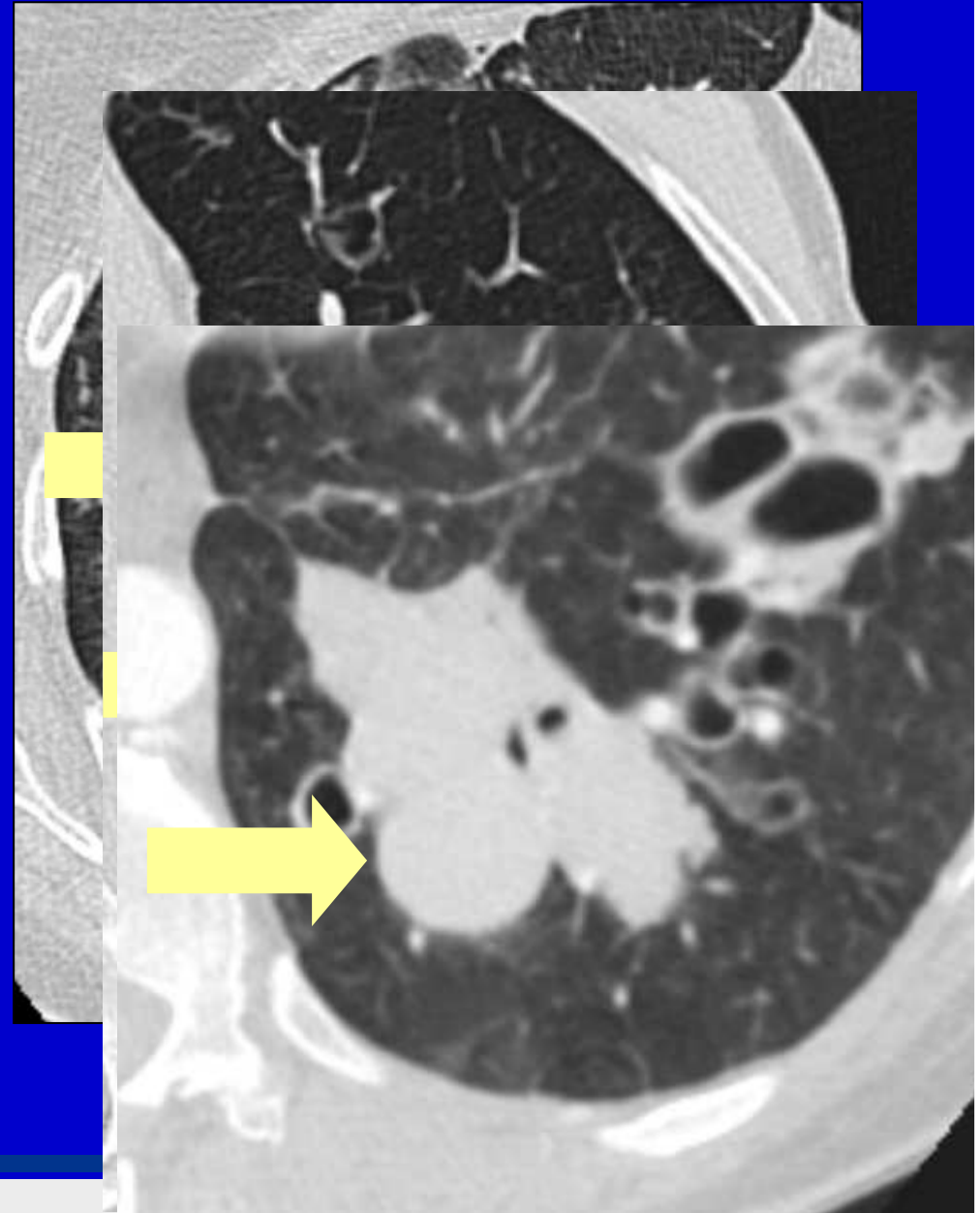
# Aspergillus infections (non-IPA)

- Allergic bronchopulmonary aspergillosis (APBA)
- Aspergilloma
- Chronic pulmonary aspergillosis

