

Bacteria of medical importance

Common Pathogenic Bacteria

Objectives

- To:
 1. Discuss some selected individual bacteria of medical importance
 2. Describe their general characteristics
 3. Explain the infection/diseases they cause
 4. Describe their mode of transmission
 5. Discuss their pathogenesis

Genus Staphylococcus

- Of greatest medical importance:
 - *S. aureus*, *S. epidermidis*, *S. saprophyticus*
- Distinguished by:
 - Coagulase production
 - Protein A on cell surface
 - Production of recognized exotoxin
 - Resistance to novobiocin (5µg)
 - Hemolysin production

Staphylococcus aureus

- Gram-positive coccus in clusters
- White or golden color on blood agar
- Catalase and coagulase –positive
- Mannitol-positive & tolerant of salt
- Diseases/infections:
 - **Skin infections**
 - **Post-op wound infection**
 - **Scalded skin syndrome (SSS)**
 - **Catheter-associated infections**
 - **Endocarditis, septicemia,**
 - **Osteomyelitis,**
 - **Pneumonia**

Staphylococcus aureus

■ Transmission

- Skin, nose
- Contact or airborne

■ Epidemiologic analysis

- Methicillin-resistant strains (MRSA)
- Hospital and community outbreaks
- Bacteriophage, Pulsed-field gel electrophoresis (PFGE)

Staphylococcus aureus

■ Pathogenesis

- Coagulase
- Mucopeptide
- Extracellular products – enterotoxins, epidermolytic toxin, toxic shock syndrome toxin, membrane-damaging toxins (haemolysins), leukocidin, staphylokinase

Staphylococcus epidermidis

- Catalase positive, coagulase-negative, mannitol negative
- Produces extra-cellular slime
- Infections
 - Opportunistic infections associated with device-associated sepsis, e.g.:
 - ✓ catheter-related sepsis, prosthetic valve endocarditis, infection of artificial joints and shunt infection.
 - Urinary tract infection (UTI)
 - Sternal wound osteomyelitis

Staphylococcus saprophyticus

- Catalase-negative, coagulase-negative
- Whitish colony on Blood agar
- Resistant to novobiocin

- Infections
 - UTI (**Honeymoon cystitis**) in previously healthy women





Genus *Streptococcus*

- Gram-positive in chains
- Medically significant streptococci are divided according to:
 - Hemolysis on blood agar – beta (β), alpha (α) or gamma (γ) -hemolysis
 - Presence of group specific carbohydrate antigen i.e. Lancefield groups A, B, C, D -V

Beta (β)-hemolytic streptococci

- *Streptococcus pyogenes* (GA β -HS or GAS)
- Infections
 - Pharyngitis
 - Cellulitis
 - Erysipelas
 - Lymphadenitis
 - Scarlet fever
 - Non-suppurative sequelae – acute glomerulonephritis and rheumatic fever

Streptococcus pyogenes

■ Transmission

- Airborne droplet or by contact

■ Pathogenesis

- ✓ Elaborates many enzymes and exotoxins:
 - Erythrogenic toxin, streptolysins, streptokinase A and B, deoxyribonuclease, hyaluronidase ('spreading factor')





Streptococcus agalactiae

- Group B β -hemolytic *Streptococcus* (GBS)
- Gram-positive coccus in chains

Infections

- Neonatal meningitis and septicemia, pneumonia, UTI and soft tissue infection in adult diabetics.

