Streptococci and enterococci

Oto Melter

Content

- Morphology & identification
- Antigenic structure
- Toxins & enzymes
- Classification of β-hemolytic streptococci
- Classification of enterococci
- Clinical diseases
- Laboratory diagnosis
- Treatment

1. Morphology & identification

- gram-positive spherical bacteria arranged in chains (lancet shaped – pneumococci)
- catalase-negative
- culture: 1 – 2 mm large α, β, γ matt or glossy hemolytic colonies
- nutritive requirements: need enrichment with blood or growth factors
- atmosphere with enhanced CO_2, temperature 37°C, facultative anaerobes

2. Antigenic structure

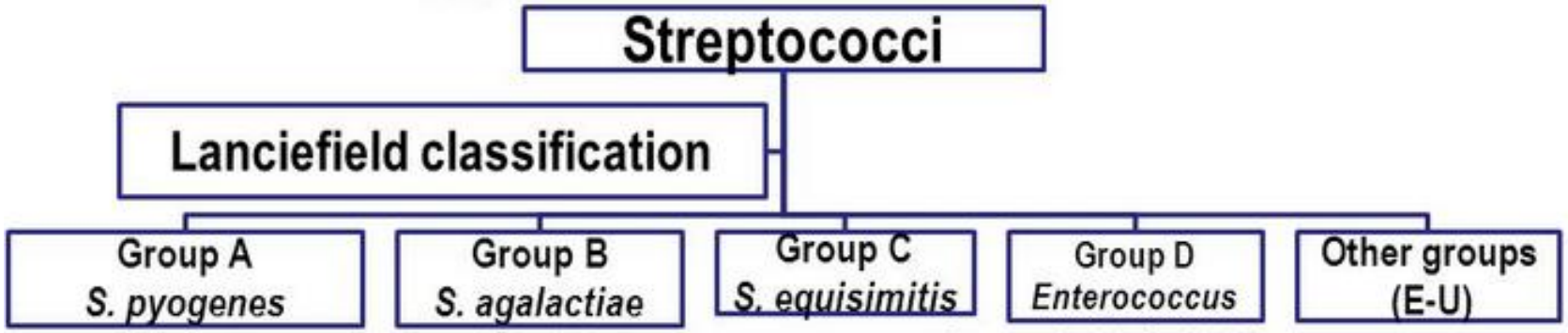
a) group-specific cell wall antigen: Lancefield group (A-U)

b) M protein: virulence factor associated protein (typing)

c) T substance

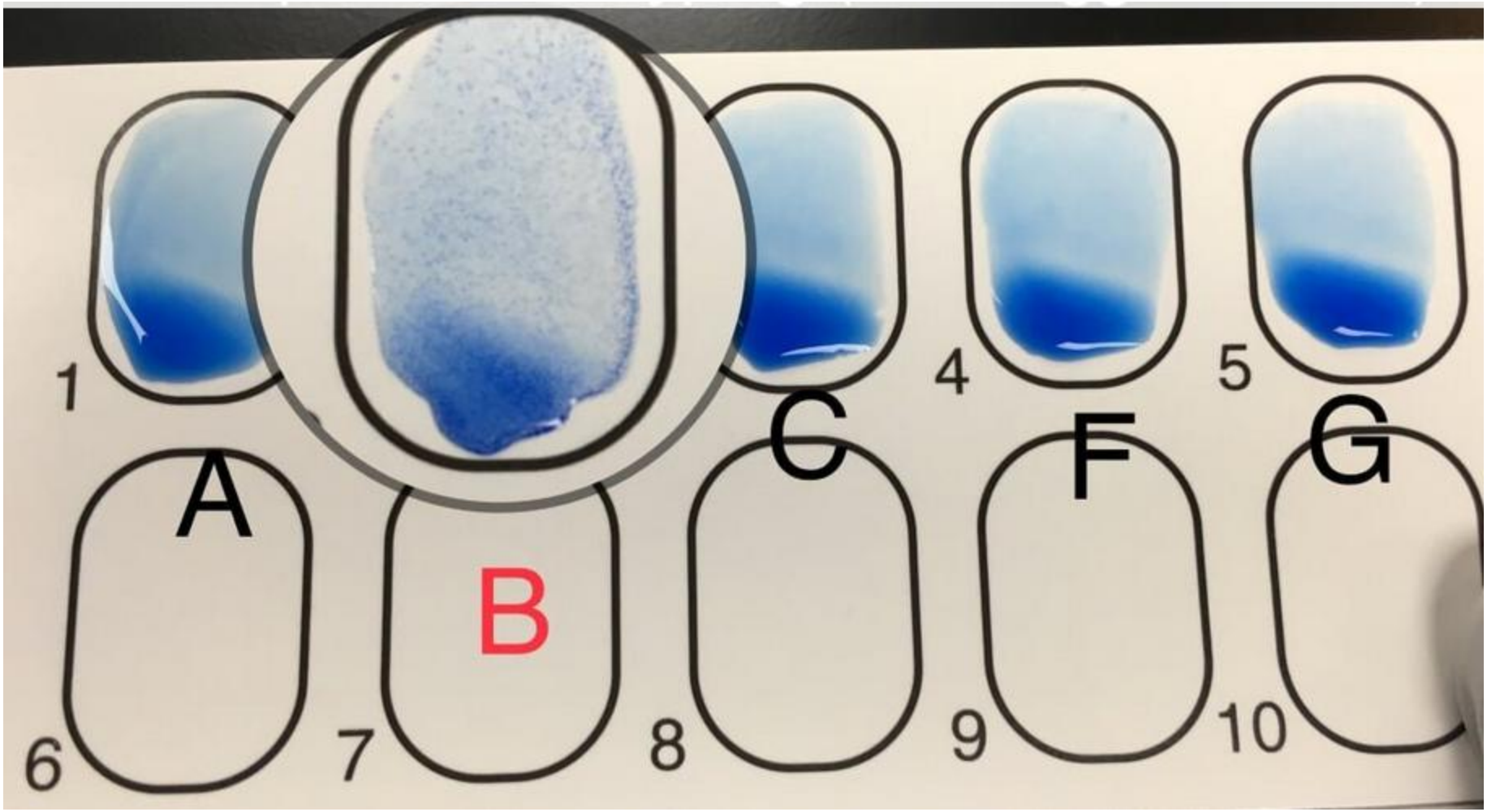
d) Nucleoproteins

S. pneumoniae – polysaccharide capsule



- Streptococci classified into many groups from A-K & H-U
- One or more species per group
- Classification based on C- carbohydrate antigen of cell wall
  - **Groupable streptococci**
    - A, B and D (more frequent)
    - C, G and F (Less frequent)
  - **Non-groupable streptococci**
    - *S. pneumoniae* (pneumonia)
    - viridans streptococci
      - e.g. *S. mutans*
      - Causing dental carries

Example of hemnolytic streptococci agglutination (group B = *S.agalactiae)*



3. Toxin & enzymes

- Streptokinase: digest fibrin and other proteins, spread microoranism
- Deoxyribonuclease: spread microoranism
- Hyaluronidase: spread microoranism
- Erythrogenic toxin: rash/scarlet fever
- Hemolysins (α incomplete hemolysis, β complete hemolysis)
- Streptolysins (S oxygen stabile, O oxygen labile): lyse Ec, Leu, Pla
- Enterococci dont have a potent toxin or well defined virulence factor (although could be agents of life-threating nosocomial infections)

4. Classification of beta-hemolytic streptococci

1. Beta-hemolytic
- Group A: *Streptococcus pyogenes*
- Group B: *Streptococcus agalactiae*
- Groups C and G

2. Non-Beta-hemolytic
- *Streptococcus pneumoniae*
- Viridans streptococci

4. Classification of enterococci

Group D: e.g. *Enterococcus faecalis*, *Enterococcus faecium*

5. Clinical diseases

• Invasion & *Streptococcus pyogenes:* erysipelas, puerperal fever, sepsis

• **Local infection** & *Streptococcus pyogenes* products: *sore throat, pyoderma*

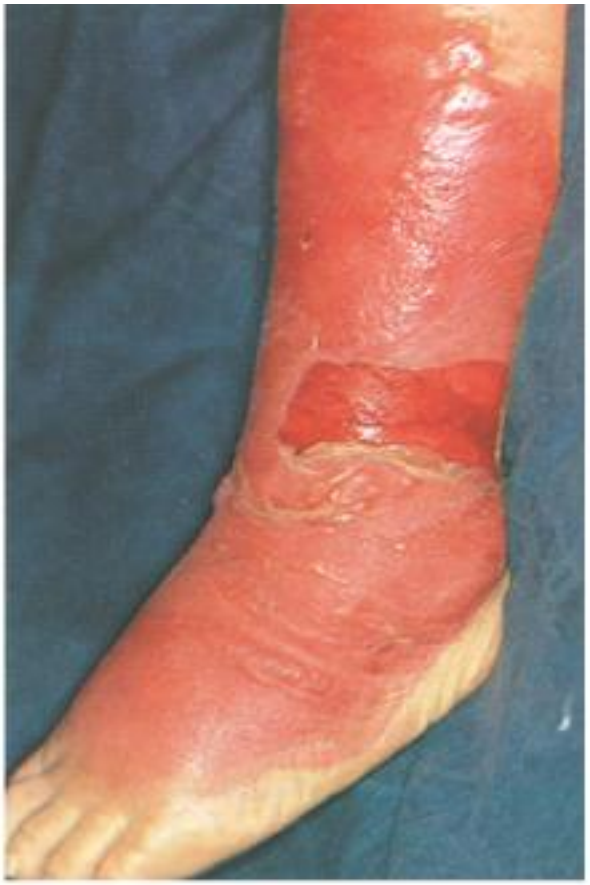
• **Systemic infections***:* necrotizing fasciitis, streptococcal toxic shock syndrom

•Infective endocarditis: acute & subacute endocarditis

•other infections: *S. agalactiae* (B) – meningitis, pneumonia, sepsis in neonates, infection in pregnant women, *S. pneumoniae* – pneumonia, meningitis, otitis, sepsis, enterococci – UTI (urinary tract inf.) and nosocomial infections

