Chapter 22-23

Actinomycetes-Nocardia-Mycoplasma

Actinomycetes

-- ***Actinomycetes*** are a family of bacteria that form **long, branching filaments that resemble the hyphae of fungi**.

-- They are **Gram positive**.

-- Some such as ***Nocardia asteroides*** are **weakly acid fast**.

Actinomyces israelii

It causes **actinomycosis**.

Important properties and pathogenesis

-- It is an **anaerobe** and member of **normal flora of oral cavity**.

-- After **local trauma** it may invade tissues, **forming filaments** surrounded by areas of inflammation.

-- The typical lesion appears as a **hard, non tender swelling** that develops slowly and **eventually drains pus** through sinus tracts.

-- **Hard, yellow granules (sulfur granules)** composed of a mass of filaments are formed in pus.

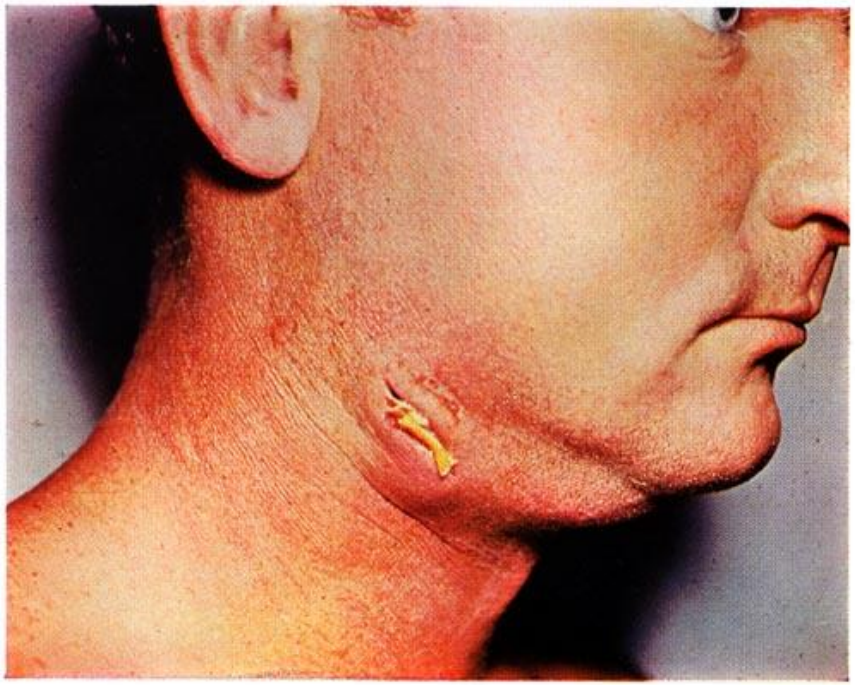
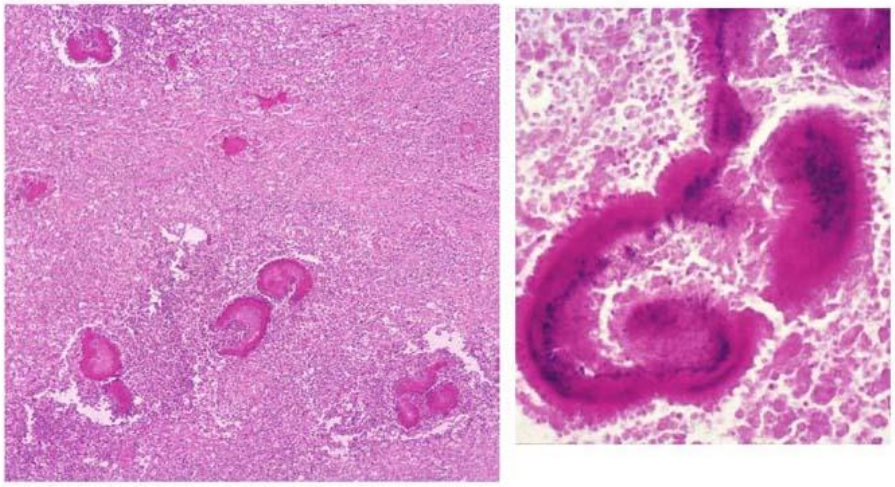


FIGURE 1.—Actinomycosis, jaw, observed at Letterman General Hospital, San Francisco, Calif., in a sergeant who had punctured the floor of his mouth with a weed stem while picking his teeth.