Transmission

- From gut and vagina

Pathogenesis

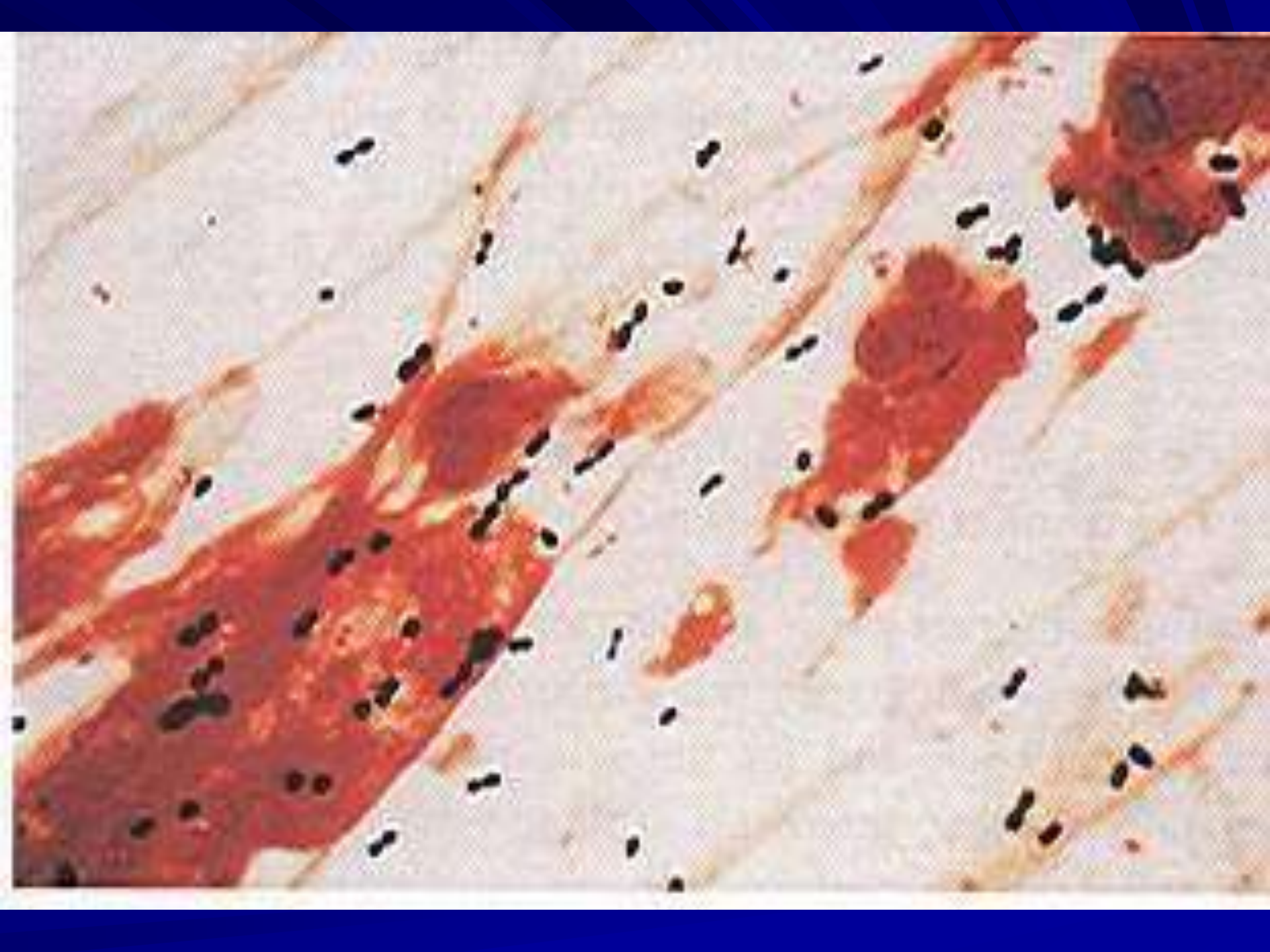
- Virulence factors not clearly identified.

Streptococcus pneumoniae

- Alpha (α)-hemolytic *Streptococcus*
- Gram-positive cocci in pairs i.e. diplococci
- Optochin positive
- Bile soluble

Infection

- Pneumonia
- Meningitis
- Septicemia
- Otitis media, sinusitis
- Transmission is via droplet spread
- Pathogenesis
 - Capsule, pneumolysin
 - Splenectomy, splenic dysfunction, sickle cell disease



Listeria monocytogenes

- Short Gram-positive rod
- Motile with 'tumbling' movement
- Hemolytic on sheep or horse blood agar
- **Infections**
 - Meningitis & sepsis in neonates
 - Sepsis on immunocompromised patients and in pregnant women
- **Transmission**
 - Ingestion of contaminated food
 - Transplacental
- **Pathogenesis**
 - Internalins (cell attachment factors), haemolysins, motility protein, survives inside phagocytes

