RADIOLOGIC EVALUATION OF PULMONARY NTM INFECTION

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Disclosures

None
Goals

- Identify the imaging features of pulmonary NTM infection on CT and X-ray
- Understand radiological phenotypes of pulmonary NTM infection
- Understand the role of other imaging modalities
Overview

I. CT technique

II. NTM imaging signs

III. Radiological/Clinical Phenotypes & Secondary Causes and Underlying Disease
CT Technique

- Spiral & Volumetric CT
CT Technique

- Spiral CT

- Most CTs in US.

- Quick - One breath hold (10-30 sec)

- Reconstruct in: Any plane, Any thickness, 3D
CT Technique

- HRCT (1 mm)
- Why? Fine Details!
  - “Subtle” bronchiectasis
  - Air trapping/ Semi-Functional Evaluation
  - Subtle interstitial disease (i.e. mild ILD or mild change)
CT Technique

• Our Protocol
  • HRCT for initial eval
  • Low-Dose CT if any follow-up

• CASE - 83 y/o M with indoor hot tub. + NTM sputum
CT Technique

- HRCT (1 mm)

- Often reconstructed from Spiral CT

- Often also:
  1) End expiration (air trapping)
  2) Possible Prone
Slice Thickness

NTM from same CT, with 3 different thickness reconstructions

1.5 mm  3 mm  5 mm
CT Technique

- **Contrast?**
  - Usually not needed
  - Use for “Soft Tissue”
    - Mediastinum/Hila?
    - Pleural evaluation?
  - Chest wall?
NTM Imaging Signs

- Tree-In-Bud and Centilobular Nodules
- Bronchiectasis
- Cavities
- Ground-Glass and Consolidation
- Atelectasis
NTM Imaging Signs

Example Case - RML and Lingula
- Where we are going
NTM Imaging Signs

• **Centrilobular Nodules and Tree-In-Bud**

- Typically from Airways

- Infection, Infection, Mucus Plugs/Aspiration…
NTM Imaging Signs

- *Bronchiectasis*
NTM Imaging Signs

- Bronchiectasis
NTM Imaging Signs

- Bronchiectasis
NTM Imaging Signs

- **Bronchiectasis**
Slice Thickens

Bronchiectasis?

5 mm

1 mm

Maybe?

Yes!

Bronchi bigger than arteries
Slice Thickens

Bronchiectasis?

5 mm

Yes!
Bronchi bigger than arteries

1 mm

Maybe?
NTM Imaging Signs

- Cavities - and “feeding bronchus” sign

Kim et al AJR 2005; 184:1247-1252
NTM Imaging Signs

- Cavities
NTM Imaging Signs

- Cavities
NTM Imaging Signs

- Cavities - and “feeding bronchus” sign
NTM Imaging Signs

- Cavities - and “feeding bronchus” sign

Kim et al AJR 2005; 184:1247-1252
NTM Imaging Signs

- Consolidation and Ground-Glass
NTM Imaging Signs

- Consolidation and Ground-Glass
NTM Imaging Signs

• Atelectasis
NTM Imaging Signs

- Atelectasis
NTM Imaging Signs

- Atelectasis
Aside: NTM with *Normal CXR*
Overview

I. CT technique

II. NTM imaging signs

III. Radiological/Clinical Phenotypes & Secondary Causes and Underlying Disease
Radiological/Clinical Phenotypes of NTM

I. Bronchiectasis/Tree-in-bud
   - Right middle lobe/lingular bronchiectasis

II. Upper Lobe Cavities

III. Solitary Pulmonary Nodule

IV. NTM superimposed on underlying disease
   - Chronic Obstructive Pulmonary Disease (COPD)
   - Idiopathic Pulmonary Fibrosis (IPF)
   - Cystic Fibrosis (CF)

V. Hot Tub Lung
CASE 1
- **Mild**
- Look for active disease
  - Tree-in-bud, consolidation
    - possible
    - look for stability (\& clinical)
  - GGO
    - typically active inflammation
Radiological/Clinical Phenotypes of NTM

1. Bronchiectasis & Tree-in-Bud - CASE 1

CASE 1
• **Mild**
• Look for active disease
  • Tree-in-bud, consolidation
    • possible
    • look for stability, (*clinical*)
• GGO
  • typically active inflammation
Radiological/Clinical Phenotypes of NTM

I. Bronchiectasis & Tree-in-Bud - CASE 1

- **Mild** - no significant/minimal air trapping
Radiological/Clinical Phenotypes of NTM

1. Bronchiectasis & Tree-in-Bud - CASE 2

CASE 2
- Note RUL cystic bronchiectasis
- More severe:
  - Nodules/nodular consolidations
  - Bronchiectasis
CASE 2

Progression from 2011-2014

2011

2014
Radiological/Clinical Phenotypes of NTM

I. Bronchiectasis & Tree-in-Bud - CASE 2

CASE 2
- More severe, progressive
- Cavity formation
CASE 3
- RUL Cavity.
- Also bronchiectasis elsewhere
- Note soft tissue in cavity:
  - Debris?
  - Fungus?
  - Rare cancer?
    - Progressive enlarging solid
Radiological/Clinical Phenotypes of NTM

