BHARATHIDASAN UNIVERSITY

Tiruchirappalli- 620024
Tamil Nadu, India.

Programme: M.Sc., Biomedical Science

Course Title : Clinical Microbiology

Course Code : 18BMS48C15

Unit-I

TOPIC: General Properties of Medically important Bacteria

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General Properties of Medically important Bacteria

Bacteria

Gram positive

Cocci

Staphylococcus aureus

Streptococcus pneumonia

Streptococcus pyogenes

Rods

Bacillus anthracis

Bacillus subtilis

Clostridium tetani

Clostridium botulinum

Gram negative

Cocci

Nesseria meningitis

Nesseria ghonorrhea

Rods

Salmonella typhimurium

Pseudomonas aeruginosa

Escherichia coli O157: H7

Staphylococcus spp

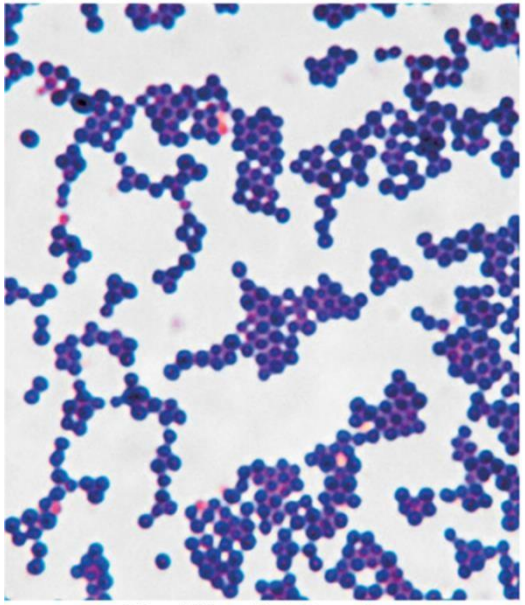
- Family: Micrococcaceae
- Genus:
  - A. *Staphylococcus*- derived from Greek Include major human pathogen and skin commensals
- *Staphylococcus* divided into coagulase positive & coagulase negative categories

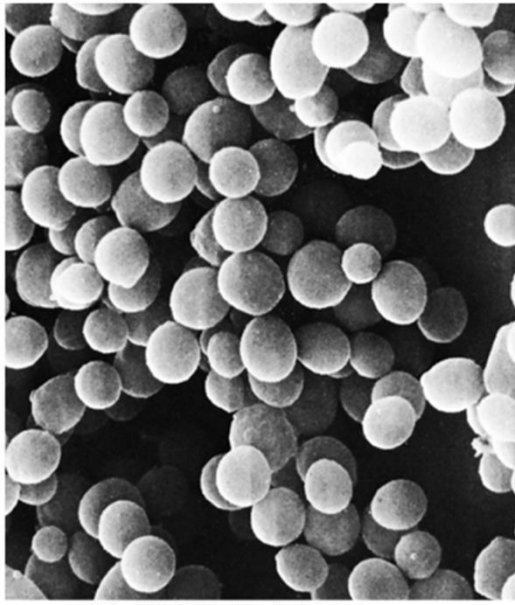
- Commonspp:
  - *S. aureus*
  - *S. epidermidis*
  - *S. saprophyticus*
  - B. Micrococcus- skin commensal

- Gram-positive spherical cells (0.5-1.5 mm) in singles, pairs, and clusters
- Appear as —bunches of grapes