Mycobacterium spp

Characteristics

- Gram-positive cell wall structure
- Stains with difficulty because of long-chain fatty acid (mycolic acid) in cell wall.
- Acid fast: stains with Ziehl-Neelsen stain
- Growth 3-7 days; some 6 – 8 weeks
- All, except *M. leprae*, can be grown on artificial culture
- Intracellular parasites

Mycobacterium spp

Infection

■ *M. tuberculosis*

- Pulmonary tuberculosis and extra-pulmonary diseases, e.g. meningitis, vertebral osteomyelitis

■ *M. leprae*

- Leprosy

■ *Mycobacterium* other than *M. tuberculosis* (MOTT)

- Atypical pneumonia in immunocompromized hosts, e.g. AIDS patients

Mycobacterium spp

■ **Transmission**

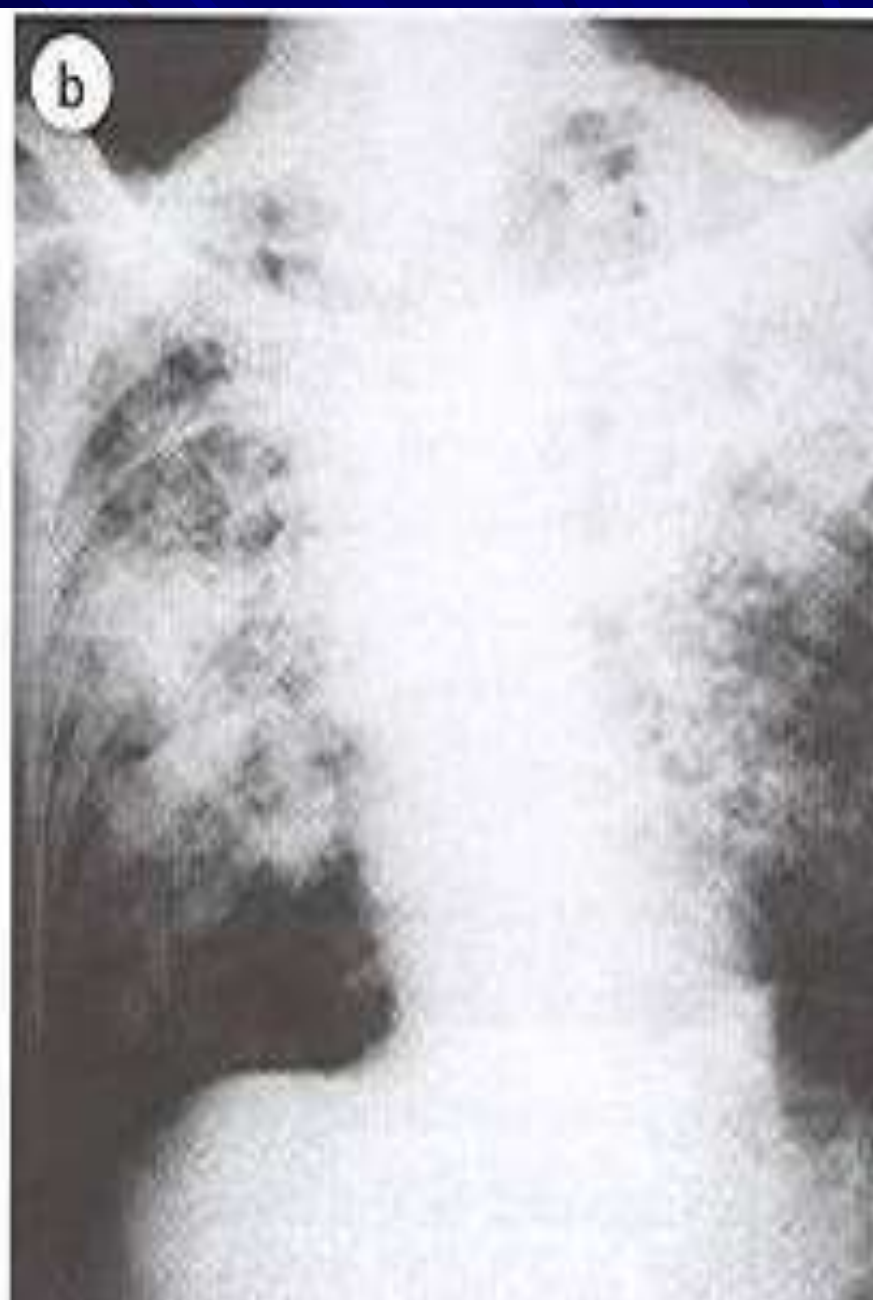
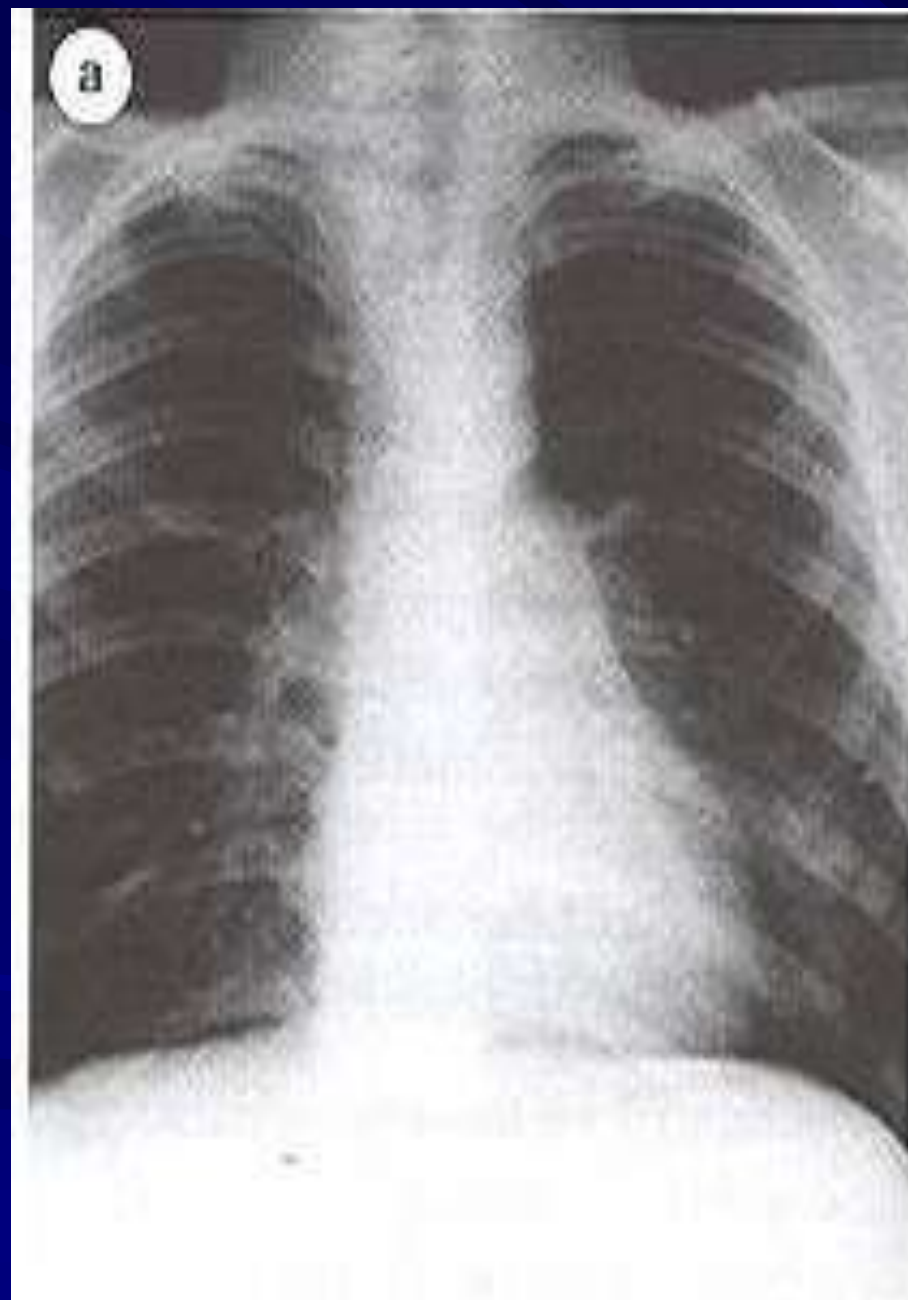
- Droplet
- Unpasteurized milk
- Leprosy requires close contact

