Bronchiectasis and Lung abscess

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• Bronchiectasis is defined as permanent and abnormal dilatation of the bronchi
• It is a radiological/pathological diagnosis
• Generally speaking, a bronchus is considered to be dilated if the broncho-arterial ratio (its internal diameter divided by the diameter of its accompanying artery) exceeds 1
• Affects lower lobes preferentially
– Permanent **dilation of bronchi**
– peri-bronchial inflammation and organization (fibrosis)
– Can sometimes see **mucopurulent debris in bronchioles**
Figure 1. A "vicious circle" hypothesis of the pathogenesis of bronchiectasis.
Pathophysiology

- Principally affects the medium-sized bronchi, but often extends to the more distal bronchi and bronchioles.
- The affected bronchi show transmural inflammation, mucosal edema, cratering, ulceration, and neovascularization.
- The bronchial epithelium may show a polypoidal appearance due to underlying granuloma formation and mucosal prominence.
- Dilated and tortuous bronchial arteries may be seen secondary to the development of extensive bronchial-pulmonary anastomoses.
Microscopically......

• Bronchiectasis is associated with
  – Loss of cilia,
  – Cuboidal and squamous metaplasia,
  – Hypertrophy of bronchial glands, and lymphoid hyperplasia.
  – Intense infiltration of the bronchial wall with neutrophils, lymphocytes, and monocytes
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<thead>
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<tbody>
<tr>
<td>Immunodeficiency</td>
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<td>Young syndrome</td>
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<td>Aspiration</td>
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<td>Primary ciliary dyskinesia</td>
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<td>Childhood respiratory infection</td>
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<td>Rheumatoid arthritis</td>
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<tr>
<td>Cystic fibrosis</td>
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<td>4</td>
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<tr>
<td>Idiopathic</td>
<td>35</td>
<td>80</td>
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<td>Ulcerative colitis</td>
<td>0</td>
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Clinical features

- History of recurrent chest infections,
- **Cough**: invariably present
- **Expectoration**: Purulent, tenacious sputum production, frequently worse in the morning
- “Dry bronchiectasis” presenting as cough, minimal sputum expectoration, and/or hemoptysis is occasionally described.
- **Hemoptysis**: 40 to 70%
- Increasing cough, dyspnea, and volume and colour of sputum, fever are hallmarks of acute exacerbations.
Physical examination

• Pleuritic chest pain occurs in 50 percent of patients and reflects the presence of distended peripheral airways or distal pneumonitis adjacent to a visceral pleural surface

• Chest auscultation usually reveals findings of early and mid-inspiratory crackles as well as diffuse rhonchi and prolonged expiration

• Clubbing: seen less commonly
Symptoms due to

• accumulation of pus in dilated bronchi
  – Chronic productive cough, often copious and purulent
  – worse in mornings,
  – Often brought on by change of posture
• Inflammatory changes in lung or pleura
  – Fever, pain etc
• Hemoptysis
Classification of bronchiectasis by REID

a) Tubular (or cylindrical) bronchiectasis.

- The bronchi are regularly outlined (tubular), dilated in diameter, with straight walls, often coming to a straight abrupt end, instead of a tapering end, due to obstruction of the peripheral bronchial tree by secretions, casts, and inflammatory wall edema.
- This is the dominant form currently seen.
b) **Varicose bronchiectasis.**

Presence of irregular dilatations, outpouchings, and tortuosity of the airways. characterized by focal constrictive areas along the dilated airways that result from defects in the bronchial wall.
c) **Cystic bronchiectasis.**

Dilatation and cystic distortion of the distal airways that may be focal or more generalized, resulting in saccules that appear as a cluster of grapes. This finding is indicative of severe form of bronchiectasis.
Three types of focal airway obstruction