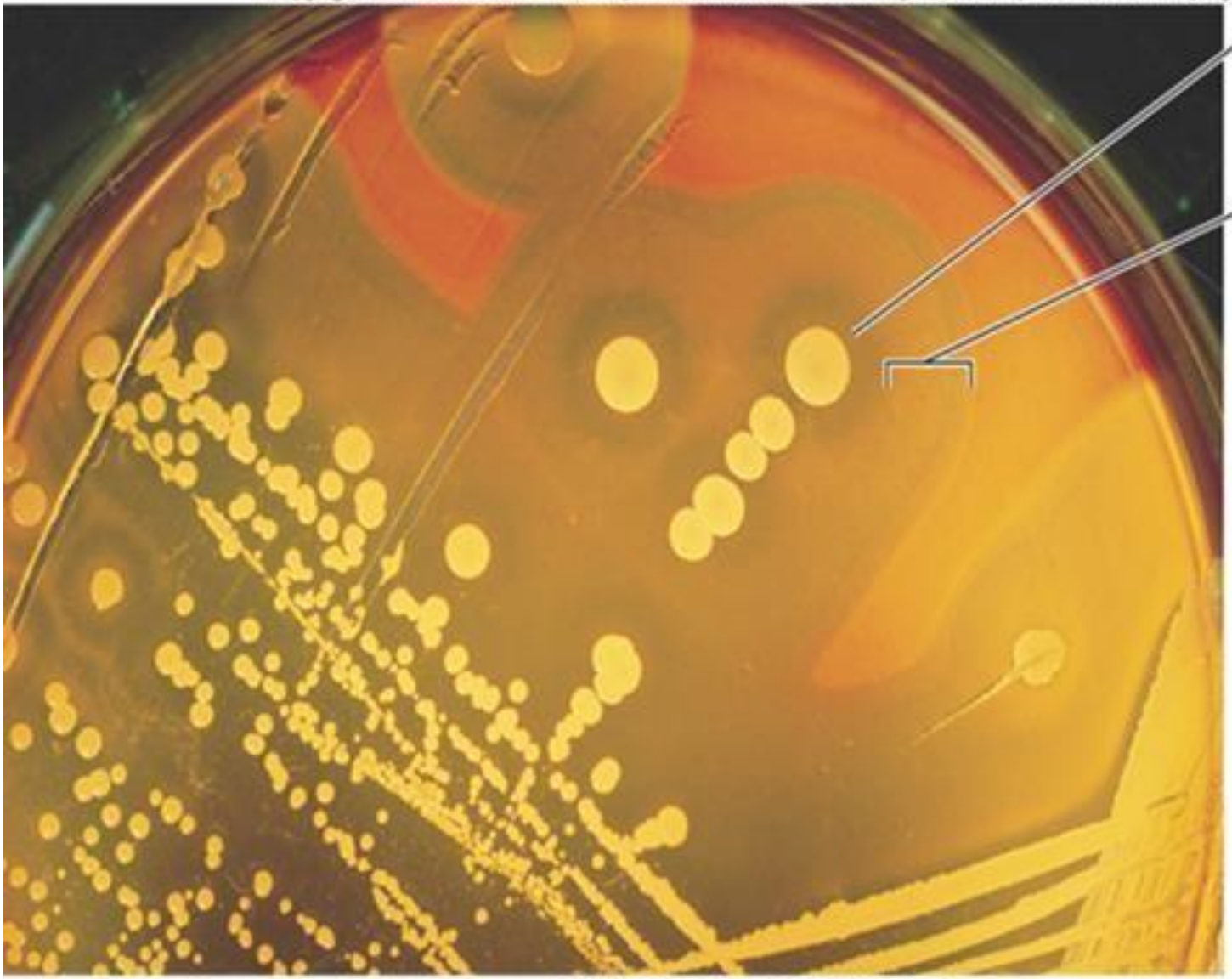
S. aureus

- Non motile
- Non–spore-forming
- Nonencapsulated
- Catalase-producing





- Primarily aerobic, some facultatively anaerobic
- Inhibited by high bile salt concentration
- S. aurues ß-hemolytic
- Colony morphology:
  - buttery looking, cream or white colored

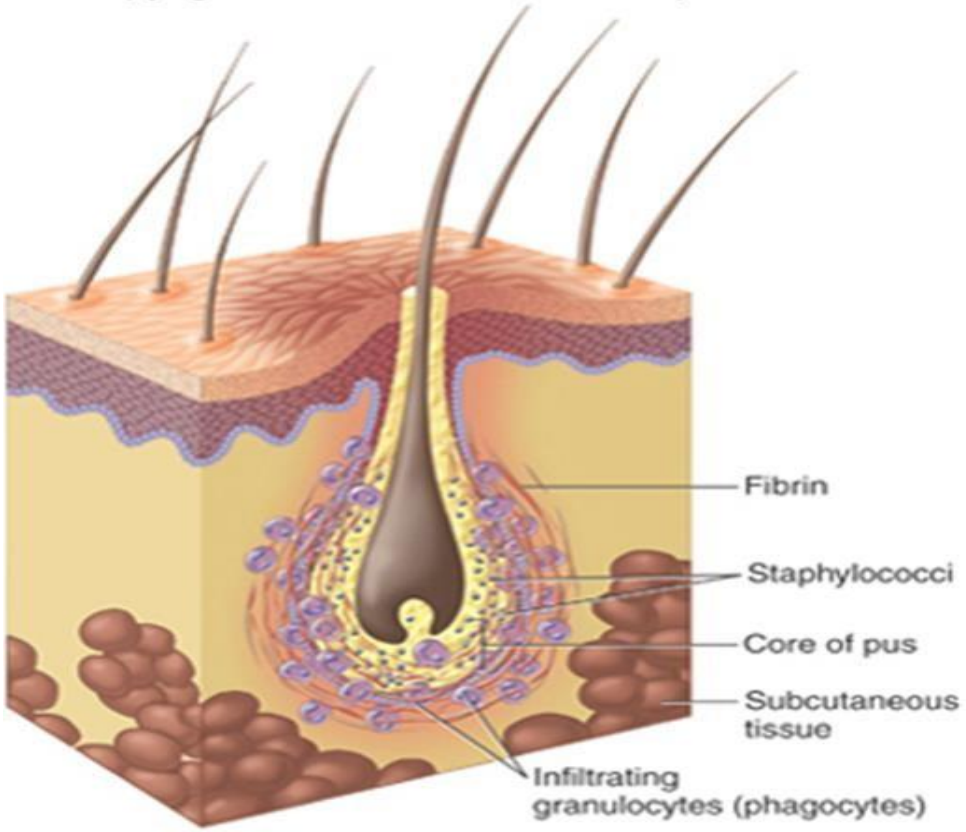


Virulence factors of *S. aureus*

- Toxins:
- Hemolysins (α, β, γ, δ) – lyse red blood cells
- Leukocidin – lyses neutrophils and macrophages
- Enterotoxin – induce gastrointestinal distress
- Exfoliative toxin – separates the epidermis from the dermis
- Toxic shock syndrome toxin (TSST) - induces fever, vomiting, shock, systemic organ damage

Epidemiology and pathogenesis

- Present in most environments even humans
- Readily isolated from fomites
- Carriage is mostly in anterior nares, skin, nasopharynx, intestine.
- Predisposition to infection include: poor hygiene and nutrition, tissue injury, preexisting primary infection, diabetes, immunodeficiency.
- Increase in community acquired methicillin resistance - MRSA



(a) Sectional view of a boil or furuncle, a single pustule that develops in a hair follicle or gland and is the classic lesion of the species. The inflamed infection site becomes abscessed when masses of phagocytes, bacteria, and fluid are walled off by fibrin.

