Microbiology of Atypical Pneumonia

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Pneumonia

Pneumonia is an infection of the lungs that can be caused by viruses, bacteria, and fungi.
Atypical 
Pneumonia

- Symptoms.
- X-ray presentation.
- Different antibiotics.
1938 Paper by Reimann
## Causative Organisms

### Table 1  Microbial Agents That Can Cause “Atypical Pneumonia”

<table>
<thead>
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<th>MICROBIAL AGENTS</th>
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<td><em>Mycoplasma pneumoniae</em></td>
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<td><em>Legionella pneumophila</em></td>
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<td><em>Legionella species</em></td>
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<td><em>Chlamydia psittaci</em></td>
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<td><em>Chlamydophila pneumoniae</em></td>
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<td><em>Coxiella burnetii</em></td>
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<td>Hantavirus</td>
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<td>Rhinoviruses</td>
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<tr>
<td>Respiratory syncytial virus</td>
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<tr>
<td>Severe acute respiratory syndrome (SARS) coronavirus</td>
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<tr>
<td>Non-SARS human coronaviruses</td>
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<td>Human bocavirus</td>
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Legionellosis

The New England Journal of Medicine

Volume 297
DECEMBER 1, 1977
Number 22

LEGIONNAIRES’ DISEASE
Description of an Epidemic of Pneumonia

DAVID W. FRAZER, M.D., THEODORE R. TSAI, M.D., WALTER ORENSTEIN, M.D.,
WILLIAM E. PARKIN, D.V.M., DR. P.H., H. JAMES BEECHAM, M.D., ROBERT G. SHARRAK, M.D.,
JOHN HARRIS, M.D., GEORGE F. MALLISON, M.P.H., STANLEY M. MARTIN, M.S.,
JOSEPH E. MCDADE, PH.D., CHARLES C. SHEPARD, M.D., PHILIP S. BRACHMAN, M.D.,
AND THE FIELD INVESTIGATION TEAM*

Abstract An explosive, common-source outbreak of pneumonia caused by a previously unrecognized bacterium affected primarily persons attending an American Legion convention in Philadelphia in July, 1976. Twenty-nine of 182 cases were fatal. Spread of the bacterium appeared to be airborne. The source of the bacterium was not found, but epidemiologic analysis suggested that exposure may have occurred in the lobby of the headquarters hotel or in the area immediately surrounding the hotel. Person-to-person spread seemed not to have occurred. Many hotel employees appeared to be immune, suggesting that the agent may have been present in the vicinity, perhaps intermittently, for two or more years. (N Engl J Med 297:1189-1197, 1977)

The 58th Annual Convention of the American Legion
Philadelphia, July 1976
Legionellosis

- Causative organism: *Legionella pneumophila*.
- Gram negative rods.
- Lives freely in fresh water. Present naturally in low counts in groundwater, lakes and streams.
- Multiplies and thrives in manmade complex water systems given the right conditions.
Legionellosis

- **Mode of transmission:**
  - Contaminated aerosols: hot water showers, cooling towers, swimming pools, ice making machines, fountains.
  - The aerosol can travel up to a distance of 6 km.
  - Person to person transmission has **not** been reported to date.
• **Pathogenesis:**

  • *Legionella* lives within amoeba in the natural environment.

  • Upon inhalation the bacteria can infect alveolar **macrophages**, subverting the normal host cell machinery to create a niche where the bacteria can replicate.

  • This results in **Legionnaires' disease** and the lesser form, **Pontiac fever**.
Legionellosis

- **Pathogenesis:**
  - The disease is more severe in the *elderly*. In the United States, the disease affects between 8,000 to 18,000 individuals a year.
  
  - Incubation may take up to two weeks. Prodromal symptoms are flu-like, including fever, chills, and dry cough.
  
  - Advanced stages of the disease cause problems with the gastrointestinal tract and the nervous system and lead to diarrhea and nausea. Other advanced symptoms of pneumonia may also present.
Legionellosis

- **Laboratory Diagnosis:**
  
  - **Sample** collection: Sputum, blood or urine.
  