■ **Pathogenesis**

- Both *M. tuberculosis* and *M. leprae* are intracellular
- Give rise to slowly developing chronic conditions
- Pathology due to host immune responsiveness

■ **Treatment & prevention:**

- Prolonged with combination of drugs
- BCG vaccination
- Pasteurization of milk
- Increased hygienic standards





Enterobacteriaceae

- Gram-negative aerobic rods
- Normal flora of human and animal gut
- Facultative anaerobes

Escherichia coli

- Gram-negative aerobic rod
- Facultative anaerobe
- Grows on bile-containing selective media (MacConkey)
- Ferments lactose (LF)
- Infections
 - UTI
 - Diarrhoeal diseases
 - Neonatal meningitis
 - Septicemia

Escherichia coli

■ **Transmission**

- Spreads by contact and ingestion, food-associated, endogenous

■ **Pathogenesis**

- Endotoxin
- Adhesins – P fimbriae, colonization factors
- Capsule – K1 capsular type (neonatal meningitis)
- Enterotoxins – diarrheal diseases: Enterotoxigenic *E. coli* (**ETEC**), Enteroinvasive *E. coli* (**EIEC**), Enterohaemorrhagic *E. coli* (**EHEC**) produce verotoxin-associated with hemolytic ureamic syndrome (**HUS**)

Salmonella spp

- Gram-negative rods
- Not member of the normal flora of the gut
- Motile
- All, except *S. typhi*, are non-capsulated
- Typhoidal and non-typhoidal *Salmonella*
- Survive in the reticulo-endothelia system

Non-typhoidal *Salmonella* spp

- Contains over 2000 species
- Do not ferment lactose (NLF)
- **Diseases/infection**
 - Diarrhoea
 - Bacteremia, septicemia
 - Osteomyelitis in sickle cell disease patients
- **Transmission**
 - Widespread in animals, encountered in food chain, e.g. poultry, egg, meat, milk & cream
 - Ingestion of contaminated food and person-to-person via fecal-oral route

Typhoidal *Salmonella* spp

- *S. typhi*, *S. paratyphi* A, *S. paratyphi* B and *S. paratyphi* C
 - Capsulated
 - Human pathogens only
- **Diseases**
 - Systemic infection
 - Enteric fever – typhoid fever
- **Transmission:**
 - Fecal-oral route, via contaminated water and food
 - Carriers are important source

Treatment

- No antibiotics for salmonella diarrhea, except severe and invasive
- Fluid replacement
- Antibiotics needed for enteric fever
 - Ciprofloxacin
 - Chloramphenicol
 - Cefotaxime