(b) A furuncle on the back of the hand. This lesion forms in a single follicle.

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(c) A carbuncle on the back of the neck. Carbuncles are massive deep lesions that result from multiple, interconnecting furuncles. Swelling and rupture into the surrounding tissues can be marked.

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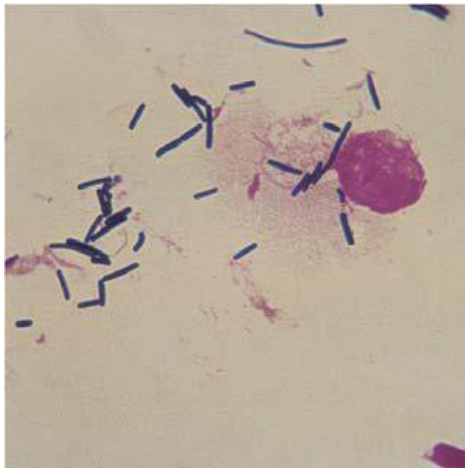
Other GPC

Catalase negative :

- *Streptococcus pneumonia* *(pneumonia)*
- *streptococcus pyogenes* (sore throat)
- *Streptococcus mutans* (tooth infection)
- *Enteroccoccus feacalis* (GIT + bacteremia)

Family: Clostridiaceae



- 3–8 um long, thick, Gram-positive
- Spore forming,rod shaped bacteria
- Motile bacteria with flagella
- strictly obligate anaerobic to aerotolerant
- Occurrence→ naturally inhabit the soil and the intestinal tracts of humans and animals.
- Common species:
  - *C. tetani* (tetanus, nervous system disorder)
  - *C. perfirengens* (anaerobic cellulitis and gas gangrene)
  - *C. botulinum* (botulism, food poisoning)

C. tetani

- Tetanus (lockjaw) is an acute clostridial disease,
- its clinical manifestations do not result directly from the invasive infection, but are rather caused by a strong neurotoxin.

- **Pathogenesis and clinical picture**.

- pathogens invade tissues via wounds/ injuries → anaerobic conditions→ proliferate and produce the toxin (tetanospsmin) → reaches the anterior horns of the spinal cord or brain stem → spasms of muscles
- (incubation period : few days to several weeks)

Toxin:

- Tetanospasmin consists of two polypeptide chains linked by a disulfide bridge. The heavy chain binds specifically to neuron receptors.
- The light chain is a zinc-metalloprotease that is responsible for proteolysis
- of components of the neuroexocytosis apparatus in the synapses of
- the anterior horns of the spinal cord. This stops transmission of inhibitory
- efferent impulses from the cerebellum to the motor end plates.

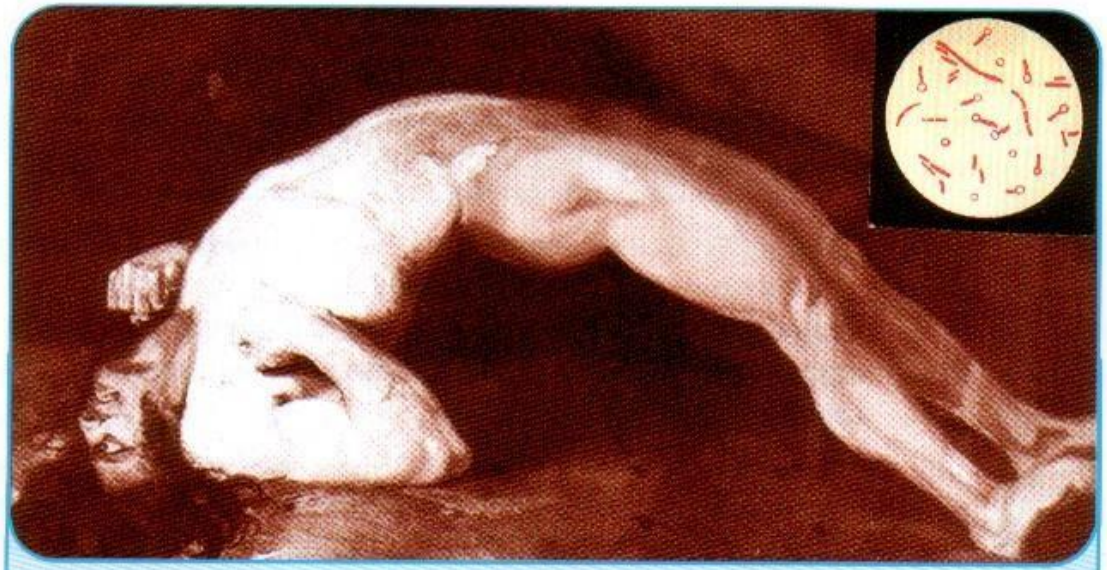
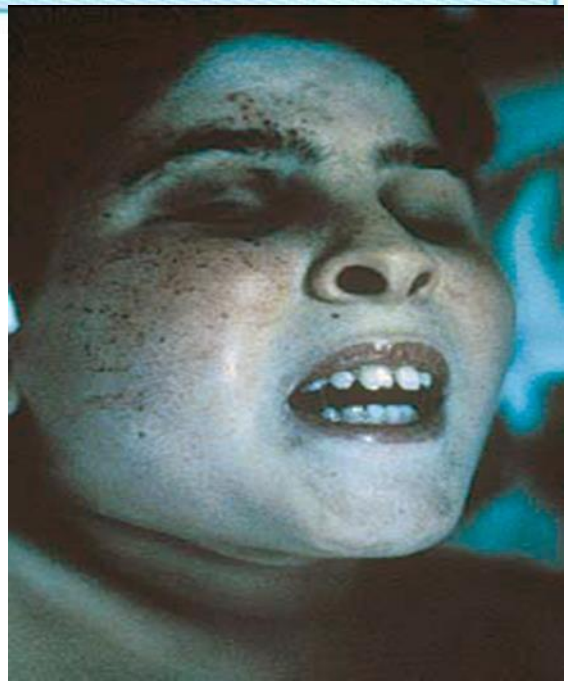