  - **Culture on:** buffered charcoal yeast extract (BCYE) agar. Requires both cysteine and iron in the media in order to grow. Takes up to 10 days.

  - Detection of *Legionella* urinary antigen is a much faster method for primary diagnosis. Only detects LP1.
Legionellosis

- **Laboratory Diagnosis:**
  - Serology: Detection of the organisms in respiratory secretions by a direct fluorescent antibody test.
  - Molecular: PCR.
Legionellosis

- **Treatment:**
  - Macrolides antibiotics: Erythromycin, Azithromycin.
  - Quinolones (specifically levofloxacin) are superior to macrolides.
Legionellosis

- **Prevention:**
  - No vaccine.
  - Prophylactic antibiotics are of no value.
  - Thermal control of water systems: above 71°C or below 21°C.
  - Chemical methods: e.g. Chlorination.
Mycoplasma pneumoniae Pneumonia

- Mycoplasmalas are the smallest free-living organisms (125-150 um) compare to myxovirus.

- They are highly pleomorphic because they lack a cell wall.

- They have a triple-layered cell membrane.
Mycoplasma pneumoniae Pneumonia

- Not stained with Gram stain but with Giemsa.
- They reproduce by binary fission.
Mycoplasma pneumoniae Pneumonia

• It is endemic in highly populated areas.

• Causes mild disease with sore throat.

• Pneumonia occurs mainly in children (5-9) and young adults. Usually a mild form.

• Person to person: droplet infection.
Mycoplasma pneumoniae Pneumonia

- **Laboratory Diagnosis:**
  - Sample: Sputum, etc..
  - Grows poorly under aerobic conditions but does grow well in nitrogen and 5 to 10% carbon dioxide.
  - Characteristic colonies with a classic ‘fried egg’ appearance on agar medium.
Mycoplasma pneumoniae Pneumonia

- Laboratory Diagnosis:
  - Molecular techniques: DNA probes and PCR.
  - Serodiagnosis: detection of Mycoplasma antibodies in serum.
Mycoplasma pneumoniae Pneumonia

- Prevention and control:
  - No vaccine.
  - Measures to control droplet infection spread.
  - Lifelong immunity does **not** result from previous infections.
Mycoplasma pneumoniae

Pneumonia

- **Treatment:**
  - Tetracyclines and erythromycin are the antibiotics of choice.
{Chalmydophila species Pneumonia}

• There are four species:
  
  • *C. pneumoniae*.
  
  • *C. psittaci*.
  
  • *C. pecorum*.
  
  • *C. trachomatis*. 


{Chalmydophila species Pneumonia}

- They are obligate intracellular bacteria, non motile and coccoid.
- They are unable to synthesize ATP and depend on the host cell to supply them with ATP and energy requirements.
Is it a virus?

- Cell wall
- DNA and RNA
- Ribosomes
- Antibiotics
{Chalmydophila species
Pneumonia}

• They exist in nature in two forms:

1. Elementary body (EB)
2. Reticulate body (RB)
Chlamydia species
Pneumonia

- They exist in nature in two forms:
  
  1. Elementary body (EB):
     
     - A non-replicating, infectious particle.
     
     - 0.25 to 0.3 µm in diameter, that is released from ruptured infected cells and can be transmitted from one individual to another.
{Chalmydophila species Pneumonia}

- They exist in nature in two forms:
  
  - **2. Reticulate body (RB):**
    
    - An intra-cytoplasmic form, 0.5 to 0.6 µm in diameter, that can replicate and grow.
    
    - The infectious elementary body enters the cell by endocytosis and develops into the non infectious reticulate body (RB) within a cytoplasmic vacuole in the infected cell. The reticulate body contains no cell wall.
Chlamydophila species Pneumonia

- They exist in nature in two forms:
  
  2. Reticulate body (RB):
    
    - The reticulate body divides by binary fission to form particles which after synthesis of the outer cell wall, develop into new infectious elementary body and is released from the cell to infect other cells.
Clinical presentation:

- Pneumonia or bronchitis.
- Gradual onset of cough with low-grade fever.
- Less common presentations are pharyngitis, laryngitis, and sinusitis.
- Asymptomatic infection to severe disease.