II. Upper Lobe Cavities - CASE 3
II. Upper Lobe Cavities - CASE 4

CASE 4 - More severe/“Classic” upper lobe cavitary dz.
Radiological/Clinical Phenotypes of NTM

II. Upper Lobe Cavities - CASE 4
CASE 5 -
“Upper” lobe cavitary dz. Mixed Change. Overall worsening
CASE 5

- Mixed change with progression
- Developed broncho-cutaneous fistula. Rare. Here after surgery.
- Broncho-pleural fistula still rare, but more common
CASE 6
• Solitary nodule.
  • less common.
• Must still rule out other causes of nodule (i.e. neoplasm)
CASE 7
- Solitary “Cavity”
- Not squamous neoplasm?
Radiological/Clinical Phenotypes of NTM

IV. NTM & underlying lung disease

Risk factors for pulmonary NTM

- Often underlying lung disease
  - Structural
  - Non-structural

- Radiology also has role also in underlying disease

HOST-RISK FACTORS
  **ANATOMIC**
  - Prior bronchiectasis
  - Emphysema
  - Pneumoconiosis
  - Chronic aspiration
  - Calcified chest adenopathy

**IMMUNOLOGIC-GENETIC**
- Cystic fibrosis, CFTR anomalies
- Alpha-1-antitrypsin anomalies
- Pulmonary alveolar proteinosis
- Partial deficiency in IFN-γ(?)
- TNFα antagonists*

ENVIRONMENTAL EXPOSURE
- Aerosolized water (hot tubs, showerheads)
- Aerosolized soil exposure
- Residence in SE United States

Host-susceptible phenotype of unknown cause
- Slender individuals with Marfanoid body habitus (scoliosis, pectus excavatum, mitral valve prolapse)

IV. NTM & underlying lung disease - CASE 8

Radiological/Clinical Phenotypes of NTM

NTM in COPD/Emphysema

- Cavities can form:
  - with bronchiectasis
  - OR in preexisting disease
- Can "spill" contents
Radiological/Clinical Phenotypes of NTM

IV. NTM & underlying lung disease - CASE 8
Radiological/Clinical Phenotypes of NTM

IV. NTM & underlying lung disease - CASE 9

NTM in Chronic Aspiration

- Nothing Specific with known NTM

Few months later

- Migratory Ground-Glass/Consolidation *most* suggestive
- Location? Anywhere, but:
  - lower-posterior - most common.
  - unilateral - sided sleeper?
  - upper - gardening, yoga, cough?
Radiological/Clinical Phenotypes of NTM

IV. NTM & underlying lung disease - CASE 9

Inspiratory

Expiratory
Radiological/Clinical Phenotypes of NTM

IV. NTM & underlying lung disease- CASE 9

Aspiration Work-up

1. Esophogram
   - Also evaluates dysmotility
   - Only 2 min intermittent for GERD

2. Tailored Barium Swallow with “Speech Pathology”
   - Oral motility issues

3. Esophageal pH testing
IV. NTM & underlying lung disease - CASE 10

**NTM in Adult CF** - often NOT specific findings
Radiological/Clinical Phenotypes of NTM

IV. NTM & underlying lung disease - CASE 10

NTM in Adult CF

Fatty Pancreas Replacement

ALSO TBM

Inspiratory

Expiratory

Dynamic Expiratory
- over 70% from Insp.
IV. NTM & underlying lung disease - CASE 11

Radiological/Clinical Phenotypes of NTM

NTM in Adult CF - example 2
- more “classic” upper lung adult CF
- but normal pancreas
Radiological/Clinical Phenotypes of NTM

IV. NTM & underlying lung disease- CASE 12

NTM in Silicosis
Radiological/Clinical Phenotypes of NTM

IV. NTM & underlying lung disease - CASE 13

NTM in IPF
Radiological/Clinical Phenotypes of NTM

IV. NTM & underlying lung disease - CASE 14

NTM in RA with TNF antagonist
Radiological/Clinical Phenotypes of NTM

IV. NTM & underlying lung disease- CASE 14

NTM in RA/TNF antagonist
Radiological/Clinical Phenotypes of NTM
IV. NTM & underlying lung disease - CASE 15

NTM in Tracheobronchomegally (aka. Mounier-Kuhn syndrome)

- *Congenital* large central airways
Radiological/Clinical Phenotypes of NTM

V. Hot Tub Lung- CASE 16

“Hot Tub Lung”

- Ground-Glass
- Centrilobular nodules
"Hot Tub Lung"
- Air-trapping essentially always present
- Could be only finding by CT
- Normal CXR in 20+%
PET/CT and NTM

- NTM will cause increased uptake (like most infections)
- SUV typically about 8.5 (4.4-9.7)
- So caution in evaluating for cancer with NTM

- May be useful for disease activity/response (but higher radiation)
  - Hahm et al. Lung. 2010 Jan-Feb;188(1):25-31
PET/CT and NTM

• Lung Cancer with NTM
MRI and NTM

• Cavities - Excellent
• Good but not perfect for other findings. (may miss small/mild findings and change)
• NO Radiation

References