- Luminal blockage by a foreign body, broncholith, or slowly growing tumor.
- Extrinsic narrowing due to enlarged lymph nodes. The best example is the middle lobe syndrome, which involves a small angulated orifice surrounded by a collar of lymph nodes that may enlarge and encroach on the main airway after infection with granulomatous diseases due to mycobacteria or fungi.
- A third type of obstruction is twisting or displacement of the airways after a lobar resection (for example, the occasional cephalad displacement of a lower lobe after surgery for the resection of the upper lobe).
- Recurrent or persistent lobar pneumonia is a key distinguishing feature of the first two types of focal bronchiectasis and is important to recognize, since interventional bronchoscopcy or surgery may offer palliation and sometimes cure.
<table>
<thead>
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<th>TABLE 2</th>
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<tbody>
<tr>
<td>Causes of Bronchiectasis</td>
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<tr>
<td><strong>Postinfection</strong></td>
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<tr>
<td>Bacteria: necrotizing pulmonary infections</td>
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<tr>
<td>Mycobacteria: tuberculosis, nontuberculous mycobacteria</td>
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<tr>
<td>Viruses: adenovirus, measles</td>
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<tr>
<td>Fungi</td>
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<tr>
<td><strong>Bronchial obstruction</strong></td>
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<tr>
<td>Intrinsic: stenosis from scarring, broncholiths, foreign body, tumor</td>
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<tr>
<td>Extrinsic: diseased lymph nodes, tumor, aneurysm</td>
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<tr>
<td><strong>Immune deficiency:</strong></td>
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<tr>
<td>Primary</td>
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<tr>
<td>Antibody deficiency (agammaglobulinemia, common variable immunodeficiency, activation-induced deaminase deficiency, antibody deficiencies with normal immunoglobulin titers, etc.)</td>
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<tr>
<td>Combined immunodeficiency (transmembrane peptide transporter deficiency, etc.)</td>
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<tr>
<td>Other (Wiskott-Aldrich syndrome, high immunoglobulin E titer, defective neutrophil function, etc.)</td>
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<tr>
<td>Secondary: chemotherapy, transplant, hematologic neoplasm, human immunodeficiency virus infection</td>
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<tr>
<td><strong>Impaired mucociliary clearance</strong></td>
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<tr>
<td>Cystic fibrosis</td>
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<tr>
<td>Primary ciliary dyskinesia</td>
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<tr>
<td>Young syndrome</td>
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<tr>
<td><strong>Inflammatory pneumonitis</strong></td>
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<tr>
<td>Aspiration, gastroesophageal reflux disease</td>
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<td>Toxic inhalation (drugs, gases, etc.)</td>
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<tr>
<td><strong>Structural airway abnormalities</strong></td>
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<tr>
<td>Tracheobronchomegaly (Mounier-Kuhn syndrome)</td>
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<td>Cartilage defects (Williams-Campbell syndrome)</td>
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<tr>
<td>Pulmonary sequestration</td>
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<tr>
<td>Tracheobronchomalacia</td>
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<tr>
<td>Tracheal bronchi</td>
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<tr>
<td><strong>Associated with other diseases</strong></td>
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<tr>
<td>Systemic diseases: rheumatoid arthritis, systemic lupus erythematosus, Sjögren syndrome, Marfan syndrome, relapsing polychondritis, ankylosing spondylitis, sarcoidosis</td>
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<td>Inflammatory bowel disease: ulcerative colitis, Crohn disease</td>
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<tr>
<td>Other respiratory diseases: asthma, chronic obstructive pulmonary disease, Swyer-James syndrome</td>
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<tr>
<td>α1-antitrypsin deficiency, yellow nails syndrome</td>
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<tr>
<td>Aspergillosis or allergic bronchopulmonary mycosis</td>
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<tr>
<td>Diffuse panbronchiolitis</td>
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<tr>
<td>Unknown cause</td>
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</table>
• **Bronchiectasis** in patients with allergic bronchopulmonary aspergillosis (ABPA) is due to an immune reaction to aspergillus, the actions of mycotoxins, elastase, and interleukin-4 and interleukin-5, and in later stages, the direct invasion of the airways by the fungus.
• primary ciliary dyskinesia have Kartagener's syndrome (bronchiectasis, sinusitis, and situs inversus or partial lateralizing abnormality)
• humoral immunodeficiency syndromes involving deficiencies of IgG, IgM, and IgA are at risk for recurrent suppurative sinopulmonary infections and bronchiectasis.
BRONCHIECTASIS
THE CHEST RADIOGRAPH

- Often normal if not severe
- Too many white lines extending from the hila = tram-tracks
- Elongated (tubular) opacities (white)
- Small circles containing air (black) or fluid and air (air-fluid level)
MILD BRONCHIECTASIS
Normal chest radiograph presents with hemoptysis
MODERATE BRONCHIECTASIS
- Coarse white lines extending out from hila
TOO MANY WHITE LINES
SEVERE BRONCHIECTASIS
SEVERE BRONCHIECTASIS

Circle filled with air
SEVERE BRONCHIECTASIS
RINGS (CYSTS) CONTAINING AIR-FLUID LEVELS
BRONCHIECTASIS
THE CT SCAN

• Signet ring sign
• Tram-tracks
• String of beads
• Circles filled with air or air and fluid
• Tubular and branching opacities
• Bronchi visible within 1 cm of the pleura
• Scarring
Normal pulmonary artery (pearl)

Dilated bronchus (ring)