Sulfur granules produced by *Actinomyces bovis*

Left: HE staining, Right: Gram staining. *A. bovis* produces large, horse-shoe shape sulfur granule. Gram positive thread-like bacteria are seen just beneath the clubs.



-- The common sites of **initial lesion** are **face, neck, chest or abdomen**.

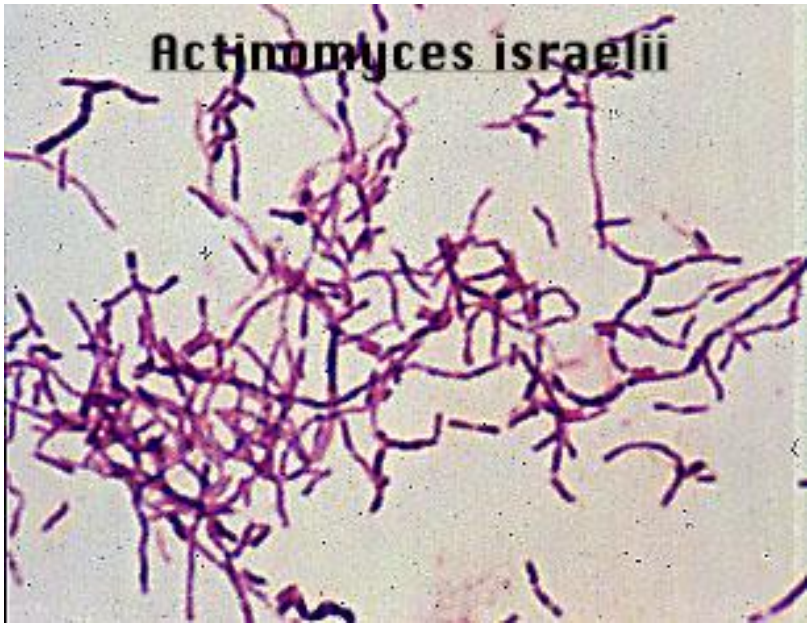
-- **Pelvic actinomycosis** can occur in women who have retained an intrauterine device for a long period of time.

-- ***Arachnia*** species may also cause actinomycosis.

Laboratory Diagnosis

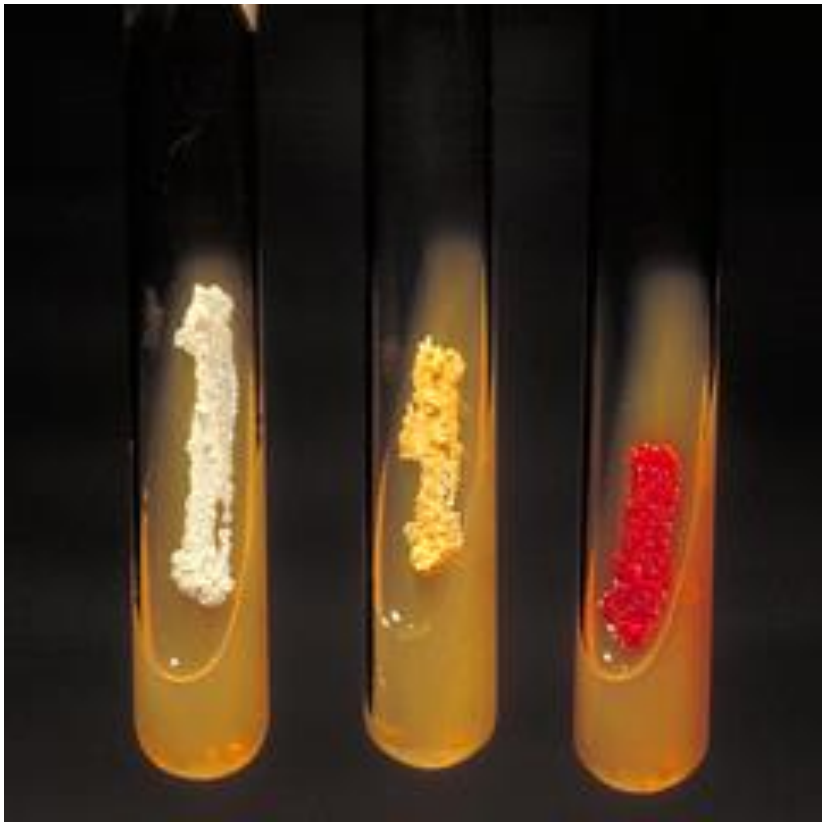
Diagnosis is made by:

