ACTINOMYCETES

General characteristics

- Large group of organisms; slender, filamentous, **fungal-like** organisms
- Filaments may fragment and single cells may be seen as cocci or bacilli
- Gram positive
- Genus *Nocardia* is both Gram-positive and weakly acid fast
- Non-motile
- Non-capsulated
- Non-spore forming

Classification

- Family: Actinomycetaceae
- Based on the ability to grow aerobically or anaerobically
  1. **Anaerobic actinomycetes**
     - *Actinomyces*
     - *Bifidobacterium*
     - *Eubacterium*
  2. **Aerobic actinomycetes**
     - *Nocardia*
     - *Streptomyces*
     - *Actinomadura*

Actinomyces species

A.israelii

A.meyeri

A.odontolyticus

A.neuli

A.radingae

A.viscosus

A.naeslundii

A.gerencseriae

A.turicensis

Actinomyces

- Anaerobic Gram-positive bacteria (facultative anaerobes or strict anaerobes)
- Branching filamentous rods
- Not acid-fast
- Grow slowly in culture
- Human commensal flora of the oropharynx, GIT, urogenital tract

Actinomyces

- Develop delicate filamentous forms or hyphae (resembling fungi) in clinical specimens or when isolated in culture
- True **bacteria** (lack mitochondria and a nuclear membrane, reproduce by fission, inhibited by penicillin but not antifungal antimicrobial agents)
  - >30 species
  - Produce chronic, slowly developing infections

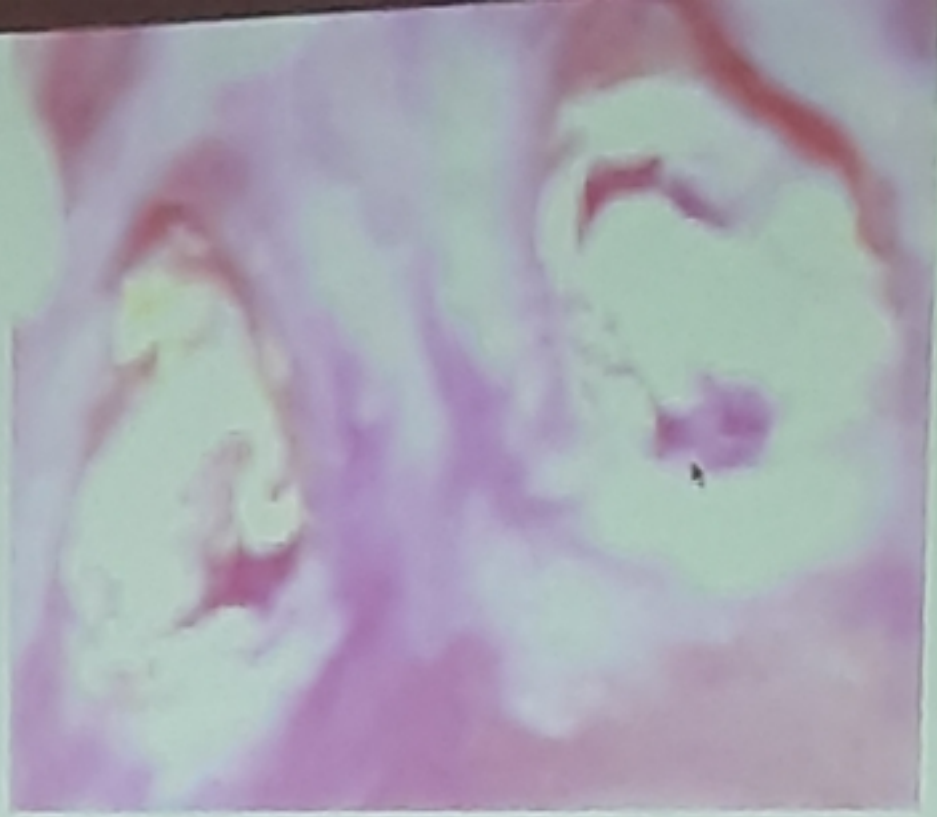
Clinical manifestations

1. Cervicofacial actinomycosis

- Most frequent clinical form
- 'Lumpy jaw syndrome'
  - Large abscesses
  - Mandibular osteomyelitis
  - Distant organ dissemination:brain, lungs, digestive tract
- Predisposing conditions
  - Poor oral hygiene
  - Oral mucosa trauma