{CDC}
{Chalmydophila species Pneumonia}

• **Sequelaes:**

  • *C. pneumoniae* infection may be associated with atherosclerotic vascular disease.

  • Associations with Alzheimer's disease, asthma, and reactive arthritis have been proposed.

{CDC}
Chlamydophila species Pneumonia

- Transmission

- Person-to-person transmission by respiratory secretions.
Chalmydophila species Pneumonia

- **Risk Groups**

  - All ages at risk, but most common in school-age children.

  - In the United States, about 50% of adults have evidence of past infection by age 20.

  - Reinfection throughout life appears to be common.

{CDC}
Chalmydophila species
Pneumonia

- Laboratory Diagnosis:

  - Microscopic examination:

    - Inclusion bodies are detected by:
      
      - Staining with Giemsa or iodine.
      
      - Staining with fluorescent monoclonal antibodies.
Chlamydophila species
Pneumonia

- **Laboratory Diagnosis:**
  - **Culture: (cell culture)**
    - On McCoy cells: after incubation, typical cytoplasmic inclusions are seen.
    - Yolk sac of embryonated egg: have been used to isolate Chlamydiae.


**Chalmydophila species Pneumonia**

- **Laboratory Diagnosis:**
  
  - **Serology:**

  - Detection of chlamydial antigen directly in specimens:
    
    - By using specific immunofluorescent antibodies prepared against either C trachomatis or C psittaci.

  - Detection of anti-Chlamydia antibodies in serum:
    
    - by complement fixation or micro-immunofluorescence tests.
{Chlamydophila species Pneumonia}

- Laboratory Diagnosis:
  - Molecular techniques:
    - DNA probes and PCR.
Chlamydia species pneumonia

- **Treatment**
  - Macrolides are often the first-line treatment;
  - Tetracyclines and fluoroquinolones are also effective.
{Chalmydophila species Pneumonia}

- Prevention and control:
  - No vaccine.
  - Measures to control droplet infection spread.
  - Lifelong immunity does not result from previous infections.
Psittacosis

- Caused by *C. psittaci*.

- Clinical Features
  - In humans, fever, chills, headache, muscle aches, and a dry cough. Pneumonia is often evident on chest x-ray.
Psittacosis

**Transmission:**

- Infection is acquired by inhaling dried secretions from infected birds.
- The incubation period is 5 to 19 days.
- Pet birds (parrots, parakeets, macaws, and cockatiels) and poultry (turkeys and ducks) are most frequently involved in transmission to humans.
Psittacosis

- **Risk Groups:**
  - Bird owners.
  - Aviary and pet shop employees,
  - Poultry workers, and veterinarians.
Psittacosis

- **Prevention:**
  - Personal protective equipment (PPE) should be used when handling birds or cleaning their cages.
1. Healthcare-Associated Atypical Pneumonia
   Sarah Forgie, M.D.¹ and Thomas J. Marrie, M.D.²

2. Atypical pneumonia—time to breathe new life into a useful term?
   David R Murdoch, Stephen T Chambers

3. CDC
   Centers for Disease Control and Prevention
   CDC 24/7: Saving Lives, Protecting People™
For further reading

1 Healthcare-Associated Atypical Pneumonia
   Sarah Forgie, M.D.¹ and Thomas J. Marrie, M.D.²

2 Atypical pneumonia—time to breathe new life into a useful term?
   David R. Murdoch, Stephen T. Chambers

http://www.mohamedali.me/micro/

Supplementary material for Atypical pneumonia lecture

Please click on the links below to download papers

1) Paper 1: Healthcare-Associated Atypical Pneumonia
2) Paper 2: Atypical pneumonia—time to breathe new life into a useful term?

For further info:
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