SIGNET-RING SIGN
Dilated bronchus

BRONCHIECTASIS
Bronchi visible within 1 cm of the pleura

String of beads
Bronchiectasis

Destroyed lung (Scarring)
Worse in the upper lung zones
Dilated bronchi filled with mucus instead of air due to proximal obstruction
IMMOTILE CILIA SYNDROME

- Diffuse bronchiectasis
- May have situs inversus (Kartagener’s syndrome)
Bronchiectasis

Dextrocardia

Bronchiectasis

KARTAGENER’S SYNDROME
Bronchiectasis

KARTAGENER’S SYNDROME
Kartagener's Syndrome

- Dextrocardia
- Dilated bronchus
Spirometry

- often shows a limitation of airflow, with a reduced ratio of forced expiratory volume in one second (FEV1) to forced vital capacity (FVC), a normal or slightly reduced FVC, and a reduced FEV1.
- A reduced FVC may indicate that airways are blocked by mucus
Complications of bronchiectasis

- Pneumonia
- Abscess
- Septicaemia
- Empyema
- “Metastatic” abscess
- Amyloidosis
Treatment

• Control of infection: Since infection plays a major role in the causation and perpetuation of bronchiectasis (exacerbations), reducing the microbial load and associated inflammatory mediators remains a cornerstone of therapy.

• Antibiotics: for treatment of exacerbations and as prophylactic to prevent exacerbations by suppression and/or elimination of attendant flora.

• Usual duration – 10-14 days
Bronchial hygiene

• Chest percussion and postural drainage have been the traditional method of facilitating mucus clearance.
• Labor intensive, Hypoxemia and chest discomfort
• Autogenic drainage, mechanical vibration with ultrasonic devices, positive expiratory pressure, and Flutter valve use without the assistance of another caregiver have been shown to achieve good chest clearance provided the patient has motivation, breath control, and the neuromuscular function to perform.
Mucus clearance

- Proper hydration
- Humidification of air
- Nebulized saline, N-acetylcysteine
Bronchodilators

- Bronchiectasis is usually associated with signs of airway obstruction and hyperreactivity
- Anti-inflammatory Therapy: Nebulized steroids
Surgery

- Massive/recurrent hemoptysis
- Fungal colonization
- Recurrent/intractable symptoms
  - Lobectomy/ pneumonectomy
  - Bronchial artery embolization
Primary insult, e.g., infection, immunodeficiency, inflammation, abnormal airway anatomy

Airway clearance
Mucolytics

Impaired mucociliary clearance

Acute/chronic bacterial infection

Persistent inflammation

Antibiotics

Anti-inflammatory drugs

Lobectomy
Lung transplant

Irreversible fibrotic changes
Pulmonary hypertension
Initial assessment

Management of exacerbations
- Patient educated to recognise clinical deterioration
- Antibiotics
- $\uparrow$ mucociliary and cough clearance
- $\uparrow$ use of bronchodilators
- If no improvement in 2–3 days may need escalated treatment (e.g. change in antibiotics or hospitalisation)

Management of clinically stable disease
- Regular mucociliary and cough clearance (physiotherapy, mannitol/saline)
- Bronchodilators as required
- Vaccination
- Treat any underlying cause (e.g. hypogammaglobulinaemia)
- Consider long-term antibiotics
- Consider multidisciplinary team
- Management of upper airway disease

Follow up
- Initively review every 6–12 months (more if required)
- Yearly lung function
- Identify rapidly deteriorating patients or those with severe disease

Rapidly deteriorating/severe disease
- Refer to multidisciplinary team/specialised centre
- Try to identify any pathogens not responsive to standard antibiotics
- Echocardiogram and oxygen assessment
- Consider referral for transplant or palliation
The goals of surgery

• removal of an obstructing tumor or the residue of a foreign body;
• the elimination of the segments or lobes that are the most damaged and that are suspected of contributing to acute exacerbations, overwhelming viscous secretions, mucous impaction, and plugs;
• the elimination of areas that are subject to uncontrolled hemorrhage;
• the removal of damaged lung suspected of harboring problematic organisms.
SURGERY

• Removal of destroyed lung partially obstructed by a tumor or the residue of a foreign body.
• Reduction in acute infective episodes occurring in the same pulmonary segment.
• Reduction in overwhelming purulent and viscid sputum production from a specific lung segment.
• Elimination of bronchiectatic airways causing poorly controlled hemorrhage; or removal of an area suspected of harboring resistant organisms, such as MAI or Aspergillus.
Lung Abscess
Definition

- A localized area of destruction of lung parenchyma in which infection by pyogenic organisms results in tissue necrosis & suppuration.
- It manifests radiographically as a cavity with an air – fluid levels.
- Collection of pus in the cavity which is lined by chronic inflammatory tissue.
Causative factors