1. Observation of **Gram positive branching rods** esp. in presence of **sulfur granules.**



2. **Colonial morphology** after culture under anaerobic conditions

There are **no serological tests**.



Treatment and Prevention

-- Treatment consists of **prolonged administration of penicillin G**, coupled with **surgical drainage**.

-- There is **no significant resistance to Penicillin G**.

-- **No vaccine** or prophylactic drug is available.

Nocardia

Nocardia asteroides

It causes **nocardiosis**.

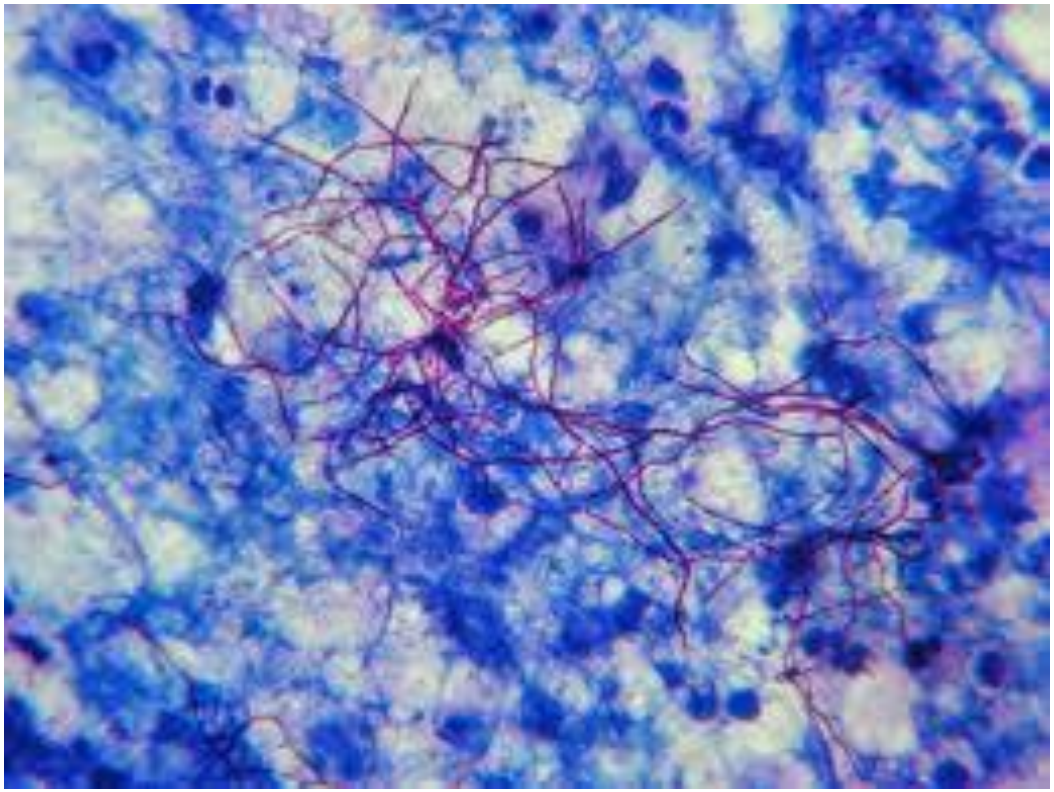
Important properties and pathogenesis

-- ***Nocardia*** species are **aerobes** and found in the environment particularly in soil.