[Eur Radiol.](#) 2003 May;13(5):1179-84

# ABPA

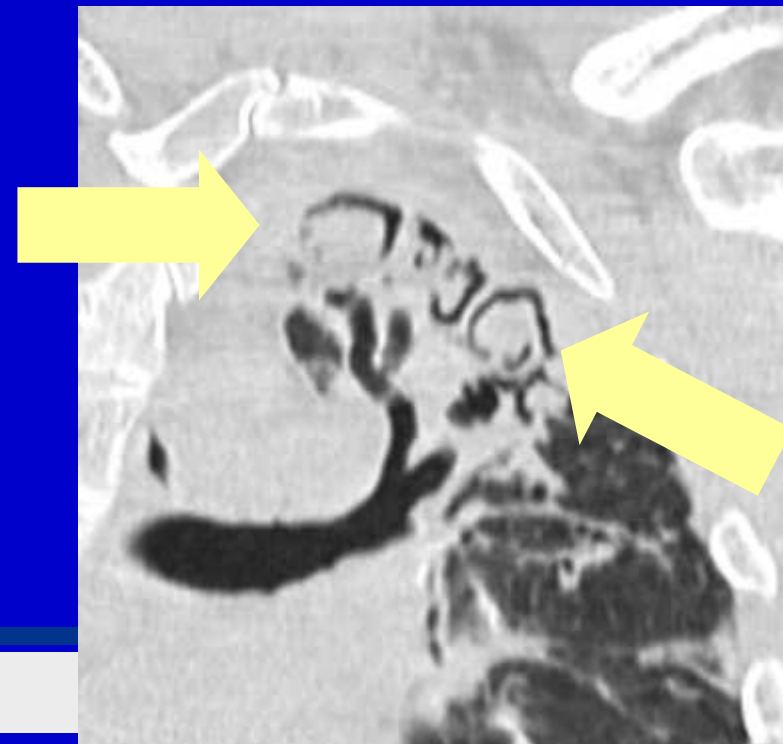
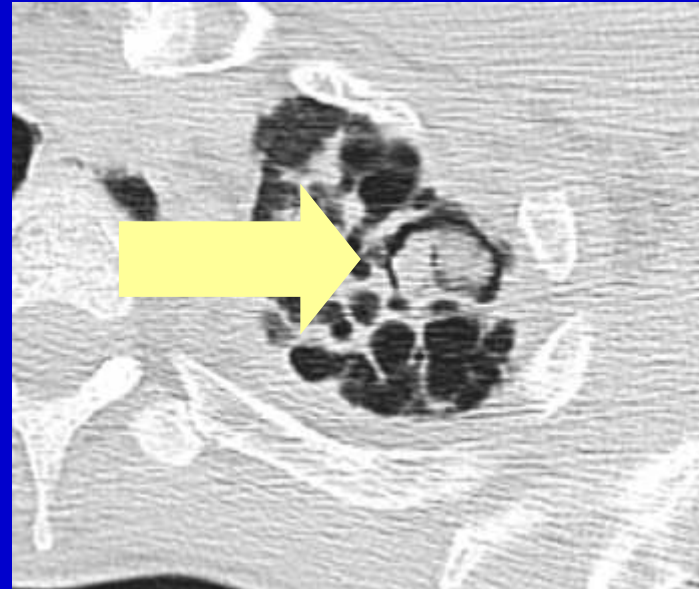
- Hypersensitivity in colonized airways
- Radiologically:
  - Central bronchiectasis
  - Bronchial wall thickening
  - Mucus plugging