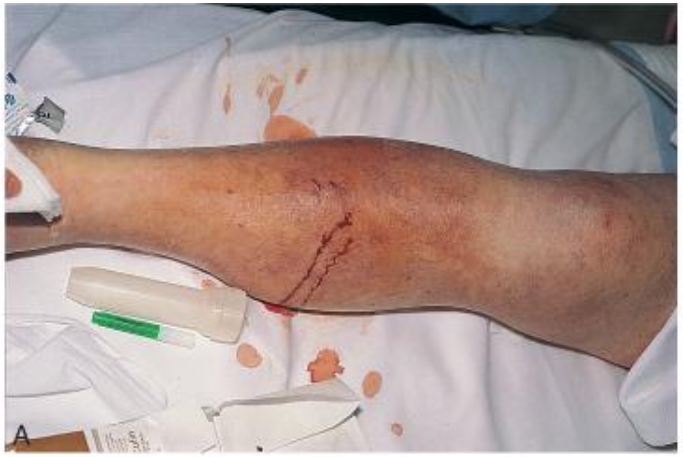
• Poststreptococcal diseases: rheumatic fever, acute glomerulonephritis

Acute stage of erysipelas

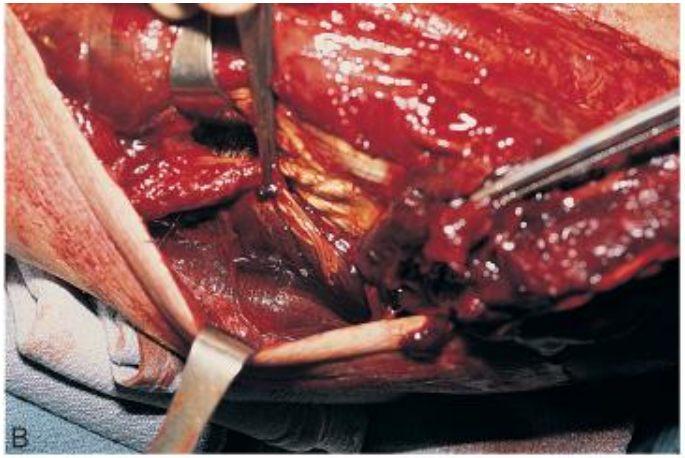


Erythema and bullae formation (material to analyze – hemoculture)

Necrotizing fasciitis (*S. pyogenes*)



A



B

A. The patient presented with 3 day history of malaise, diffuse myalgia, low grade fever, two small, purple bullae over the calf.

B. Extensive necrotizing fasciitis was present on surgical exploration. The patient died despite aggresive surgical and medical management.

See also another case report: https://pmc.ncbi.nlm.nih.gov/articles/PMC9476833/pdf/cureus-0014-00000028055.pdf

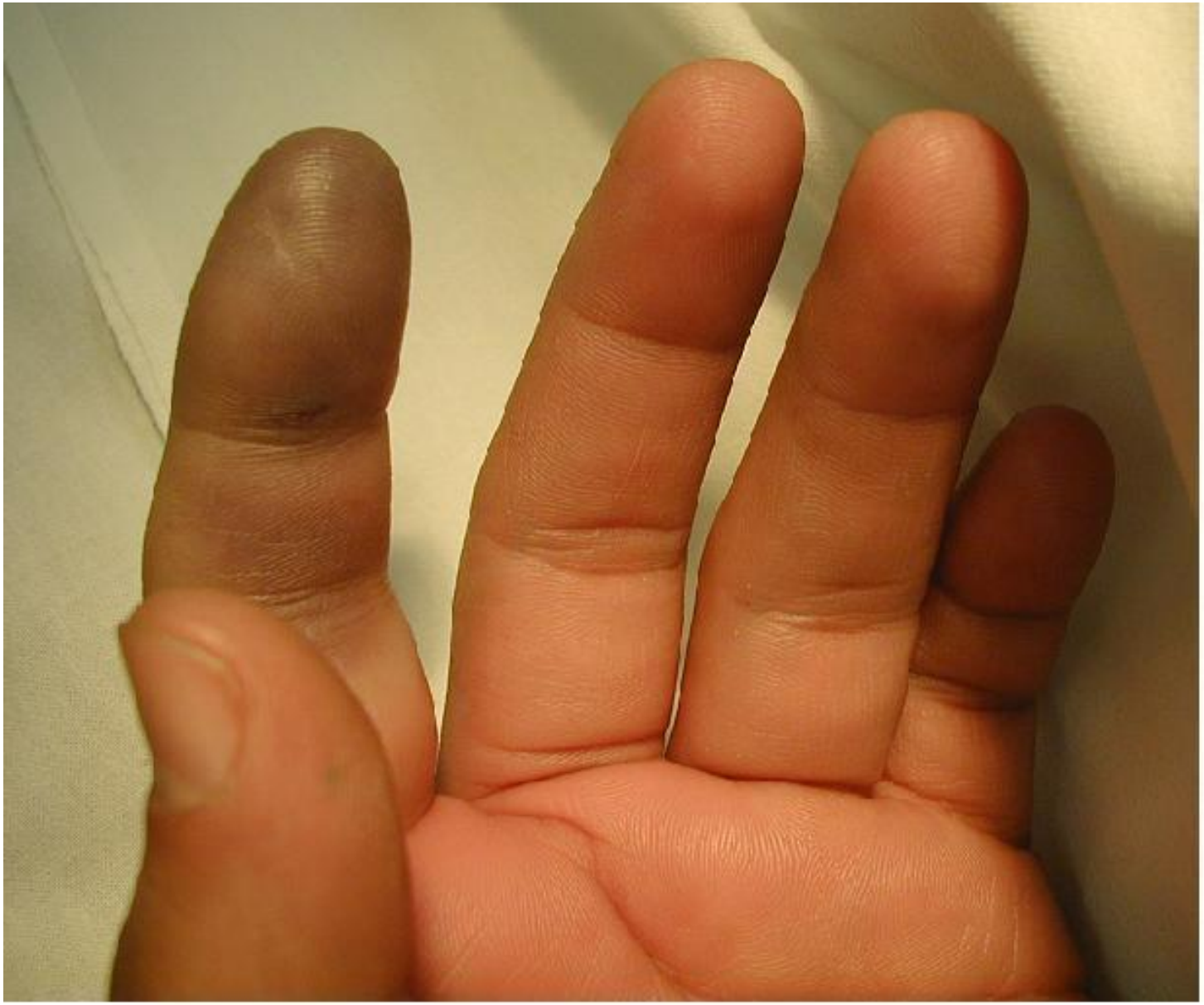
Diagnosis of Necrotizing Fasciitis

combination of clinical evaluation, laboratory tests, imaging, and—most definitively—tissue sampling.

The “appropriate clinical material” depends on what stage of diagnosis you’re referring to:

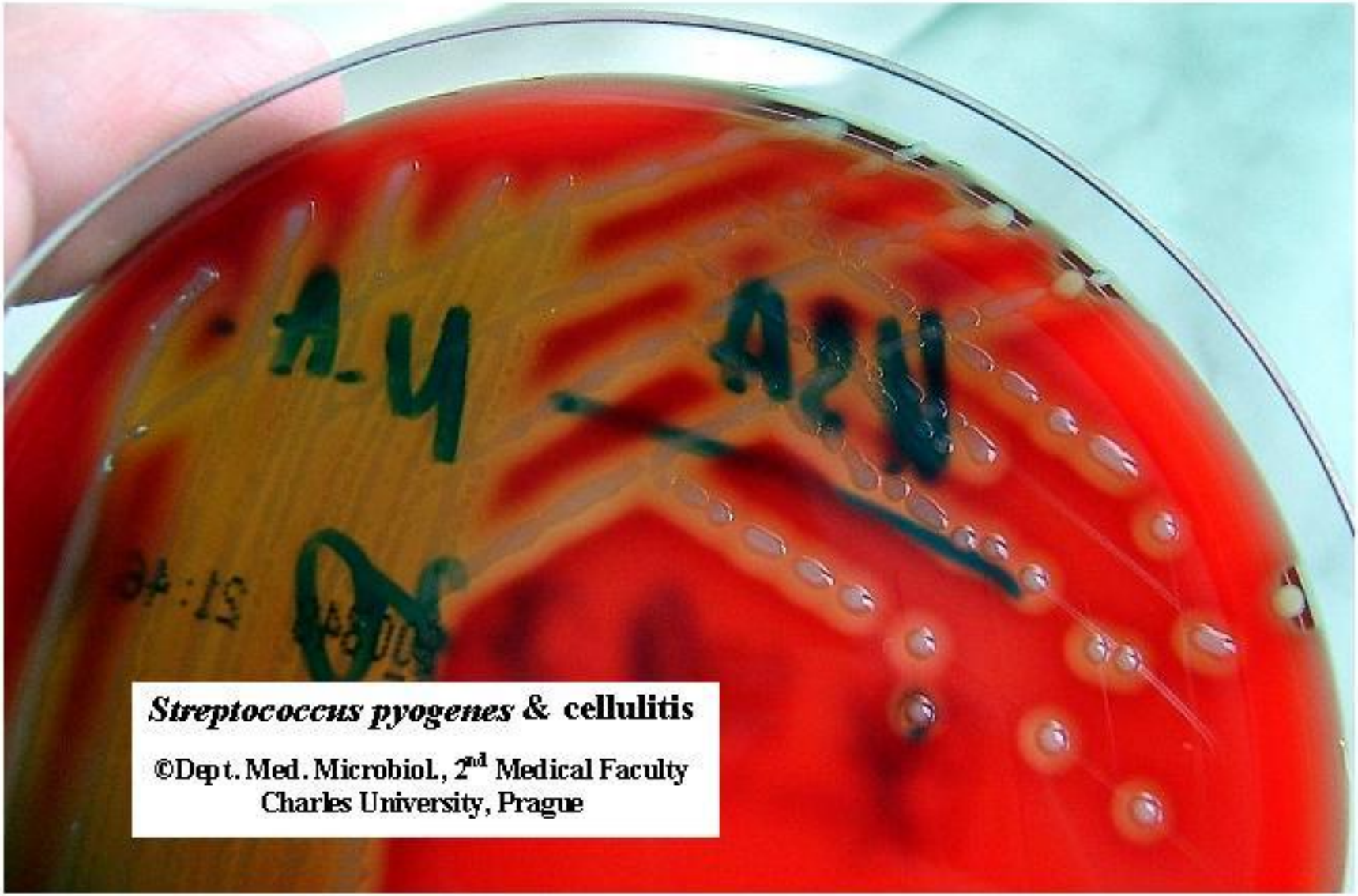
1. **Tissue** (most important) Deep tissue biopsy from the affected fascia is the gold standard. Collected during surgical exploration or debridement and sent for: Gram stain, Culture (aerobic & anaerobic), Histopathology - most reliable material because superficial swabs often miss the causative organisms.
2. **Blood samples** Blood cultures (especially if sepsis is suspected) May identify the pathogen (e.g., Group A Streptococcus, Clostridium species) 🧪
3. **Fluid or aspirate** Needle aspirate from bullae or soft tissueCan be used for:Gram stainCulture
4. **Laboratory markers** (supportive, not definitive) Used in scoring systems like LRINEC: CRP, White blood cell count… 5. Imaging - CT or MRI may show: Gas in soft tissues, Fascial thickening