-- In **immunocompromised** individuals, they can produce **lung infection** and may disseminate.

-- In tissues, ***Nocardia*** species are **thin, branching filaments** that are **Gram positive**.

-- Many isolates are **weakly acid-fast** with lower conc. of HCl.



Clinical findings

-- ***N. asteroides*** typically causes either **pneumonia, lung abscess** with cavity formation, lung nodules, or empyema.

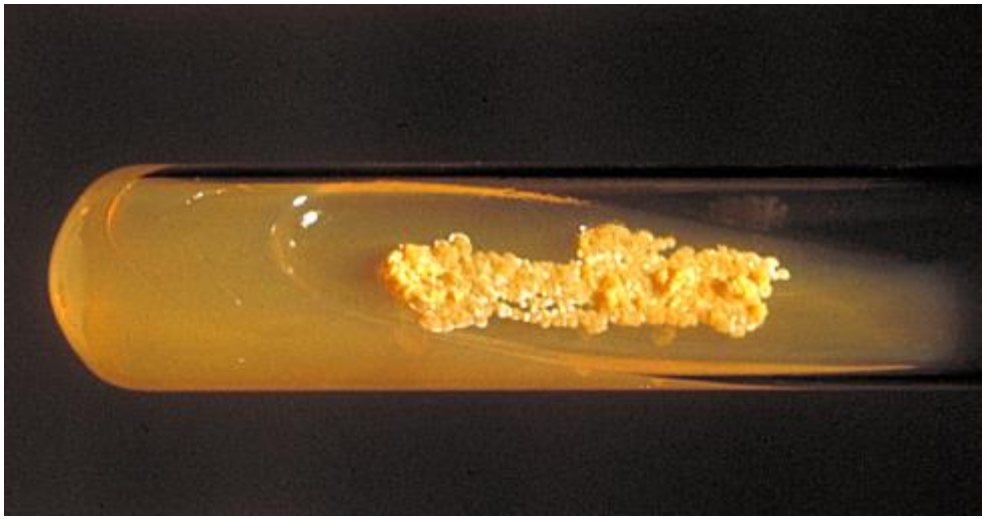
-- From the lungs, the organisms **can spread to various organs notably brain to cause abscesses.**

-- Disease occurs mostly in immuncompromised individuals esp. those with **reduced cell-mediated immunity**.

-- ***N. brasiliensis*** causes **mycetoma** usually in tropical regions.

Laboratory diagnosis

Diagnosis involves observation of **Gram positive, weakly acid fast branching rods and filaments** and seeing **aerobic growth** on bacteriological media, e.g. nutrient agar in a few days.



Treatment and Prevention

-- Treatment is **trimethoprim-sulfamethoxazole**.

-- **Surgical drainage** may also be needed.

-- Occasional drug resistance occurs.

-- **No vaccine** or prophylactic drug is available.

Mycoplasmas

-- These are **very small, wall less organisms**.

-- ***M. pneumonia*** is the major pathogen.

-- ***M. hominis*** has been implicated as an infrequent cause of pelvic inflammatory disease.

-- A related organism ***Ureaplasma urealyticum*** (urease positive) may cause app. 20% of cases of nongonococcal urethritis.

M. pneumoniae

It causes **“atypical pneumonia”**.

Important Properties

-- Mycoplasmas are the **smallest free living organism**.