Cervicofacial actinomycosis

- Involves
  - Upper or lower mandible(50%)
  - Cheek(15%)
  - Chin(15%)
  - Submaxillary ramus and angle(10%)
- Presentation
  - Slowly progressive painless mass
  - Evolves into multiple abscesses with draining sinus tracts on skin
  - Advanced stages- pain and trismus



2. GUT actinomycosis

2. GUT actinomycosis

- 2nd most frequent clinical form
- Pelvic actinomycosis in women using an IUD

Presentation

- Genital mass +/- fever(fever not usually present unless peritonitis present)

3. Respiratory tract actinomycosis

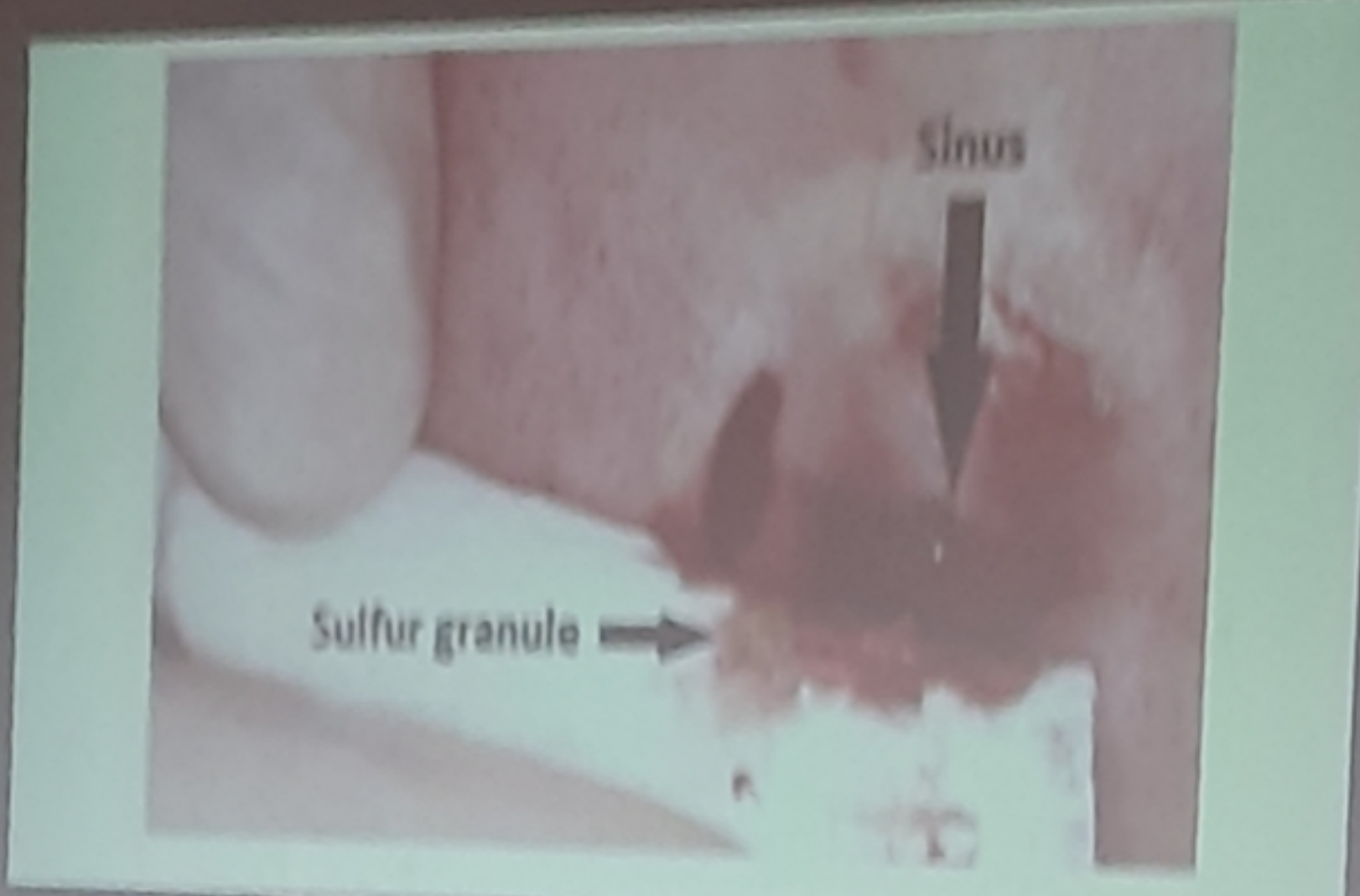
- Pulmonary, bronchial, laryngeal
- Mainly from aspiration
  - Poor oral hygiene esp. smokers with poor oral hygiene
  - Pre existing dental disease
  - Alcoholism
  - Chronic lung disease
- Direct/indirect extension from cervico-facial infection
- **Presentation**: mild fever, weight loss, productive cough, haemoptysis, dyspnea, chest pain