9. Case report - cellulitis



***Streptococcus pyogenes* & cellulitis**


Streptococcus pyogenes & cellulitis
©Dept. Med. Microbiol., 2nd Medical Faculty
Charles University, Prague



***Streptococcus pyogenes* & cellulitis**

CELLULITIS DIAGNOSIS

1. **Clinical diagnosis** is based on: Erythema, warmth, swelling, tenderness, poorly demarcated borders, possible fever and systemic symptoms. Microbiology is not always required in uncomplicated cases.
2. **Microbiological testing** is recommended in: Severe infection or systemic toxicity, Immunocompromised patients, Unusual exposures (animal bites, water exposure), Recurrent or non-responding cellulitis, Suspicion of resistant organisms (e.g., MRSA)
3. **Specimen collection methods. A) Blood cultures** - Useful in moderate to severe cellulitis, low yield (~5–10%), but may detect bacteremia , more likely positive in elderly or immunocompromised patients **B)** Needle aspiration of the leading edge - a needle is inserted into the advancing margin of infection and fluid is aspirated and sent for: Gram stain, culture limitations: low sensitivity (~10–20%)

C) Skin biopsy (punch biopsy) from affected tissue, sent for: Culture (bacterial, sometimes fungal/mycobacterial), Histopathology, Indications:A typical cases, Immunocompromised patients, Suspected unusual pathogens

D) SwabsGenerally not useful in intact skin Only helpful if: There is an open wound, ulcer, or drainage

4. Laboratory methods

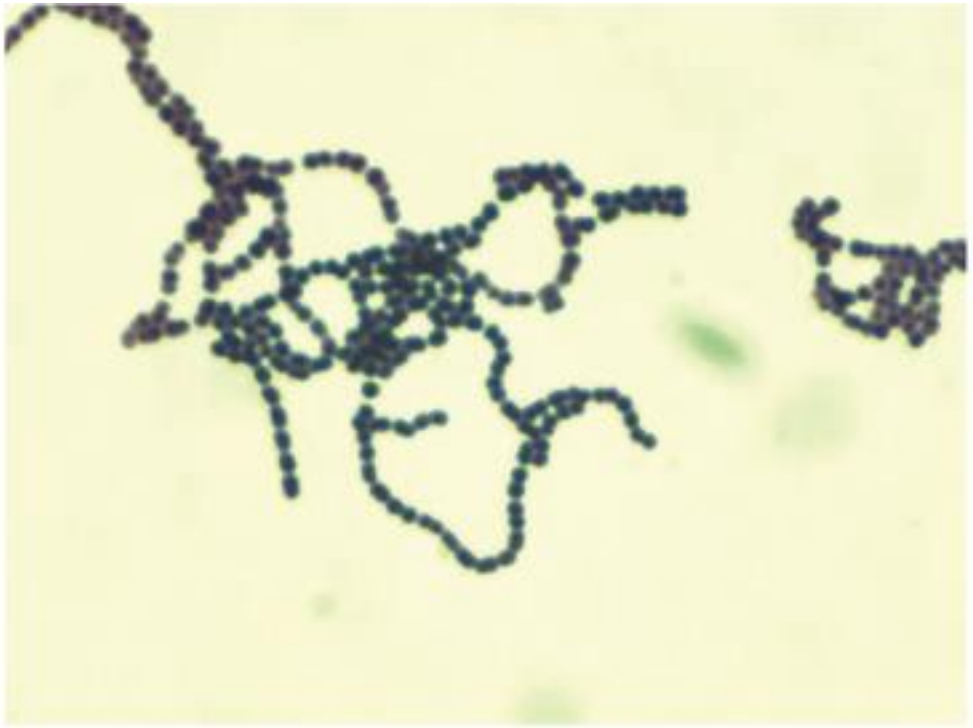
Gram stain: Rapid but often negative, **Culture:** Gold standard when organism is recovered, **PCR:** may help detect specific pathogens (e.g., MRSA), not routinely used in standard cellulitis

5. Common causative organisms *Streptococcus pyogenes* – most common Staphylococcus aureus, Others depending on exposure:Water: Vibrio, Aeromonas, Animal bites: Pasteurella

6. Diagnostic laboratory tests

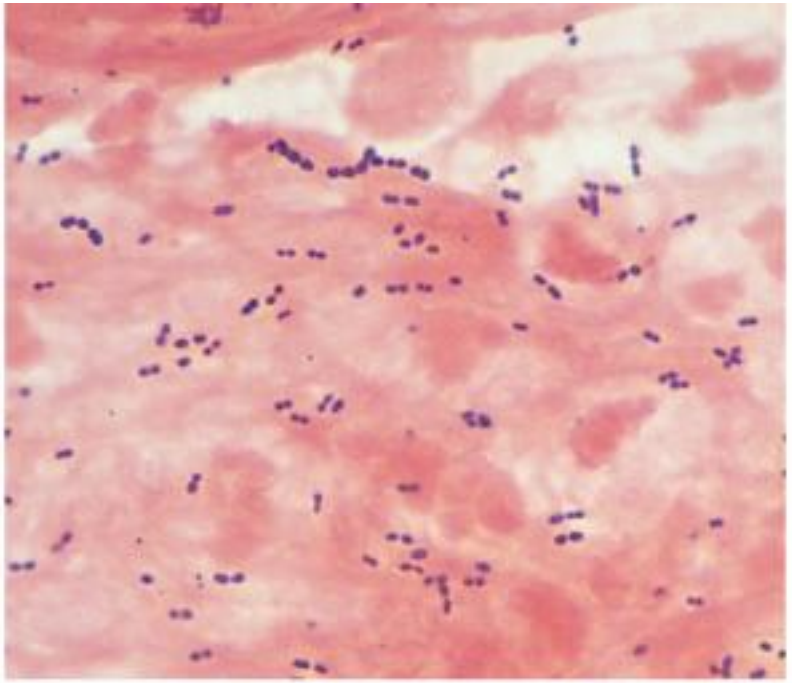
- Swab - culture, tissue: Gram staining, culture, PCR
- Culture – hemolysis
- CAMP test, PYR test
- biological/biochemical characteristics
- serologic tests: immunoassay (Ag detection, slide or aglutination test), titers of antibody ASO

6. Microscopy

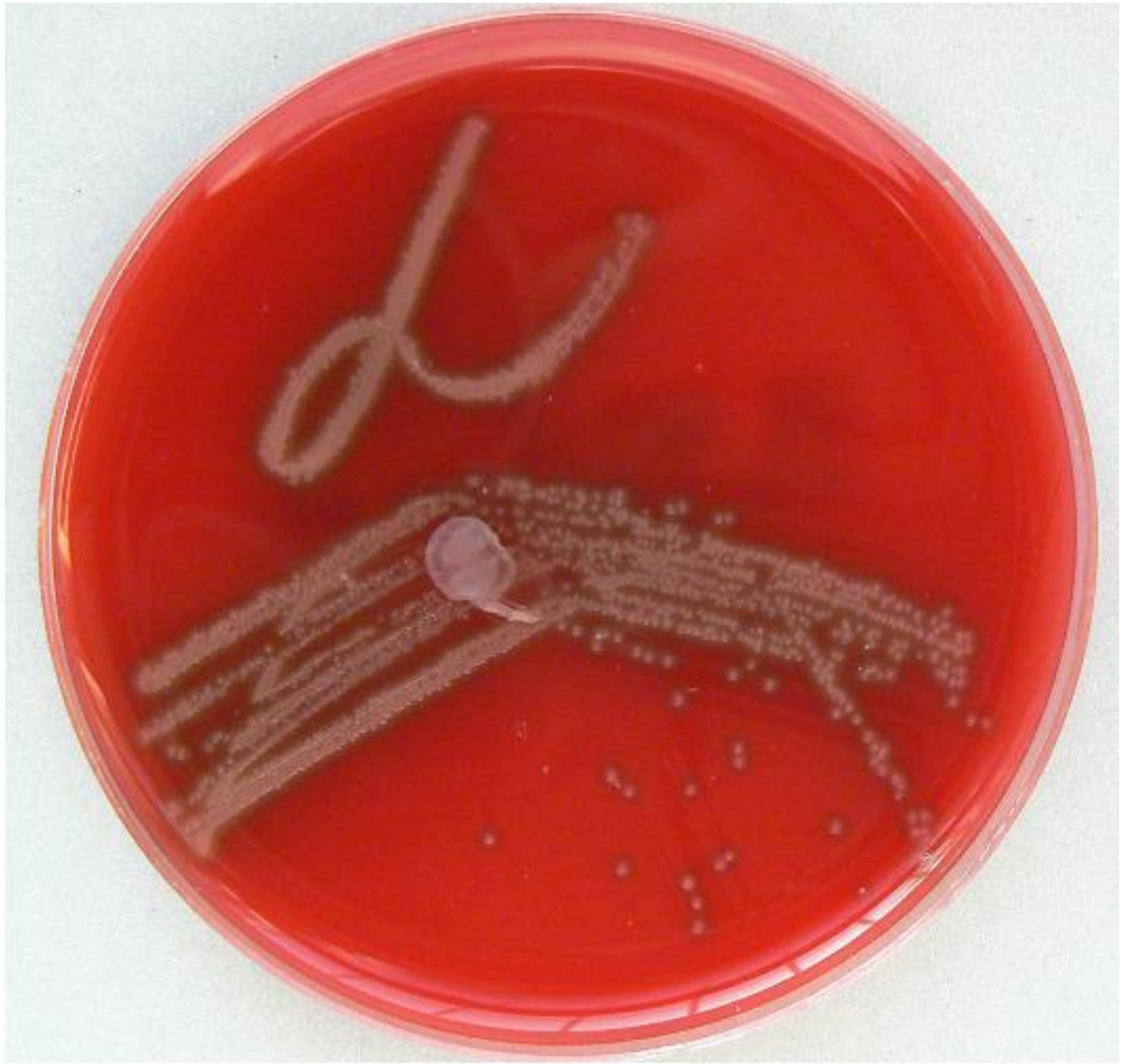


Microscopy of *Streptococcus pyogenes* – long chains when grown in liquid media (short chains in clinical specimens)