-- Many are as small as **0.3 µm** in diameter.

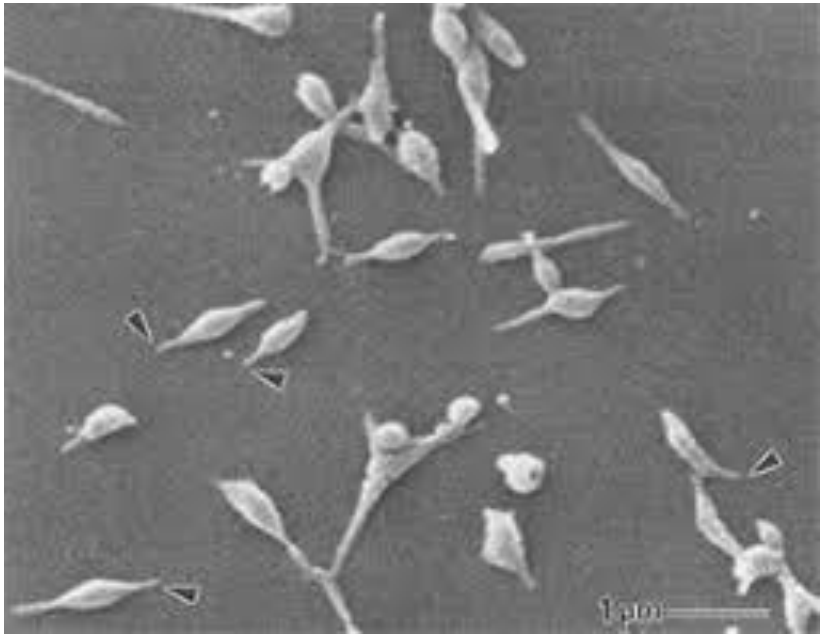
-- Most striking feature is **absence of a cell wall**.

-- For this reason, they **stain poorly with Gram stain**.

Obviously, **cell wall acting antibiotics are not effective.**

Absence of cell wall, also provides flexibility and thus they **can assume various shapes.**

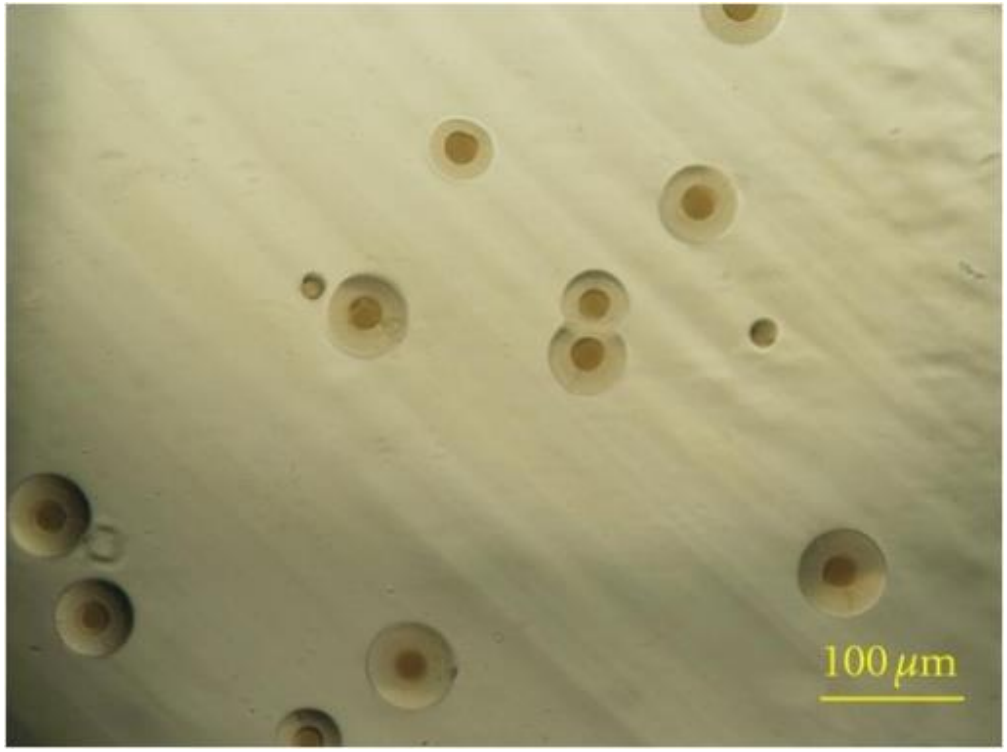
The cell membrane is **unique in containing cholesterol** (among prokaryotes), which is commonly found in eukaryotes.