Рис. 3.79. Опистотонус

Рис. 3.80. Мазок из чистой культуры C. tetani. Окраска по Граму



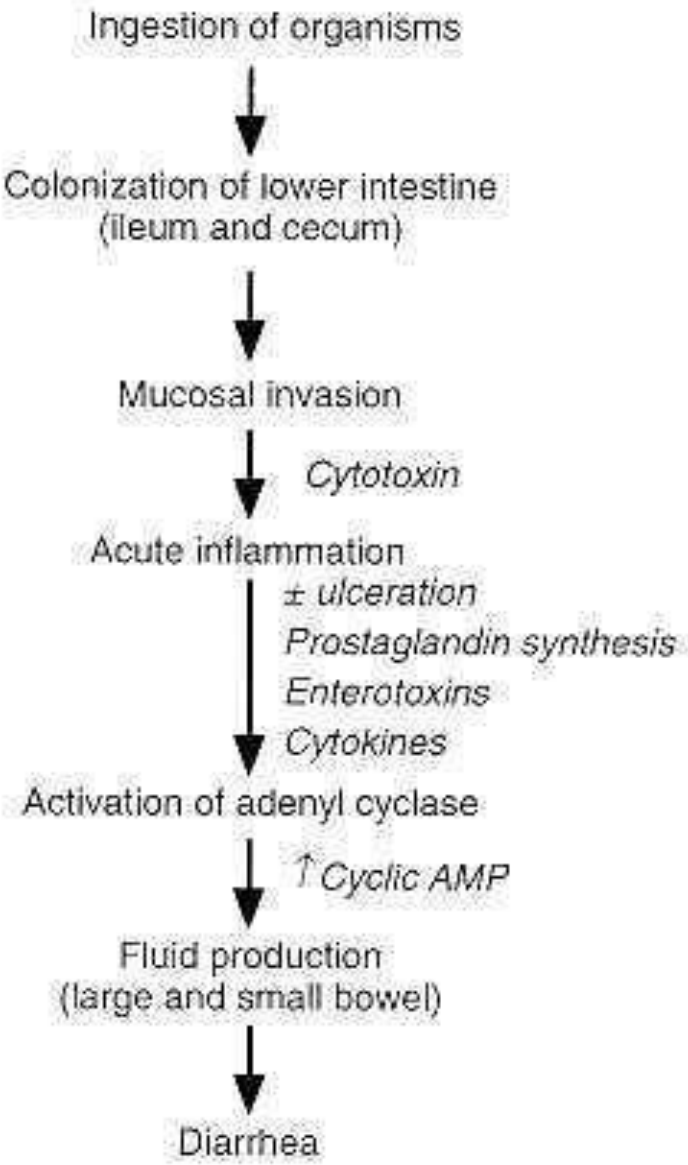
Enterobacteriaceae.

- 41 genera with hundreds of species
- Gram-negative,
- usually motile (peritrichous flagellation or swarming movement)
- facultative anaerobic rod bacteria
- natural habitat is the intestinal tract of humans and animals
- Responsible for nosocomial diseases as well
- 0.5–1.5 um thick, and 24 um long
- Generation time in vitro is 20–30 minutes