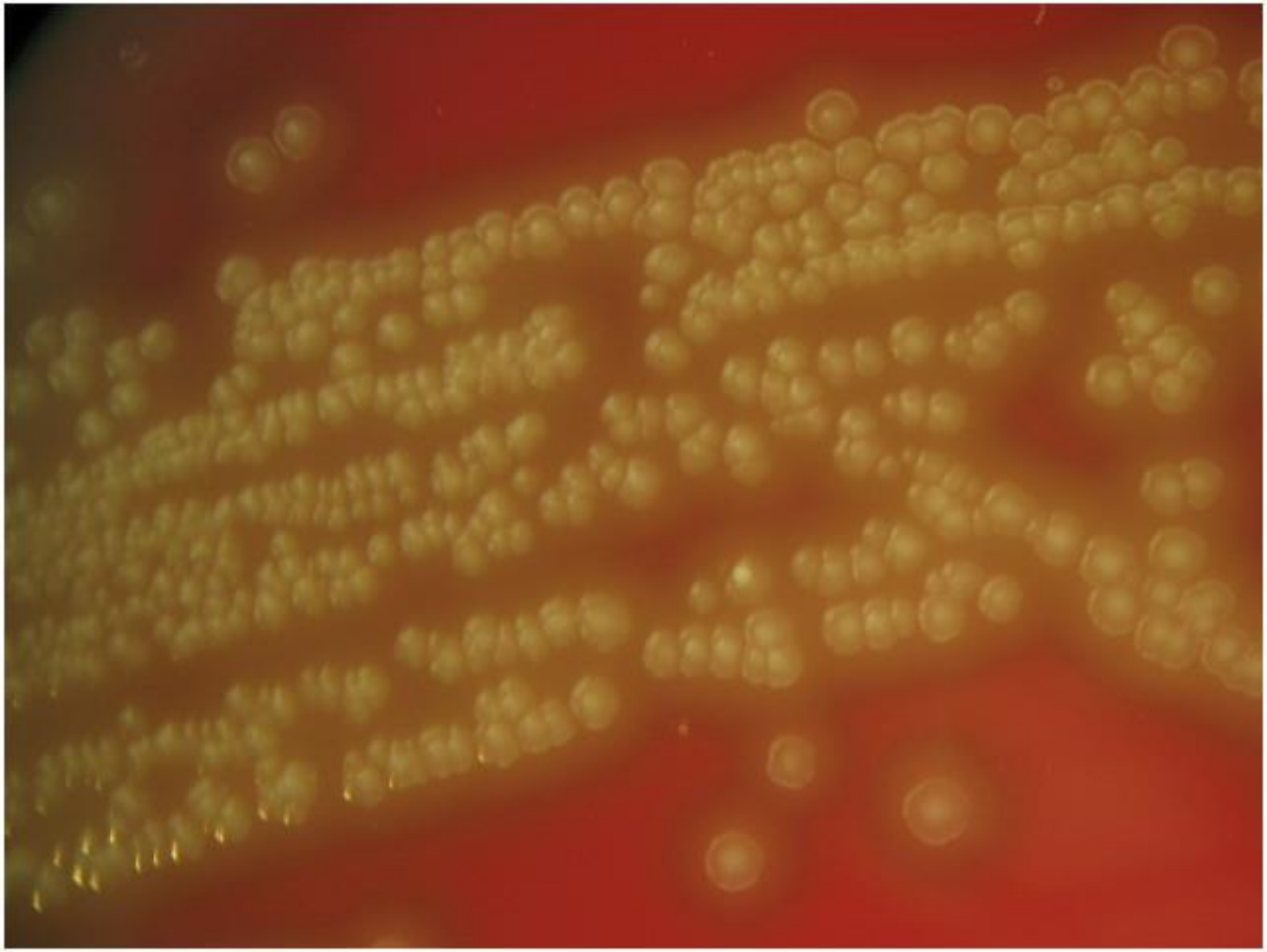
6. Microscopy



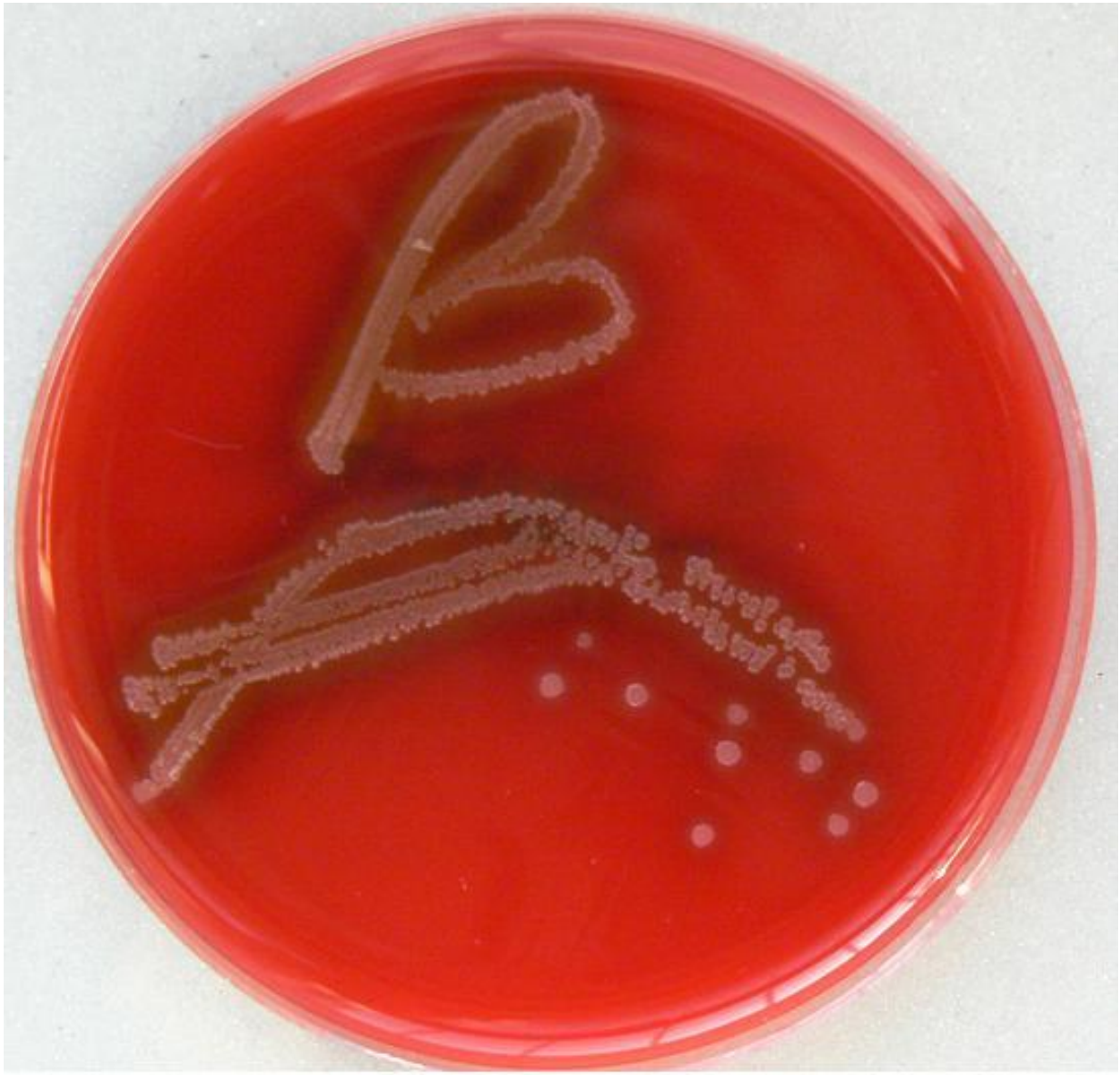
Gram stain of *S. pneumoniae* in clinical material



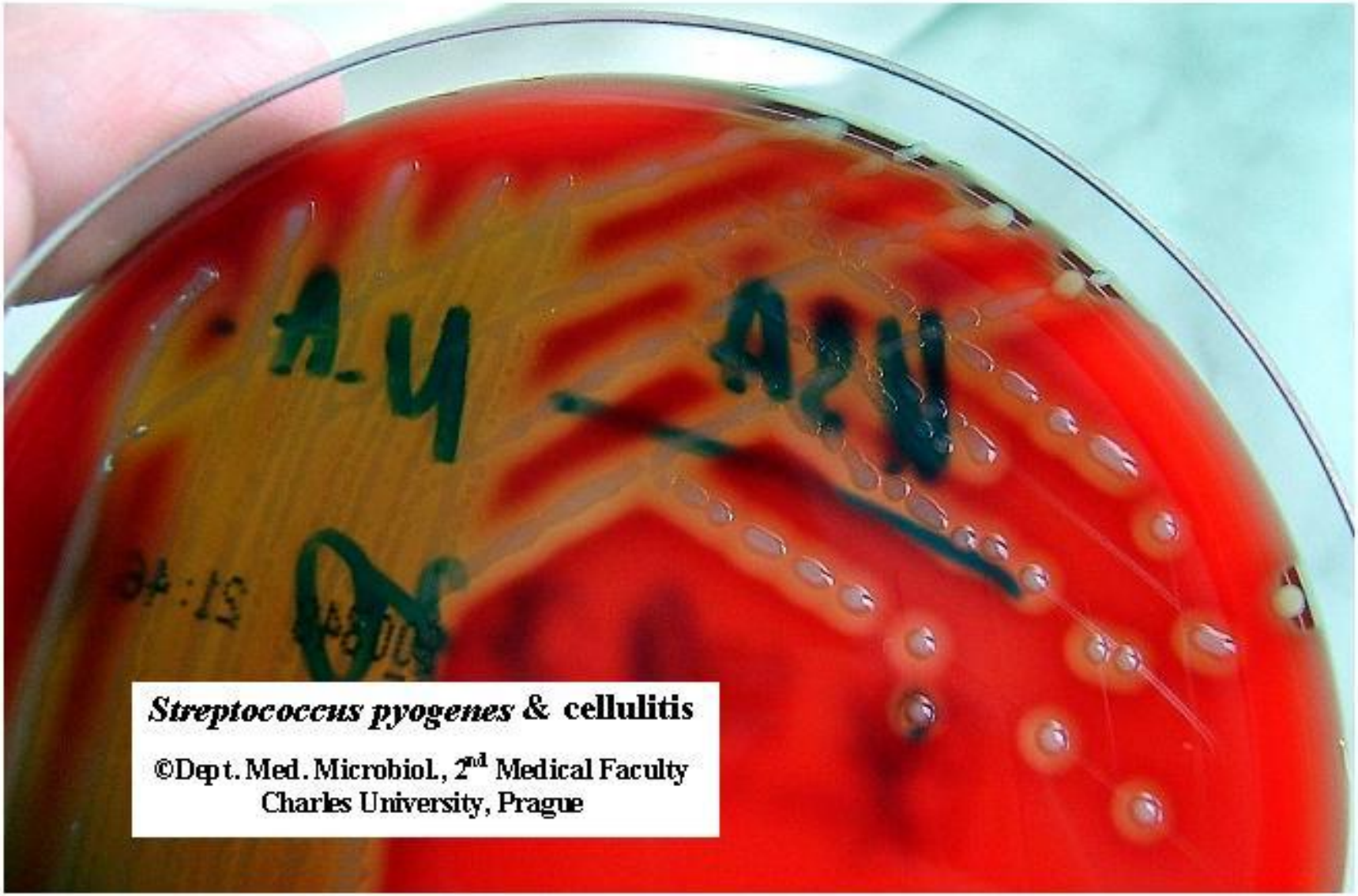
Culture of viridans (α-hemolytic) streptococci
(aerobic sporulating bacteria in the center)
Columbia blood agar