**Pulmonary aspiration of infected oropharyngeal material**

**Size, frequency of the inoculum**

**Host factors**

**ALTERED SENSORIUM**
- Alcoholism
- Coma
- Drug abuse
- Seizures
- General anaesthesia

**AIRWAY OBSTRUCTION**
- Bronchial obstruction
- Foreign body
- Tumor stricture stenosis

**NEUROLOGICAL DISEASE**
- Stroke
- Laryngeal nerve disease
- Parkinson’s disease
- Pseudo-bulbar palsy

**GASTRO-INTESTINAL DISEASE**
- GI reflux, Dysphagia
- Esophageal obstruction

**DISEASES OF THE ORAL CAVITY**
- Gingivitis

**Depressed cough and gag reflex**
- Corticosteroid therapy
- Chemotherapy
- Malnutrition, multiple trauma
Lung Abscess

Primary (More common)

- Necrosis of lung parenchyma due to an existing disease like Aspiration pneumonia

Secondary

- Secondary to septic embolization or bronchial obstruction, Lung cancer
Causative organisms

- Anaerobes
- Staphylococcus aureus
- Strep.pyogenes
- Klebsiella pneumoniae
- Pseudomonas aeruginosa
- Hemophilus influenzae
- E.coli
- Acinetobacter
- Proteus
- Legionella
Most frequently implicated
Main groups
Gram negative bacilli – Bacteroides- Bacteroides fragilis
Gram positive cocci mainly Peptostreptococcus
Long & thin gram negative rods – Fusobacterium – Fusobacterium nucleatum, Fusobacterium necrophorum
Location

• 75% of the abscesses occur in posterior segment of the Rt. upper lobe or Apical segments of either lower lobe, these being the segments to which aspirated material has been shown to gravitate in the supine subject.
Symptoms

• Acute / insidious
• Cough with expectoration
• Fever
• Pleuritic pain
• Sudden expectoration of copious amounts of foul sputum (if abscess ruptures into bronchus)
Signs

- High grade pyrexia
- Profound systemic onset
- Digital clubbing (late features)
- May reveals signs of consolidation
- Pleural rub
- Rapid deterioration of general condition
- Toxic features
Radiology

- A large dense opacity which may cavitate and show fluid level
- Central lucency (black) in round opacity
- Differential diagnosis is cavitary lung cancer
- Abscess has thinner wall than cancer
- Preexisting emphysematous bulla become infected and mimics lung abscess
LUNG ABSCESS
Air-fluid level
• Why is the abscess environment hostile to so many antibiotics?
  - Low pH, low redox potential
  - Inoculum effect
  - Dead bacteria and debris may inactivate drugs
  - β-lactamase is often plentiful
• What antibiotics penetrate abscesses well?
  - Clindamycin
  - Metronidazole
  - Chloramphenicol (generally avoided)
  - **NOT β-LACTAMS!!!**
• Since drug penetration into abscesses is so poor, we use aggressive dosing (adjusted for renal or hepatic dysfunction) for anaerobic infections
Treatment

- according to etiology
- prolonged antibiotics (4-6 wks) metronidazoles
- Removal of obstruction /cause
- Surgery if needed
- Maintenance of general condition
DIAGNOSIS

• SPUTUM CULTURE?
• BLOOD CULTURE (not helpful)
• CULTURE OF EMPYEMA
• TRANSTRACHEAL ASPIRATION
• PROTECTED BAL SPECIMEN
TREATMENT

• Antimicrobial therapy and drainage are the keystones of treatment.
• Periods of 1 to 3 months or more may be required
• PCN+METRONIDAZOLE
• CLINDAMYCIN
TREATMENT

• Postural drainage is important in therapy of lung abscess.
• Bronchoscopy may help in effecting good drainage, removal of foreign bodies, and diagnosis of tumor.
• Surgical resection of necrotic lung may occasionally be needed if the response to antibiotics is poor or if airway obstruction limits drainage.
• In patients who are poor surgical risks, percutaneous drainage via catheters may be useful.
PROGNOSIS

• At present the mortality rate is 5 to 10%.
• Higher mortality and a higher incidence of complications: large abscesses (>6 cm), progressive pulmonary necrosis, obstructing lesions, aerobic bacterial infection, immune compromise, old age, and systemic debility, and those in whom major delays have occurred in seeking medical attention.
• The most common complication is empyema, with or without bronchopleural fistula.
• Other complications, which are now rare, include brain or other distal abscesses, generalized infection, severe hemorrhage, and pulmonary gangrene.
PREVENTION

- Minimize aspiration
- treatment of periodontal disease