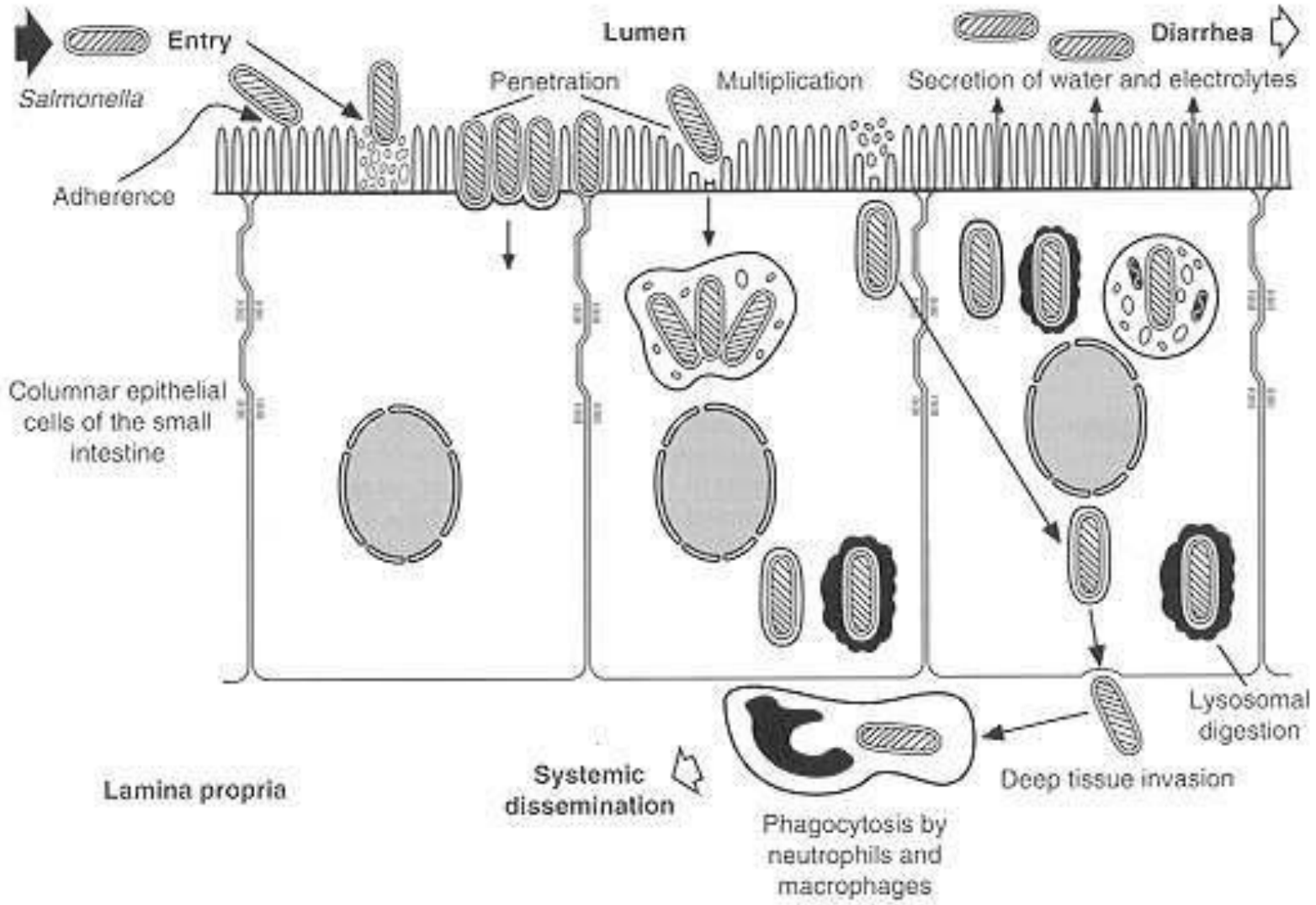
Salmonella spp

- *Salmonella enterica* with seven subspecies.
- **Typhoid salmonelloses**: typhi and paratyphi A, B, and C
- Salmonellae are taken up orally and the invasion pathway is through the intestinal tract, from where they enter lymphatic tissue, first spreading lymphogenously, then hematogenously.
- 1-3 weeks
- Human carriers are the only source of infection
- **Enteric salmonelloses :** develop when pathogens are taken up with food. The primary infection source is usually livestock. These relatively frequent infections remain restricted to the gastrointestinal tract.
- 1–2 days