Other manifestations

4. Extrafacial bone and joint actinomycosis
5. GIT actinomycosis- A.israelii mostly involved
6. CNS actinomycosis
   - Brain abscess
   - CNS involvement-
     - hematogenous from the lungs
     - contiguously from cervicofacial actinomycosis
     - Following penetrating head injury

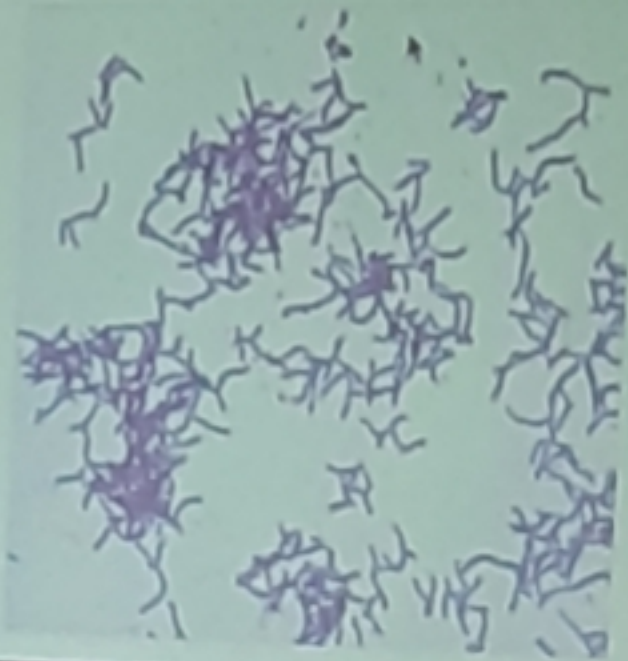
Pathology of Actinomycosis

- Tissue invasion
- Chronic granulomatous infection characterized by the formation of tiny clumps(**sulfur granules**)
- Granules=0.1-1mm diameter,
  - Internal tangle of mycelial fragments
  - A rosette of peripheral clubs
  - Stabilized by a protein-polysaccharide complex
  - Purpose=inhibit phagocytosis


Sinus
Sulfur granule

Laboratory diagnosis

- Specimen: abscess content, sinus discharge, bronchial secretions, biopsy material
- Culture: BA
  - Slow growing(produce growth on BA,CBA after 5-7 days-may take up to 15–20 days); incubation 35-37°C; **anaerobic conditions**
  - Colonies: small, cream or white, with a rough nodular surface (**molar tooth colonies**)
- Gram-stain- Gram-positive branching filametous rods except *A.meyeri* which is small and non-branching