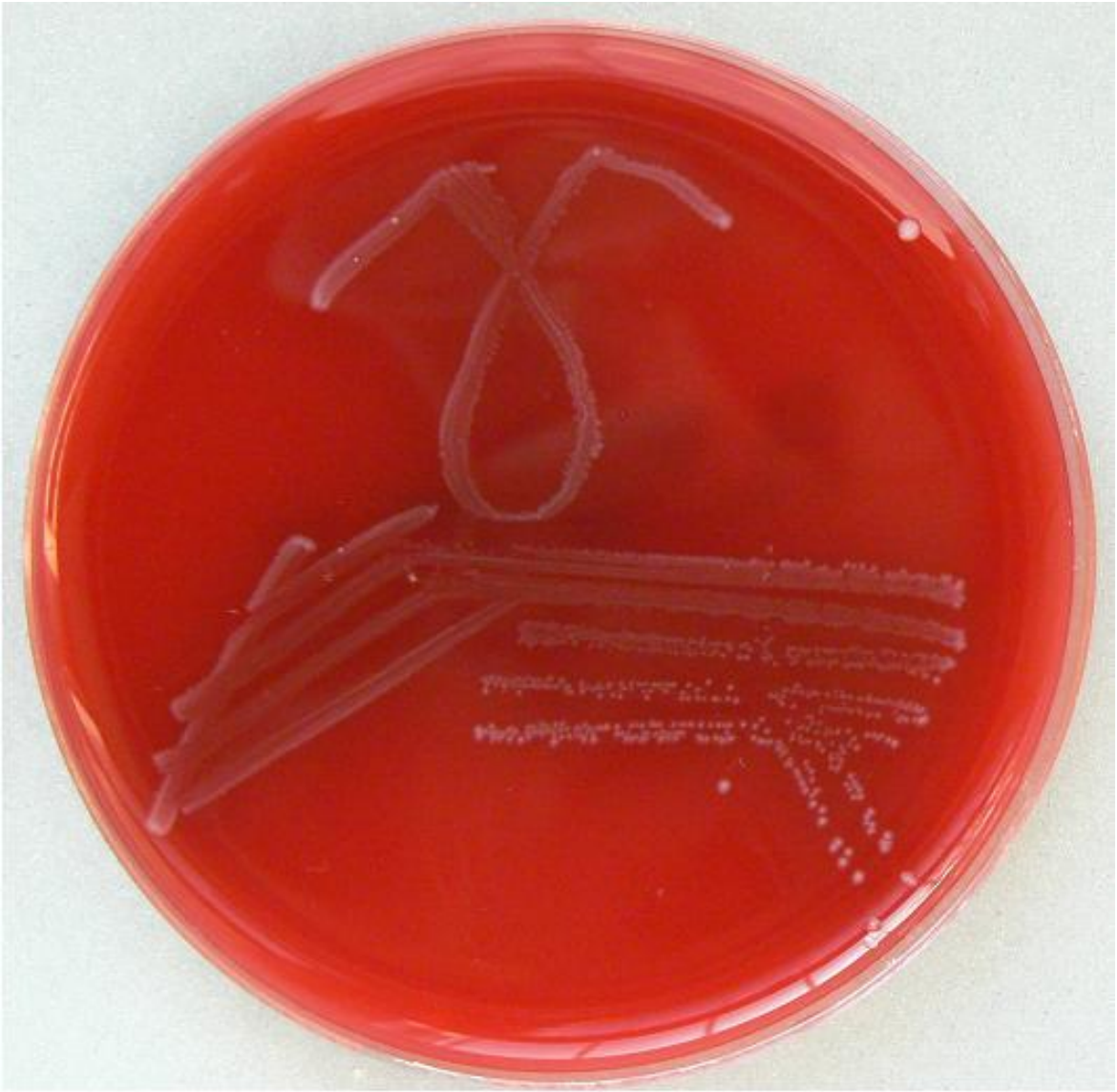
Colonies of viridans (α-hemolytic) streptococci
Columbia blood agar



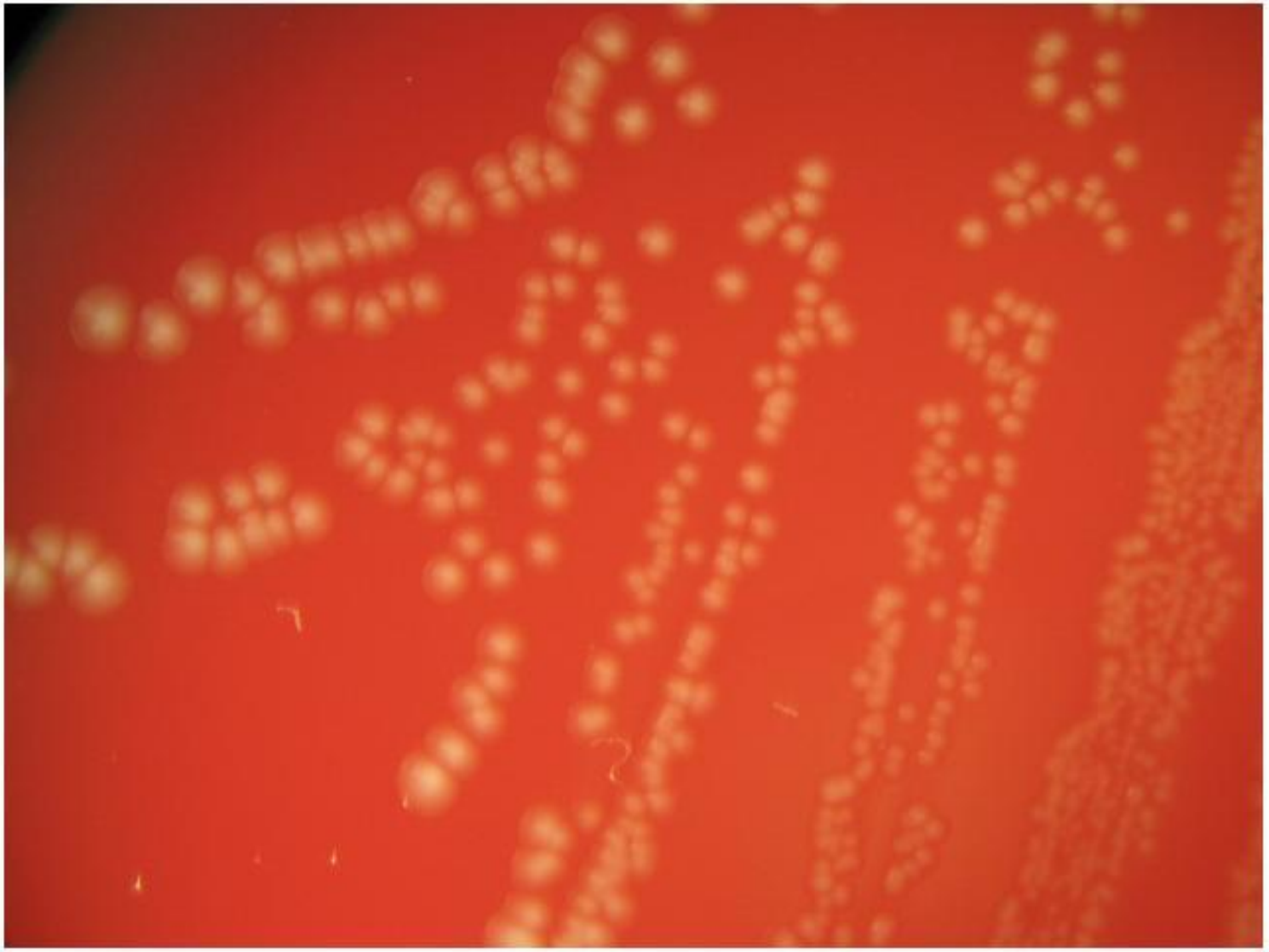
Culture of β-hemolytic streptococci
Columbia blood agar