Pathognesis



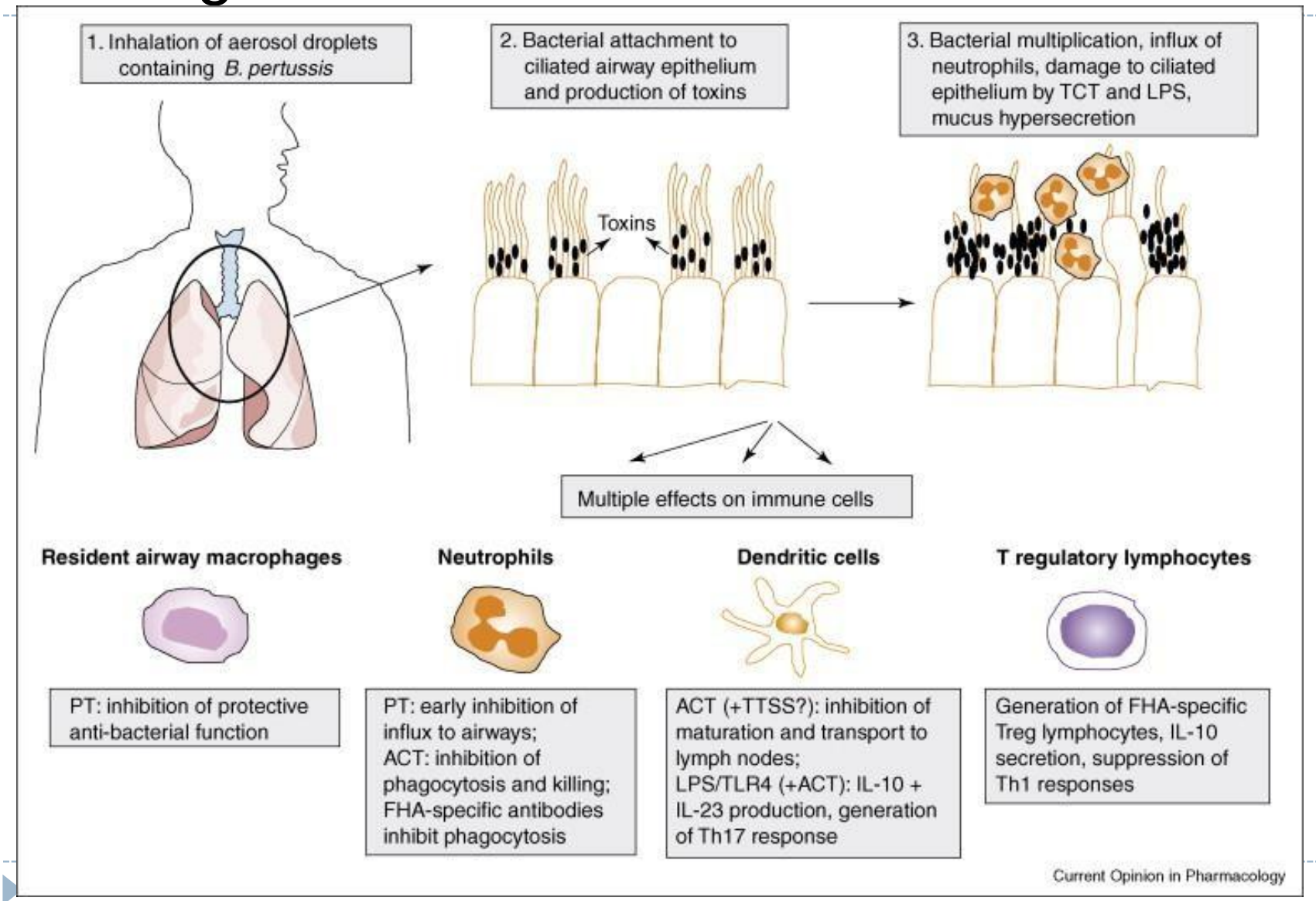
Pathogenesis

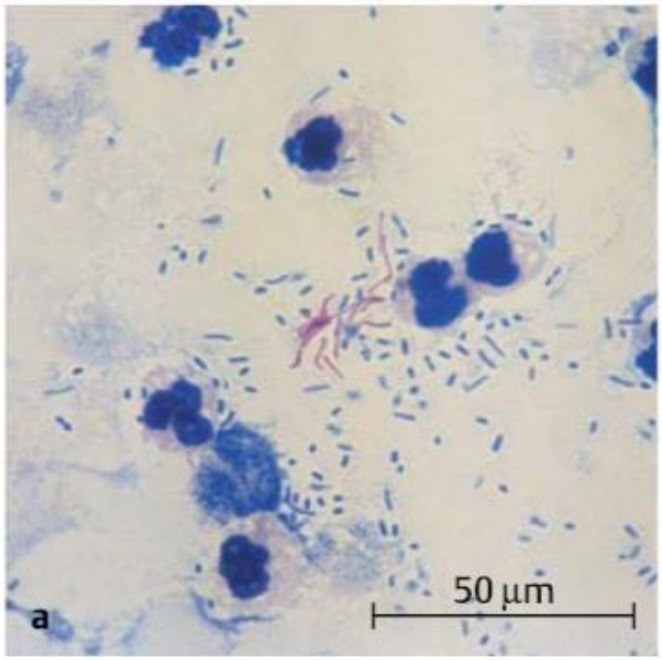


Bordetella pertussis

- Gram negative,
- aerobic,
- encapsulated *coccobacillus*
- the causative agent of pertussis or whooping cough.
- bacterium is spread by airborne droplets; its incubation period is 7–10 days on average (range 6–20 days)
- Humans are the only known reservoir for *B. pertussis*

Pathogenesis





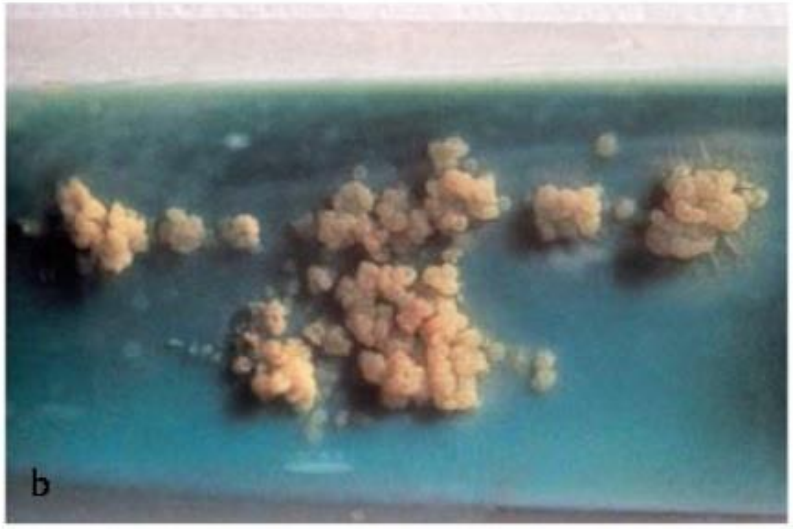


Fig. 4.**12** **a** Ziehl-Neelsen staining of a urine preparation: Fine, red, acid-fast rods, which tend to stick together. Clinical diagnosis: renal tuberculosis.
b Culture of *M. tuberculosis* on egg nutrient substrate according to Löwenstein-Jensen: after four weeks of incubation rough, yellowish, cauliflowerlike colonies.