Treatment

- Combination of drainage of a localized abscess or surgical debridement
- Uniformly susceptible to penicillin (DOC)
- Carbapenems, macrolides and clindamycin

Bifidobacterium and Eubacterium

Bidobacterium and Eubacterium

- *B.dentium*
- *E.nodatum,*
- *E.timidum,*
- *E.brachy*
- Normal microbiota of the GIT
- Potential opportunistic pathogens
- Represent clinically insignificant contaminants

Aerobic actinomycetes

Nocardia
Streptomyces
Actinomadura

Nocardia species

- *N.asteroides*
- *N.brasiliensis*
- *N.abscessus*
- *N.nova*
- *N.africana*

General characteristics

- Gram-positive bacilli
- Strict aerobes
- Microscopic appearance of branching hyphae
- >50 species described
- Possess **short chain mycolic acids(** 50 to 62 carbon atoms)
- Saprophytic components
  - In fresh and salt water, soil, dust, decaying vegetation, and decaying fecal deposits from animals
- Transmission is by **inhalation of airborne spores** or **mycelial fragments** from environmental sources

Virulence factors

- Ability to resist phagocytosis
- Catalase and superoxide dismutase
- Able to survive and replicate in macrophages

  (1) preventing fusion of the phagosome-lysosome (mediated by **cord factor**)

  (2) preventing acidification of the phagosome, and

  (3) avoiding acid phosphatase–mediated killing by metabolic utilization of the enzyme as a carbon

Clinical manifestations

Predisposing factors

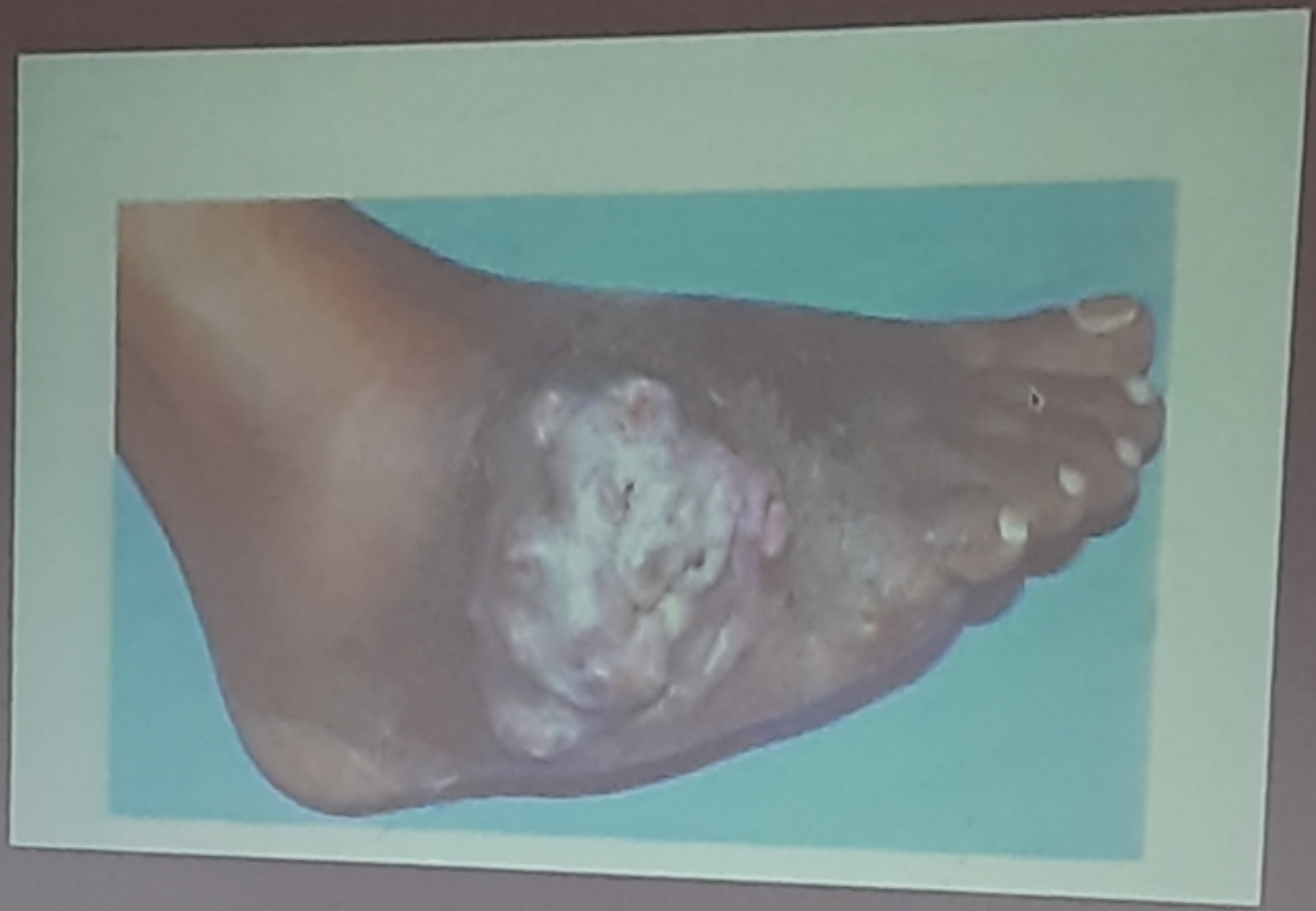
1. Underlying chronic lung disease e.g. COPD, asthma
2. Drug-induced systemic immunosuppression
3. Chronic granulomatous disease
4. Diabetes
5. HIV