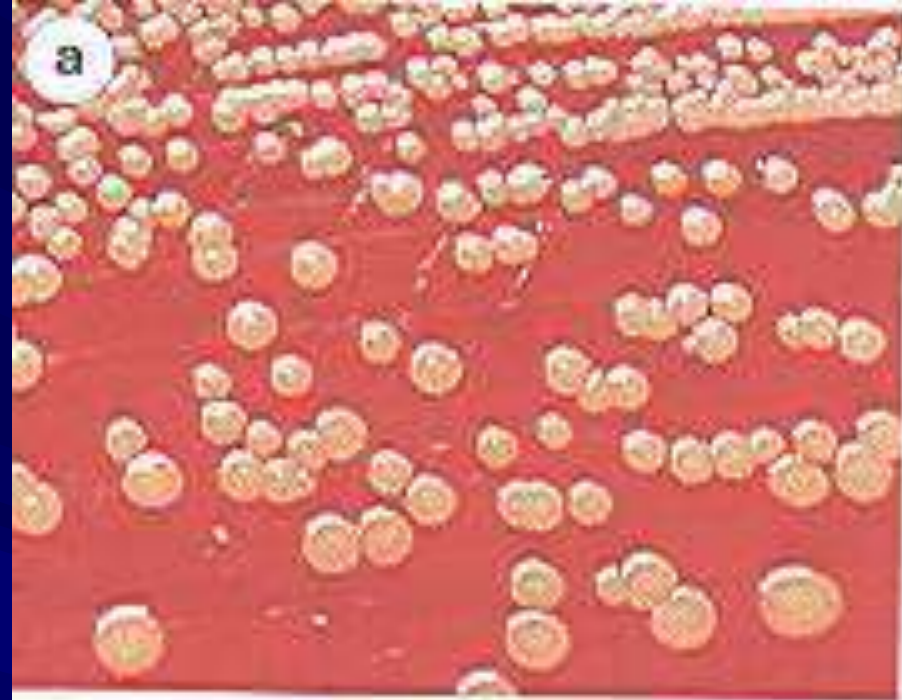
Gram-positive sporing anaerobes

- *Clostridium perfringens*
 - Gas gangrene
 - Food poisoning
- *Clostridium tetani*
 - Tetanus
- *Clostridium difficile*
 - CDAD – AAD, AAC, PMC
- *Clostridium botulinum*
 - Food poisoning - botulism



Gram-negative non-spore-forming anaerobes

- Short Gram-negative anaerobic rods
- ***Bacteroides spp***
 - Found in normal human gut flora
- ***Prevotella spp***
 - Found in the genitourinary tract
 - Black-brown pigmented
- ***Porphyromonas spp***
 - Black pigmented part of the normal oral flora
- ***Fusobacterium spp***
 - Found in the oral cavity



Bacteroides fragilis

- Most important NSA causing infection
- Small pleomorphic Gram-negative rod
- **Infection**
 - Usually mixed with aerobes and microaerophilic
 - Intra-abdominal sepsis
 - Liver abscess
 - Aspiration pneumonia
 - Brain abscesses
 - Wound infections
- **Transmission**
 - Endogenous
 - Contamination with fecal content

Bacteroides fragilis

■ Specimens

- Pus
- Biopsy materials
- Transtracheal aspiration
- Process under anaerobic conditions

■ Treatment

- Incision & drainage
- Metronidazole
- Clindamycin
- Carbapenems

Chlamydia

- Small Gram-negative bacteria
- Obligate intracellular parasites
- Lack peptidoglycan
- Lack ability to produce ATP
- *C. trachomatis*
- *C. pneumoniae*
- *C. psittaci*

Chlamydia

Infections

- Atypical pneumonia
- Trachoma
- Inclusion conjunctivitis
- Ophthalmia neonatorum
- Genital infections
- Psittacosis
- Perihepatitis

Chlamydia

■ **Transmission**

- Inhalation
- Contaminated bird litter
- Direct sexual contact

■ **Laboratory detection**

- Cell culture
- Immunofluorescence
- Serology

■ **Treatment**

- Tetracycline, erythromycin, fluoroquinolones
- No vaccine available

Mycoplasma

- Lack true cell wall
- Flexible triple-layer of protein and lipids
- Contains cholesterol in the cell membrane (absent in other bacteria)
- Important species:
 - *M. pneumoniae*
 - *M. hominis*
 - *Ureaplasma urealyticum*

Mycoplasma

Diseases/infections

- Atypical pneumonia
- Non-gonococcal urethritis
- Pelvic inflammatory disease (PID)
- Joint sepsis

Transmission

- Person-to-person and sexual contact

Rickettsia

- Gram-negative bacteria
- Require coenzyme A, NAD, ATP
- Obligate intracellular parasites

- **Diseases/infections:**
 - Typhus, Rocky mountain, Mediterranean and other spotted fevers; Q fever

- **Transmission**
 - Bite of ticks, fleas, mite and lice

Rickettsia

■ Treatment:

- Tetracycline, fluoroquinolones, chloramphenicol
- Vaccine available for at risk individuals

■ Laboratory diagnosis

- Isolation difficult.
- Mainly diagnosed by serology

Recommended Reference

Medical Microbiology, 15th Edition, ed.
David Greenwood, Richard Slack, John
Peuther, Published by Church Livingstone,
Edinburgh, London.