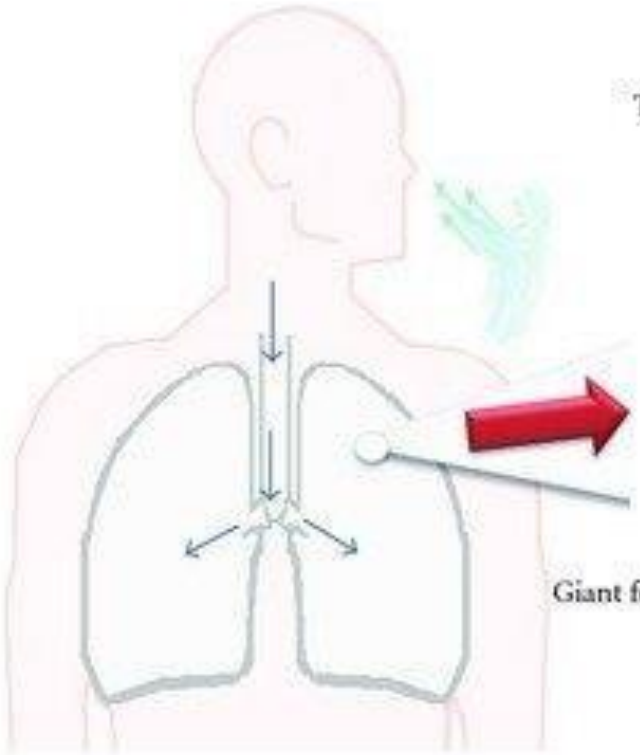
Mycobacterium tuberculosis

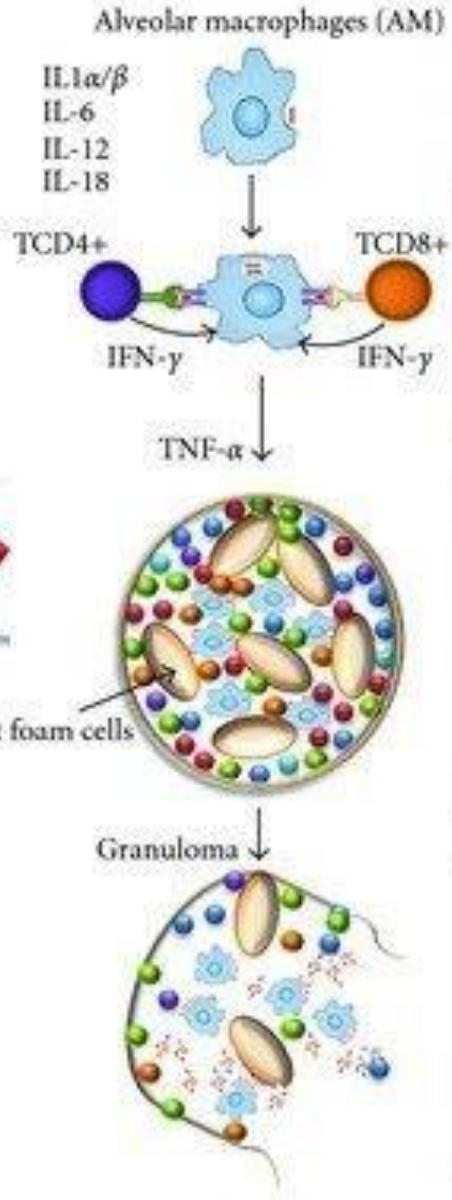
- Over a century ago Robert Koch identified *Mycobacterium tuberculosis* as the causative agent of tuberculosis
- acid-fast rods, 0.4um wide, and 3–4 um long,
- Endospore forming
- non-motile.
- can be stained with special agents (Ziehl-Neelsen staining)
- *M. bovis* and *M. africanum* can also causes TB.
- obligate aerobes

Pathogenesis

- Transmission: from other humans through droplet nuclei (1-5 micron in diameter) and the respiratory Route
- Transmission to humans from susceptible animal species and their products (e.g., milk) is also possible
- Depending on the environment, these tiny particles can remain suspended in the air for several hours.

- incubation period : about 4 to 12 weeks, and the disease develops slowly.
- symptoms : fever, fatigue, and weight loss.
  - A cough, which is characteristic of pulmonary involvement, may result in expectoration of bloody sputum.





Inhalation of Mtb
- Phagocytosis of bacilli

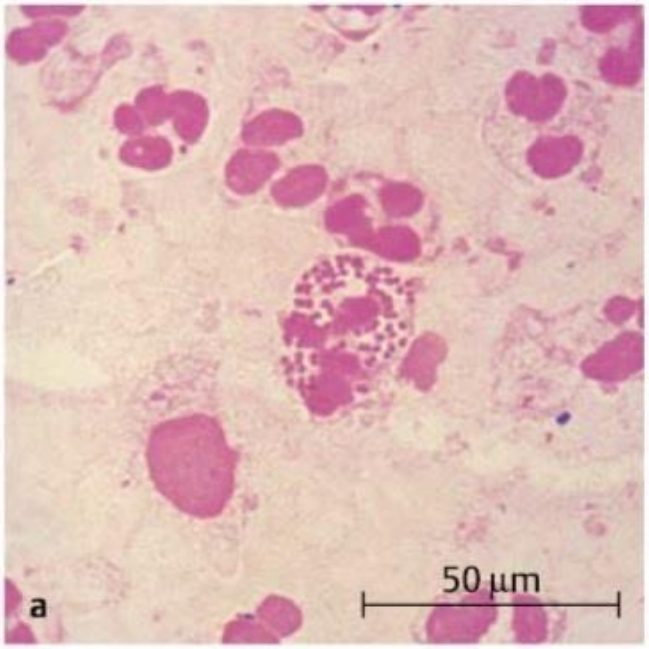
Inflammatory cell recruitment
- AM secreted IL-12 and IL-18
- IFN-γ induce bacterial killing
- TNF-α is essential in the control of Mtb growth and granuloma formation

Control of mycobacteria growth
- Stops Mtb proliferation
- Chronic cytokine stimulation
- Granuloma is formed by several cells recruited to the lung. Inside, infected macrophages contain the Mtb preventing their spread.