***Streptococcus pyogenes* & cellulitis**

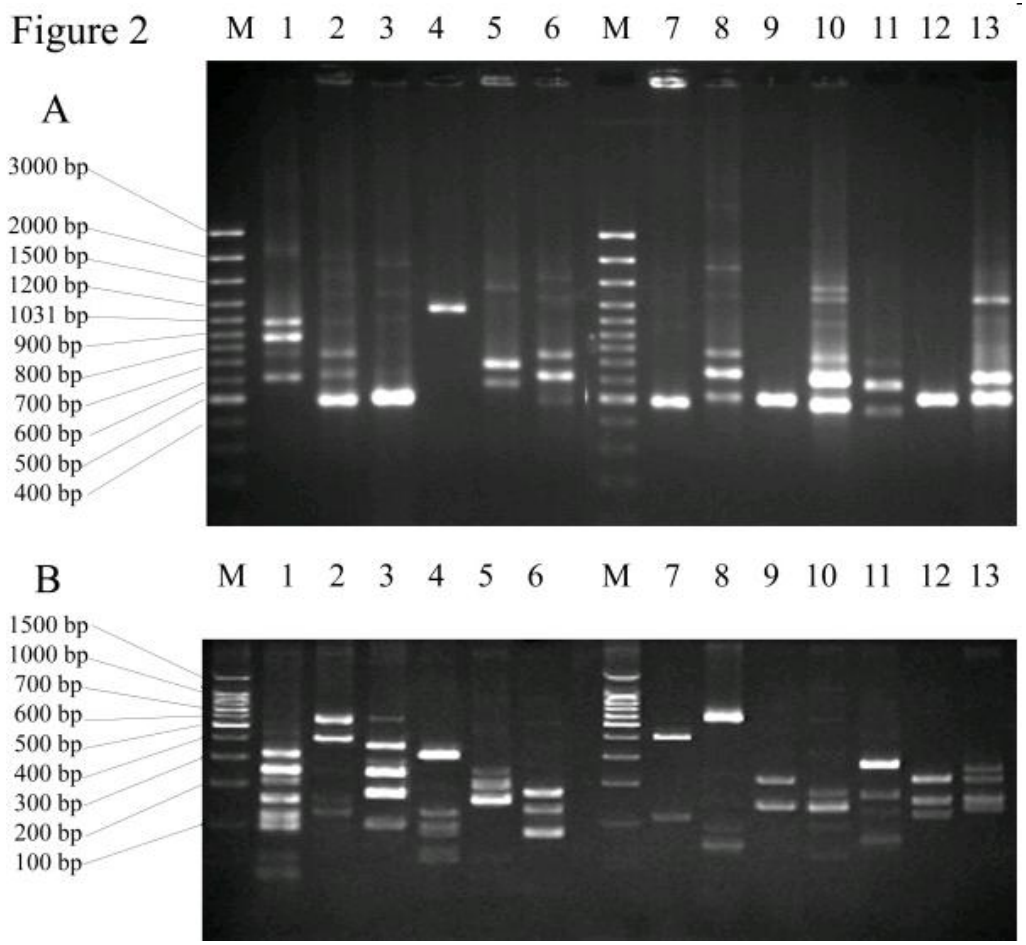


Culture of γ-hemolytic streptococci
Columbia blood agar

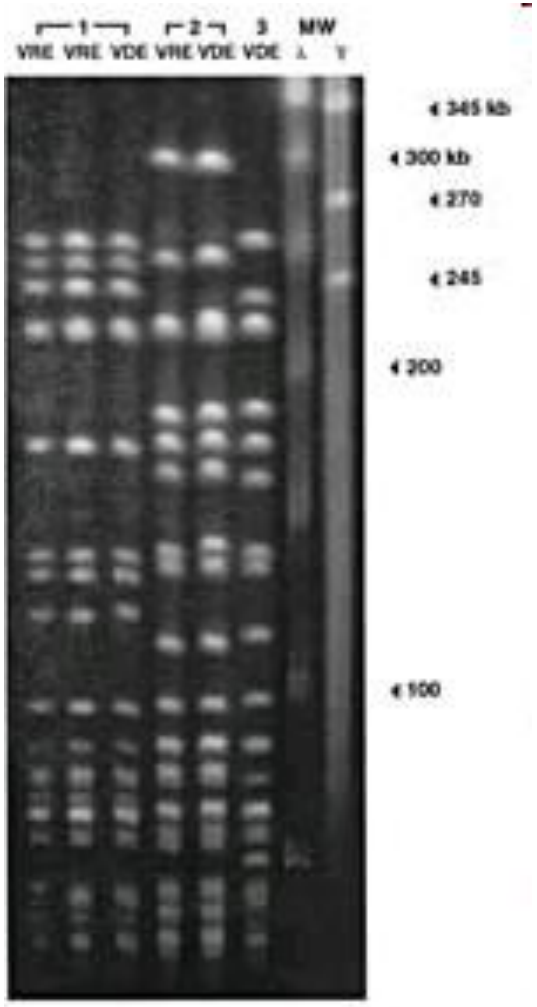


Colonies of γ-hemolytic streptococci
Columbia blood agar

7. emm typing of *S.pyogenes* isolates



7. Typing of nosocomial isolates of *E. faecium*



Enterococci (mainly ***Enterococcus faecalis*** and ***Enterococcus faecium***) are bacteria that commonly live in the human gut, but they can cause infections—especially in hospitalized or immunocompromised people.

The **most common infections caused by enterococci** are:

1. Urinary Tract Infections (UTIs)
Most frequent overall
Particularly common in:

- Hospitalized patients
- People with urinary catheters
- Enterococci are a leading cause of **catheter-associated UTIs**

2. Bloodstream Infections (Bacteremia)
Often arise from:

- UTIs
- Intra-abdominal infections
- Can progress to serious systemic illness

3. Infective Endocarditis

- Infection of the heart valves
- More common in:
  - Elderly patients
  - Those with pre-existing heart disease
- Enterococci are among the top causes of **subacute endocarditis**

4. Intra-abdominal and Pelvic Infections

Includes:

- Peritonitis
- Abscesses

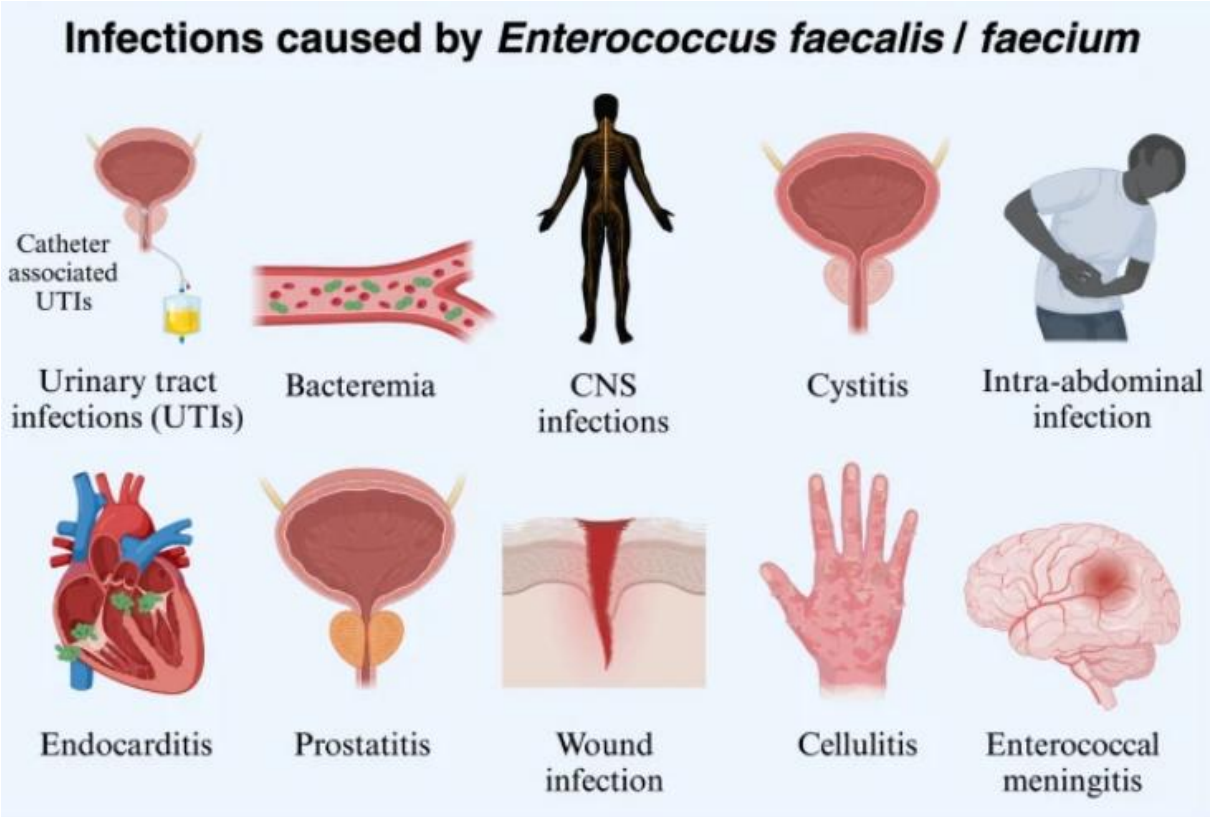
Often occur after:

- Surgery
- Bowel perforation

5. Wound and Soft Tissue Infections

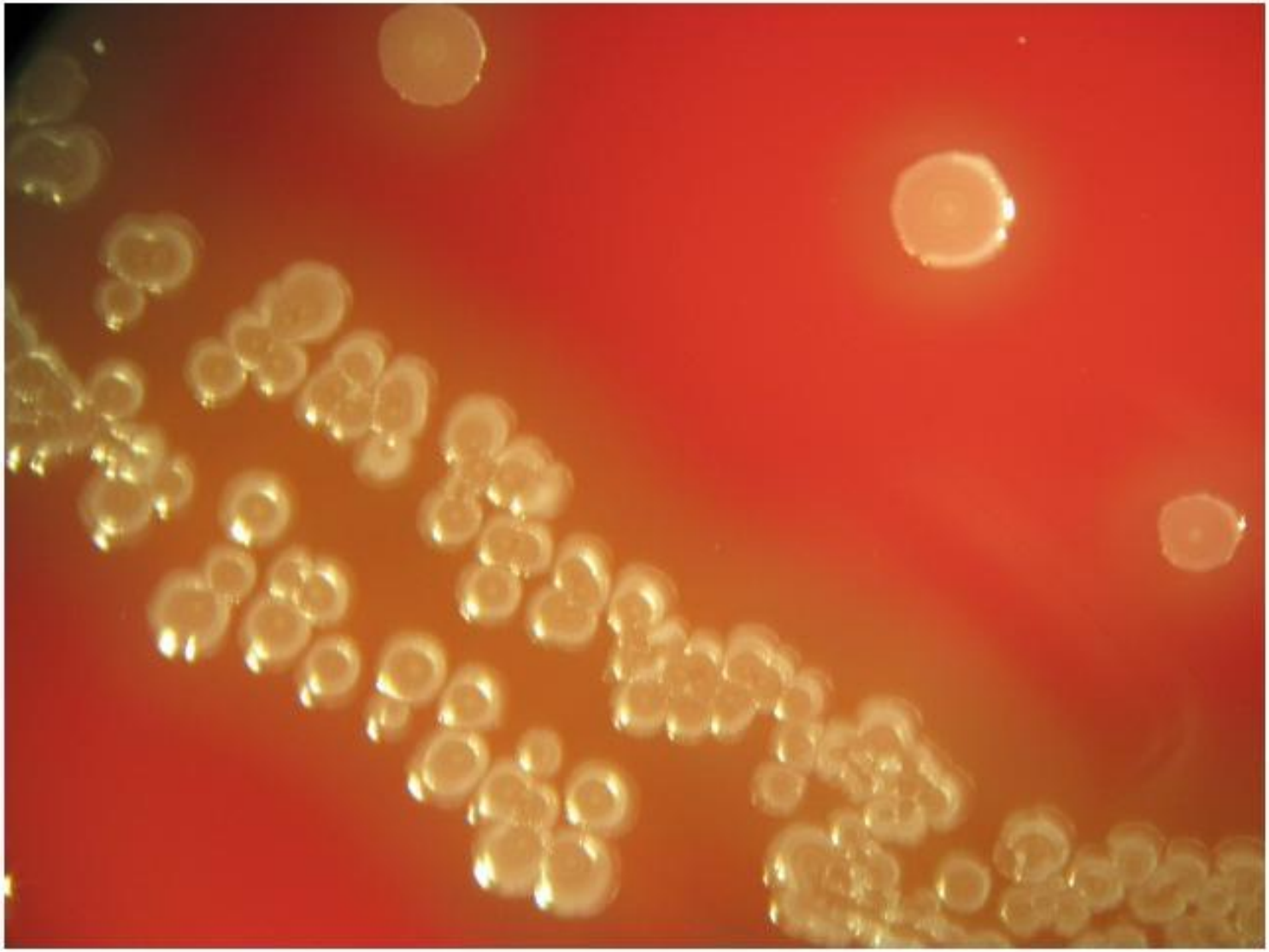
Especially in:

- Surgical wounds
- Chronic ulcers



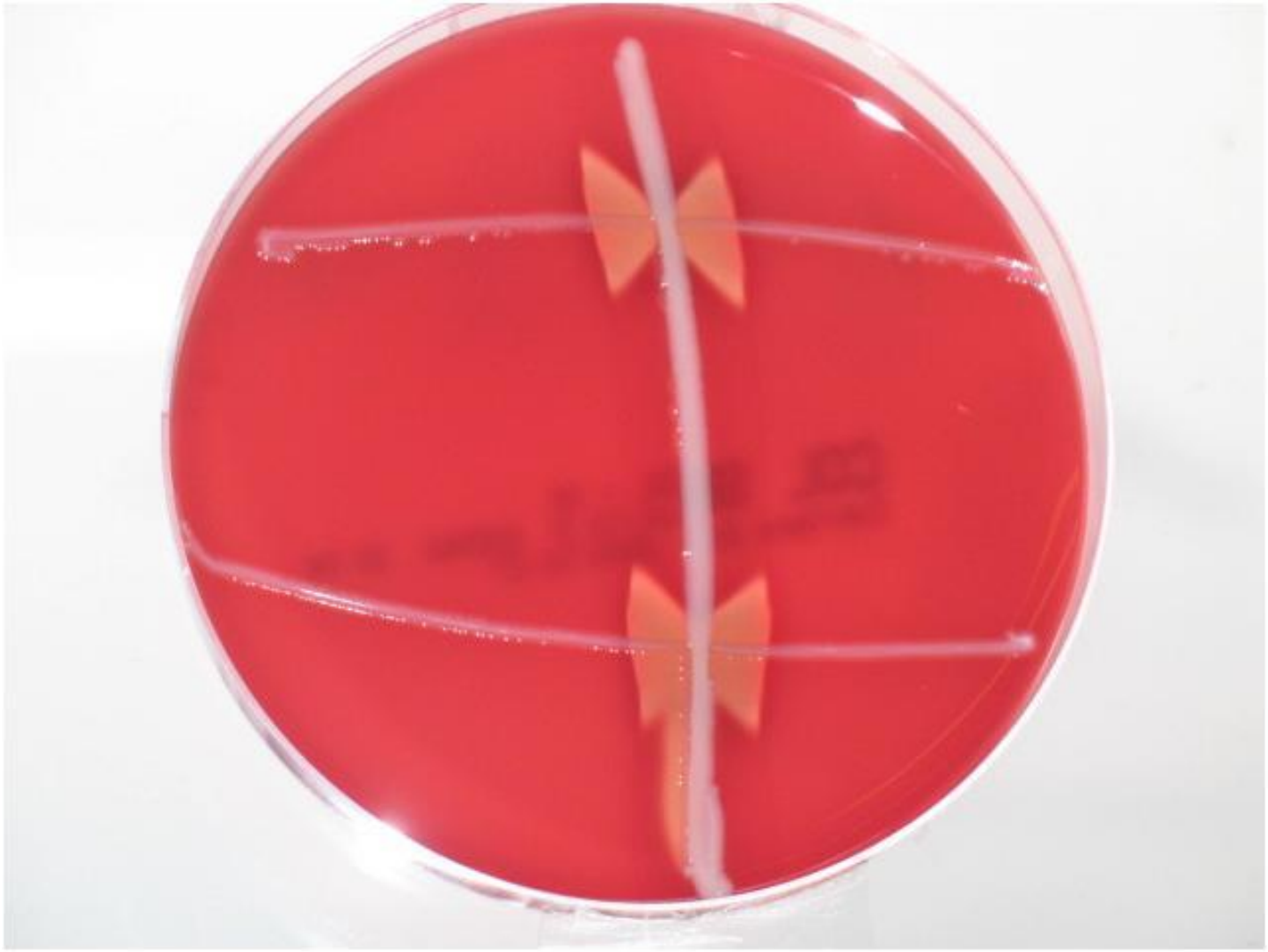
8. Treatment

- **hemolytic streptococci** sensitive to **penicillin**
- if patient is allergic to the drug macrolides could be used
- ***S. pneumoniae*** is also primary susceptible to **penicillin** but exception also exist
- **susceptibility to antibiotics vary in viridans streptococci**
- enterococci – **ampicillin** is drug of choice for ***E. faecium*** but *E. faecium* is **resistant**, also to aminoglycosides could be enterococci resistant and vancomycin also