Clinical manifestations

1. **Pulmonary nocardiosis**
   - Subacute or indolent
   - Cough, thick purulent sputum
   - Fever, weight loss, malaise
2. **Extra pulmonary nocardiosis**
   - Spread haematogenously from an asymptomatic or healed pulmonary site
   - Local extension from lungs→purulent pericarditis, mediastinitis
   - Others: skin, subcutaneous tissues, CNS

Clinical manifestations

3. **Primary cutaneous disease**
   - Immunocompetent hosts
   - *N.brasiliensis*- 80%
   - Lymphocutaneous infection, superficial cellulitis, localized abscess
   - **Mycetoma**-late-stage infection
     - Chronic, localized, slowly progressive and often painless subcutaneous and bone disease usually involving the foot



Laboratory diagnosis

- **Specimen**: bronchial washings, bronchial lavage fluids, sputum, abscesses, wound drainages, tissues, CSF
- Macroscopic examination-
- Gram stain/modified acid fast stains
  - Partially acid fast filamentous bacilli

Laboratory diagnosis

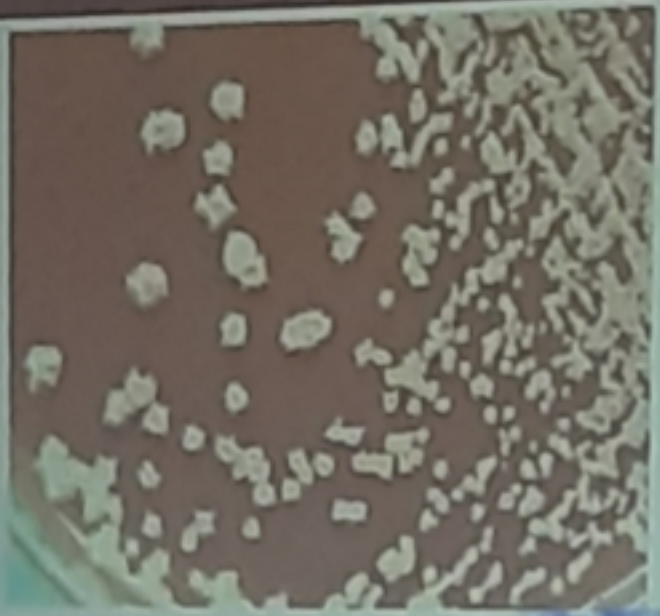
Culture:

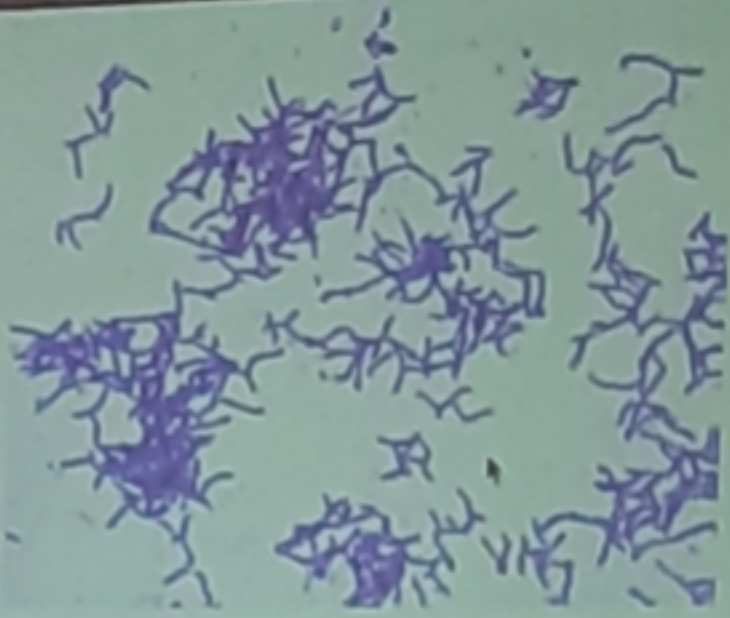
- Grow on most non-selective lab media
- Colonies may take 2-14 days to appear
- Observe macroscopically for aerial hyphae
- Colonial morphology- variable
  - Smooth bacterium-like (*N.farcinica)*
  - Chalky white appearance of most other species

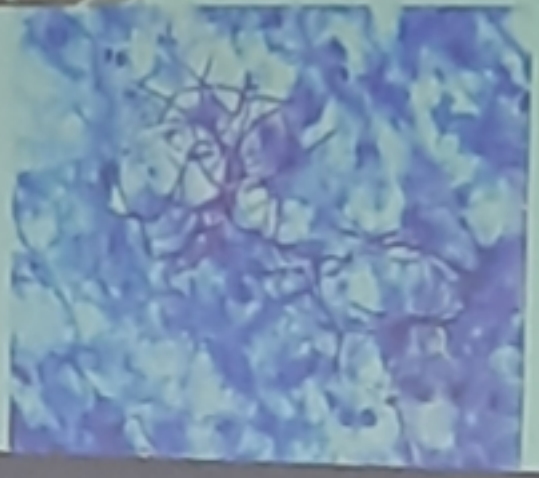
Laboratory diagnosis

Identification

- Biochemical tests
- Hydrolysis of adenine, casein, tyrosine, xanthine, hypoxanthine
- API
- Serology
- Molecular







Treatment

- Trimethoprim-Sulfamethoxazole
- Amikacin
- Ceftriaxone
- Imipenem
- Combination therapy in serious disease, CNS and dissemination

Streptomyces; Actinomadura

Streptomyces

- *Streptomyces somaliensis*
- Saprophytic soil organisms
- Cause **mycetoma(actinomycetoma)**
- Few cases of invasive disease
  - Preexisting conditions: cancer, HIV, medical devices
- Diagnosis- requires microscopic and pathological correlation to rule out contamination

Actinomadura

- *Actinomadura madurae; Actinomadura pelletieri*
- Soil saprophytes
- Cause mycetoma