Postprimary tuberculosis
- Mycobacteria persistence is associated to a failure in the immune-surveillance
- Disease may reactivate
- Damage of nearby bronchi
- Spreading of the Mtb to other areas of the lung

Neisseriaceae

- Gram-negative cocci often arranged in pairs (diplococci) with adjacent sides flattened (like coffee beans) a diameter of approximately 1 um
- Encapsulated
- Non sporeforming
- Aerobic
- Nonmotile
- Important human species
  - *Neisseria gonorrhoeae →sexually transmitted pathogen (urethritis, cervicitis)*
  - *Neisseria meningitides (meningitis, meningoencephalitis, arthritis,)*
  - species normally colonize mucosal surfaces of oropharynx and nasopharynx and occasionally anogenital mucosal membranes



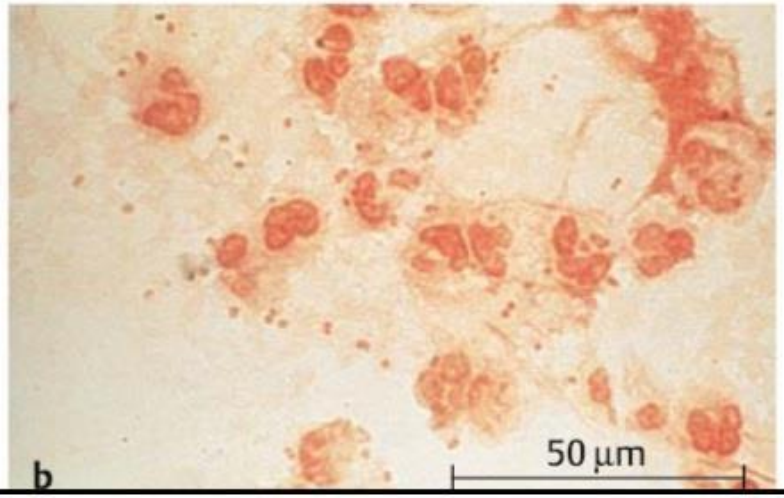


Fig. 4.**16** **a** *N. gonorrheae*: gram staining of a preparation of urethral secretion: coffee-bean-shaped diplococci, grouped within a granulocyte. Clinical diagnosis: gonorrhea. **b** *N. meningitidis*: gram staining of a preparation of cerebrospinal fluid sediment. Clinical diagnosis: acute purulent meningitis.

Neisseria meningitides

- Gram negative cocci shaped
- appears in kidney bean shape under the microscope .
- It requires anaerobic environment with 5% CO2 and enriched media containing blood for growth

  oxidase and catalase positive.
- Serogroups A, B, C, D, etc. (a total of 12

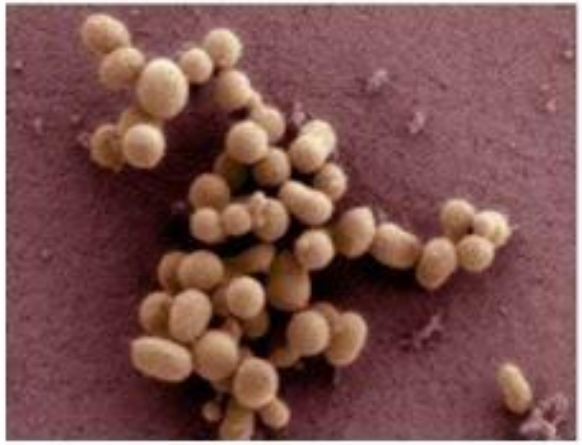
Epidemiology:

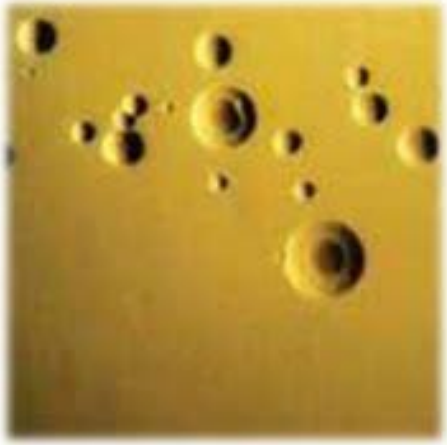
- Humans only natural hosts
- Person-to-person transmission by aerosolization of respiratory tract secretions in crowded conditions
- Close contact with infectious person
- Highest incidence in children younger than 5 years and particularly those younger than 1 year of age

Mycoplasmataceae

- Do not possess rigid cell walls for lack of a murein layer
- Ploemorphic but most common form is coccoid cell with a diameter of 0.3–0.8 lm.
- Long,
- fungi like filaments grown on culture mediums with high osmotic pressure levels.
- frequently causes pneumonias that run atypical courses, especially in young children.
- 10 -20% of pneumonias contracted outside of hospitals are caused by this pathogen
- Common species:
- Mycoplosama pneumnia
- Ureoplasma
- Infections of the respiratory organs or urinary tract.

MYCOPLASMA





Pathogenesis

- transmitted by aerosol droplets→ cells attach themselves to the epithelia of the trachea, bronchi, and bronchioles → destruction of the epithelial cells
  - → infection develops into pneumonia with an inflammatory exudate in the lumens of the bronchi and bronchioles.
- The incubation period is 10–20 days.
- Symptoms : fever, headache, and a persistent cough.

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THANK YOU