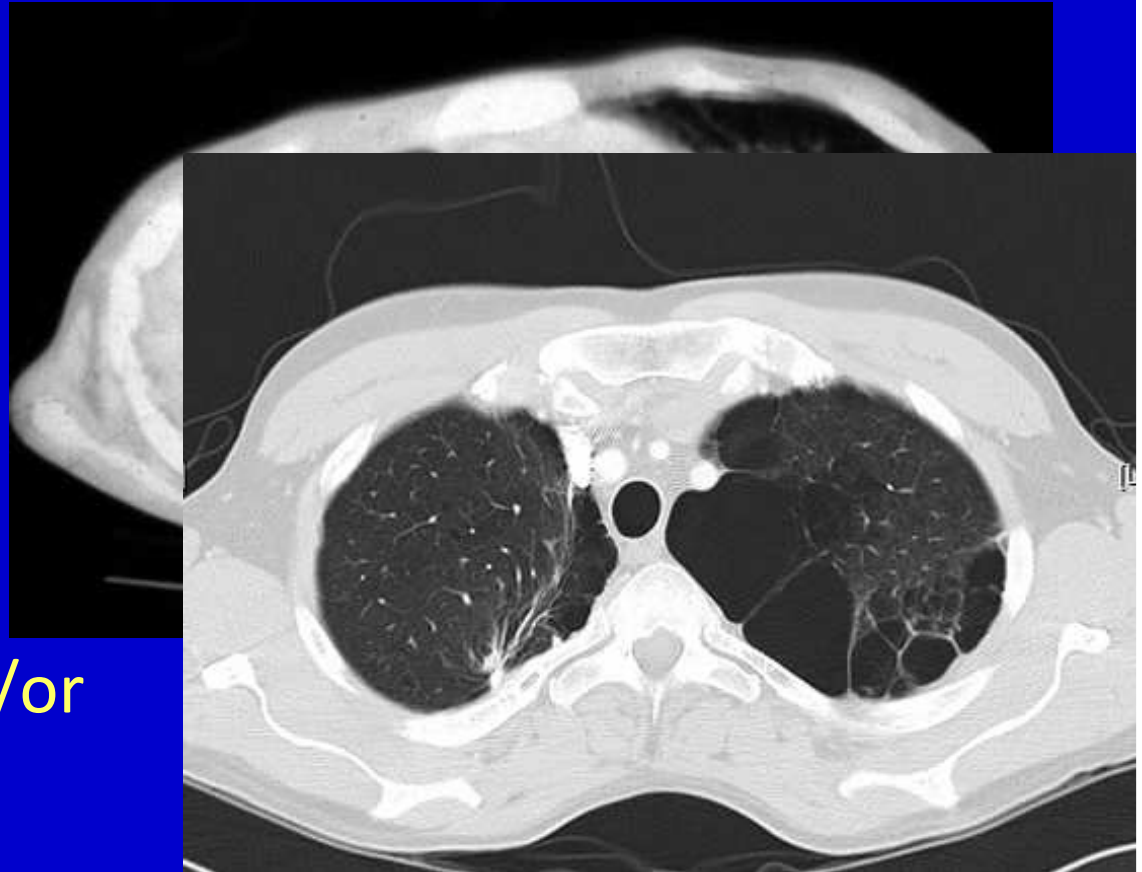
# Aspergilloma

- Aspergillus ball in preexisting cavity
- Low tendency for tissue invasion
- Complications: hemoptysis



# Chronic pulmonary aspergillosis

- Other types: necrotising and cavitary chronic pulmonary aspergillosis
- Additional consolidation and/or cavitation, GGO



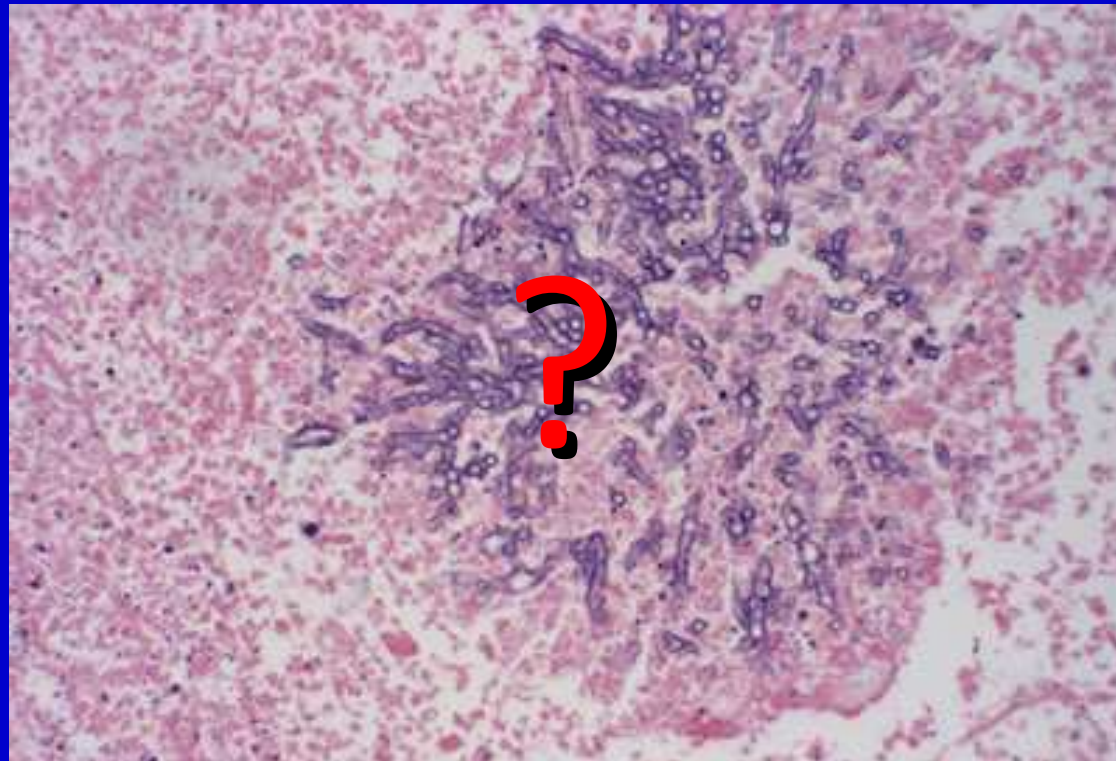
[www.aspergillus.org.uk](http://www.aspergillus.org.uk)