They **can grow on artificial media** but have complex nutritional requirements including several lipids.

They **grow slowly** and colonies become visible at least after one week.

Colonies have a characteristic **“fried-egg”** shape with a raised center and a thinner outer edge.



Pathogenesis and Epidemiology

-- It is a **strict human pathogen**.

-- Transmission is through **droplets**.

-- In the lungs, the organisms are **rod-shaped, with a tapered tip** that contain specific proteins that serve as the point of attachment to the respiratory epithelium.

-- The respiratory mucosa is not invaded, but **ciliary motion is inhibited** and necrosis of the epithelium occurs.

-- The cause of inflammation is uncertain.

-- It does **produce hydrogen peroxide** which contributes to the damage to the respiratory tract.

-- ***M. pneumoniae*** has **only one serotype** and is antigenically distinct from other species.

-- Immunity is **incomplete** and second episodes of disease can occur.

-- During infection **autoantibodies are produced** against red cells **(cold agglutinins)** and brain, lung, and liver cells giving rise to extra pulmonary manifestations.

-- ***M. pneumoniae*** infections occur **worldwide**, with increased incidence in winter.

-- It is the **most frequent cause of pneumonia in young adults** and is responsible for outbreak in groups with close contacts such as families, military personnel, and college students.

-- Only **10%** of infected individuals get pneumonia.

-- ***Mycoplasma*** pneumonia accounts for **5-10% of all community-acquired pneumonia.**

Clinical findings

-- It is the **most common cause of atypical pneumonia**.

-- Atypical means that the **organism cannot be routinely isolated** in laboratory or that the **disease does not resemble pneumococcal pneumonia.**

-- The onset is gradual beginning with a **non-productive cough, sore throat or earache.**

-- Small amounts of **whitish, non bloody sputum** are produced.

-- Fever, headache, malaise, and myalgias are pronounced.

-- The paucity of findings on chest examination is in marked contrast to the prominence of the infiltrates seen on patient's chest X-Ray.

-- The **disease resolves spontaneously** in 10-14 days.

-- ***M. pneumoniae*** may also cause bronchitis.

-- The extra pulmonary manifestations include **Stevens-Johnson syndrome, erythema multiforme, cardiac arrhythmias, arthralgias, hemolytic anemia** and neurological manifestations such as **Guillain-Barre syndrome**.

Laboratory Diagnosis

-- **Culture of sputum is not useful** because of slow growth.

-- **Serology is important**.

-- A **cold-agglutinin titer of 1:28 or higher** is indicative of recent infection.

-- Cold agglutinins are **IgM autoantibodies against type O RBCs** that agglutinate these cells at 4°C but not at 37°C.

-- However, **only half** of ***Mycoplasma pneumonia*** patients are **positive for cold agglutinins.**

-- **False positive** results also occur.

-- Confirmation can be made by **4 fold rise in specific antibody titer** in **complement fixation test**.

Treatment

-- Drug of choice is a **macrolide**, e.g., azithromycin or a tetracycline, e.g., doxycycline.

-- Drugs can shorten the duration of symptoms, otherwise the disease resolves spontaneously.

Prevention

-- There is no **vaccine** or other specific preventive measure.


Thank You!