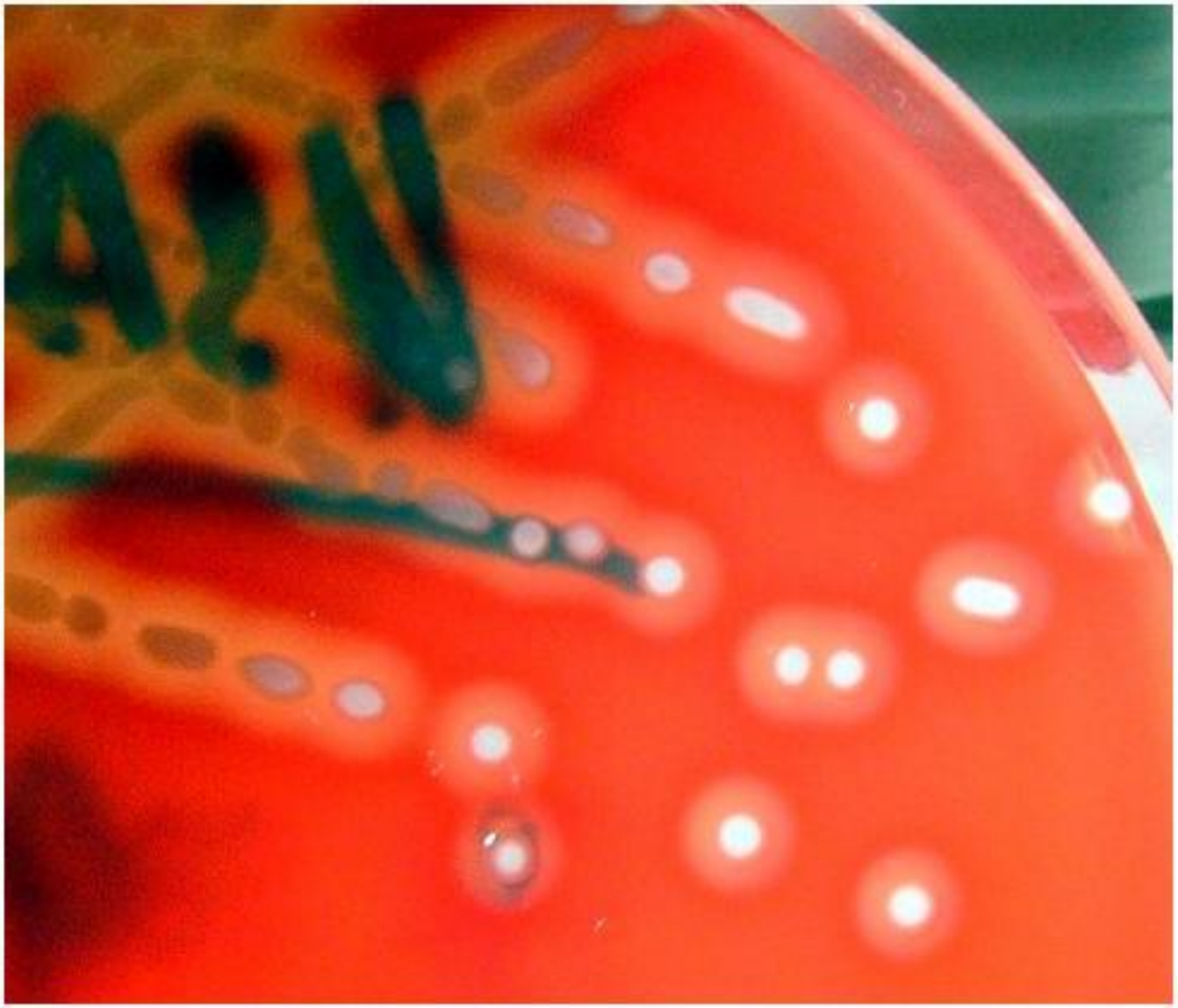


Colonies of β-hemolytic streptococci
Columbia blood agar

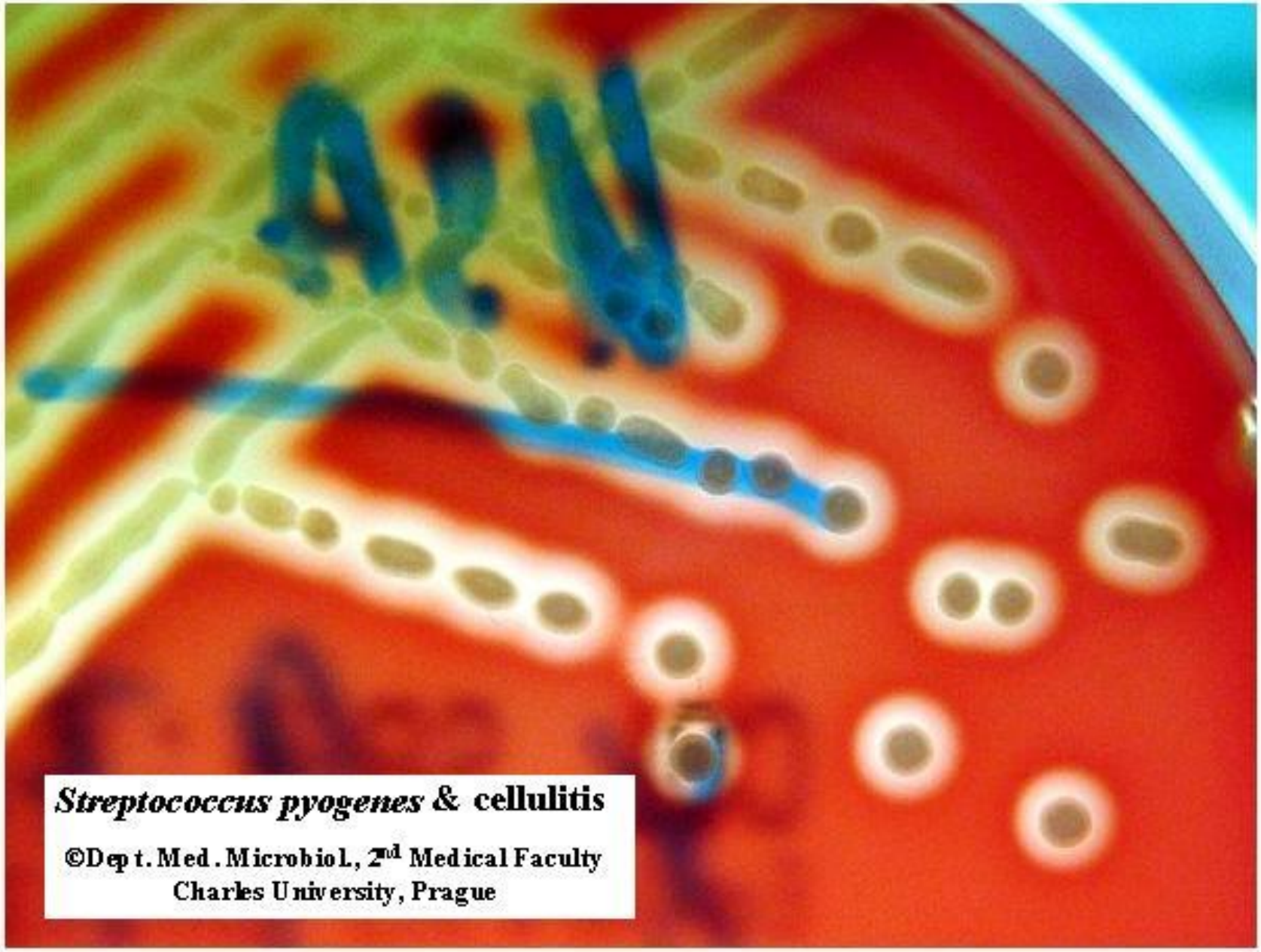
***Streptococcus agalactiae,* detail - Columbia blood agar**



CAMP test on sheep blood agar
***Streptococcus agalactiae* (horizontal lines)**
***Staphylococcus aureus* (vertical line)**



***Streptococcus pyogenes* & cellulitis**

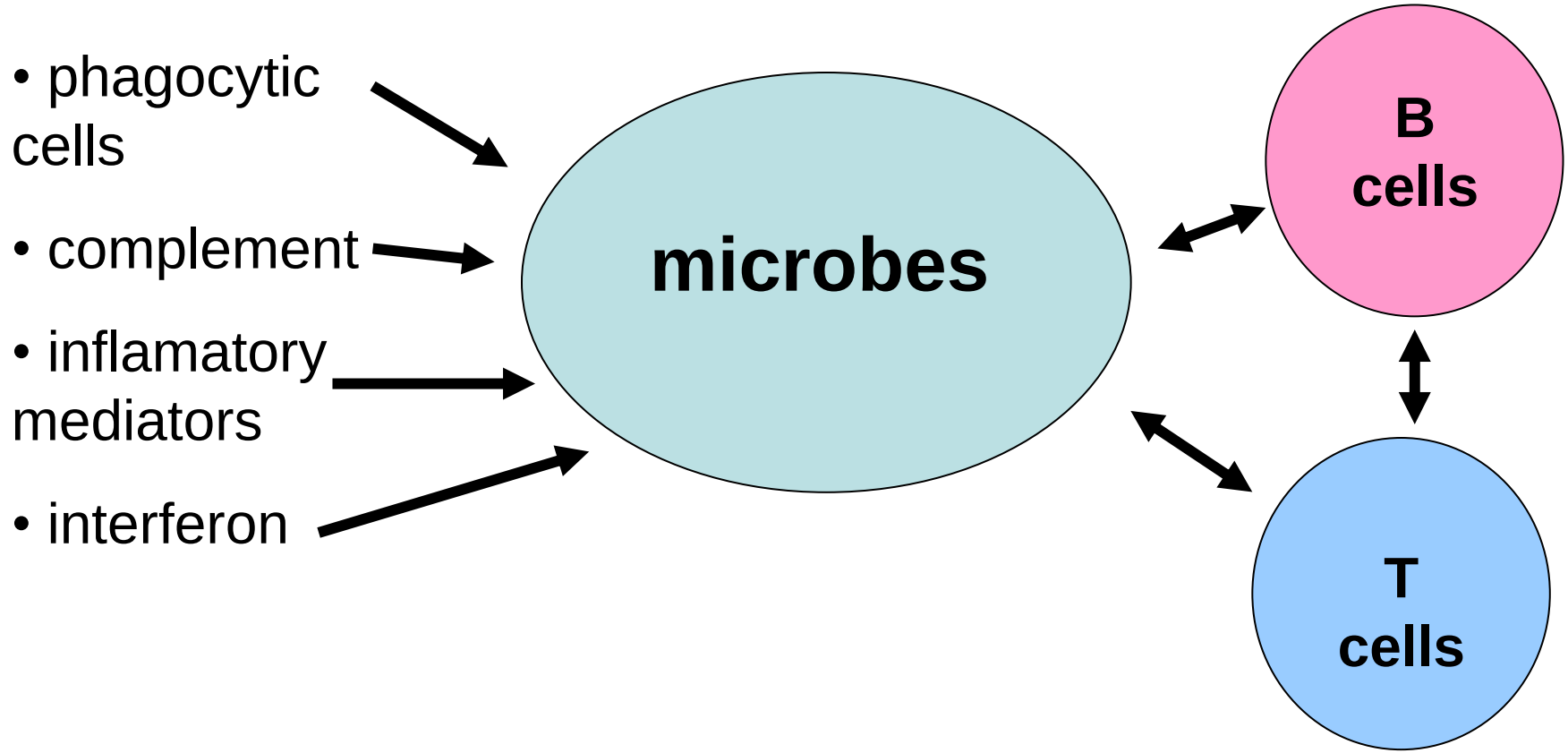


Streptococcus pyogenes **& cellulitis**

Immune system

Innate

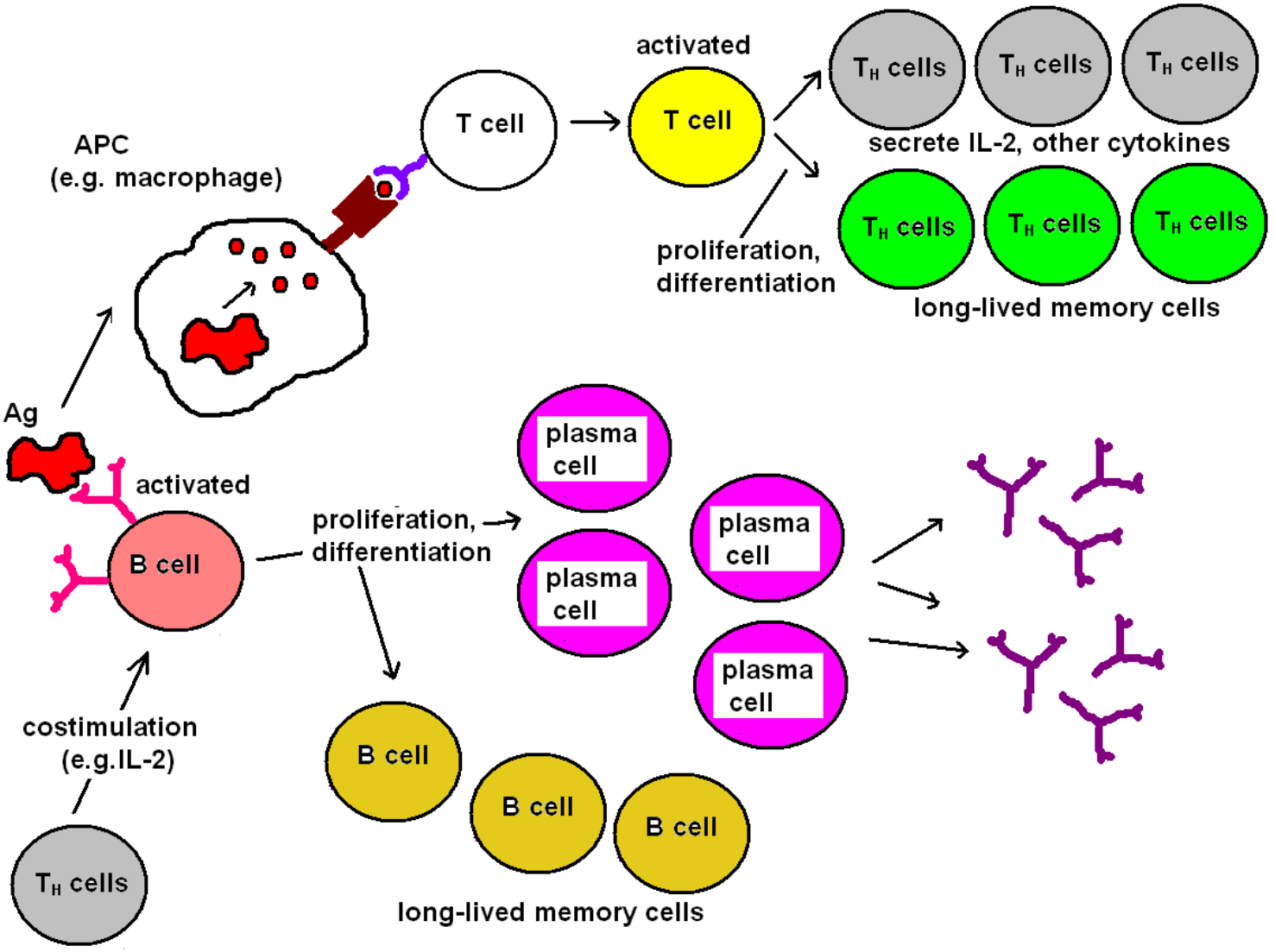
Adaptive



Physiological barriers to entry of agents

The cells activate, proliferate and differentiate (Ab production)
long term memory

Mechanism of activation, proliferation and differentiation of T and B lymphocytes



None-specific activation of T lymphocytes by superantigens