## Summary / «take home message»

- Large overlap between many diff dx
- Knowledge of immune status will help the radiologist narrow down diff dx
- In the neutropenic patient:
  - Halo sign most specific early finding, but
  - Crescentic sign most specific late finding

**Early CT gets the fungus!**

# Discussion



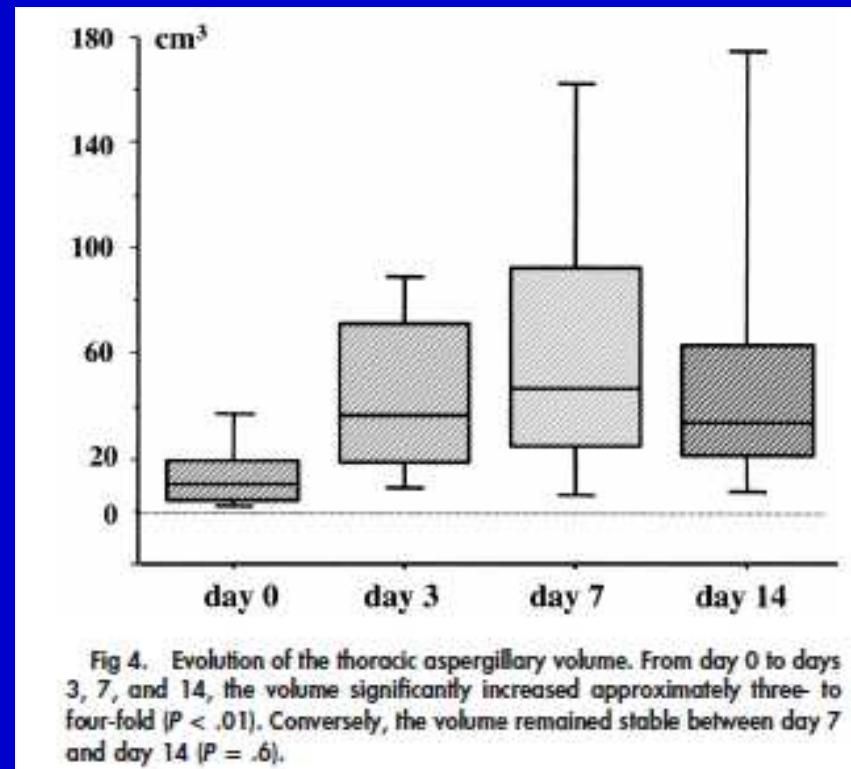


# Sources

- [www.aspergillus.org.uk](http://www.aspergillus.org.uk)
- [www.radiopaedia.org](http://www.radiopaedia.org)
- **Fleischner Society: Glossary of Terms for Thoracic Imaging**

# backup

# Development over time in IPA



[J Clin Oncol. 2001 Jan 1;19\(1\):253-9](#)