Orientation to Gram Positive Bacteria of Medical Importance

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Dr. Sulaiman Mahmoud Bani Abdel-Rahman

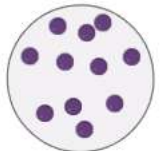
Bachelor degree in Medicine and Surgery - Mutah university

MSC Medical Microbiology – University of Manchester

PhD Medical Virology - University of Manchester

Gram-positive

Cocci



Catalase test → which degraded the Hydrogen peroxide.

Rods — Basels.

a- *Clostridium*
b- *Corynebacterium*
d- *Listeria*
c- *Bacillus*
e- *Mycobacterium*

(−) Streptococci

Growth on sheep's blood agar

γ-hemolytic
Enterococcus

β-hemolytic
Group A
S. pyogenes
Group B
S. agalactiae

α-hemolytic
Capsule
S. pneumoniae
No Capsule
Viridans streptococci

partial hemolysis

(+) Staphylococci

Coagulase test

(−) → oxidization of hemoglobin → partial green. Green color

S. saprophyticus
S. epidermidis

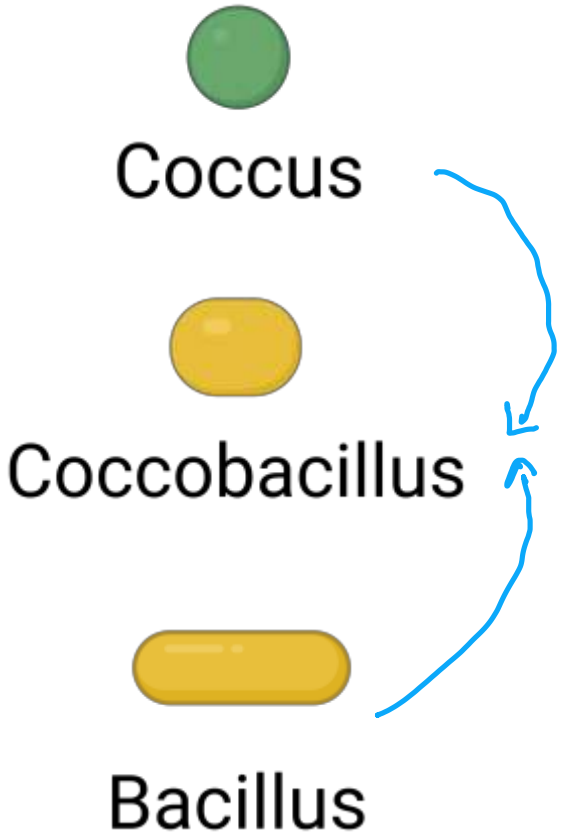
(+) → contain coagulase enzyme.

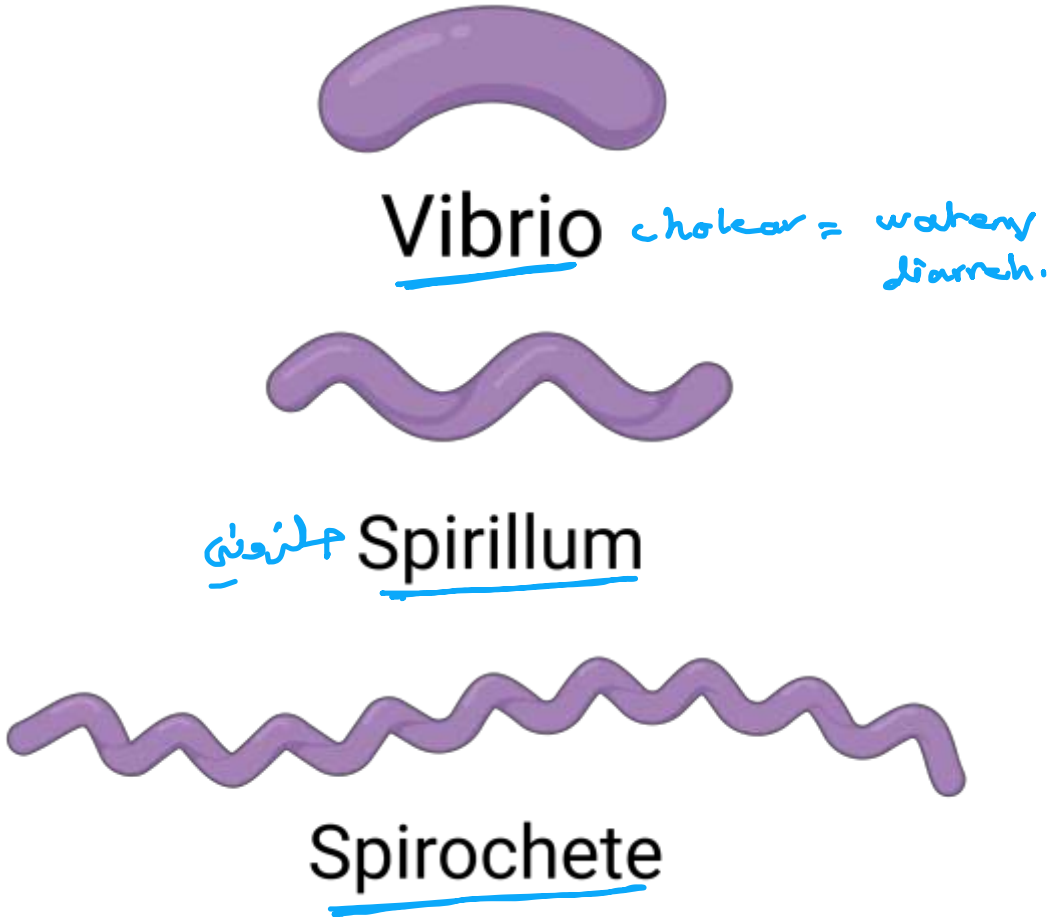
S. aureus most important
→ part of normal flora.

⇒ some bacteria contain Catalase enzyme.

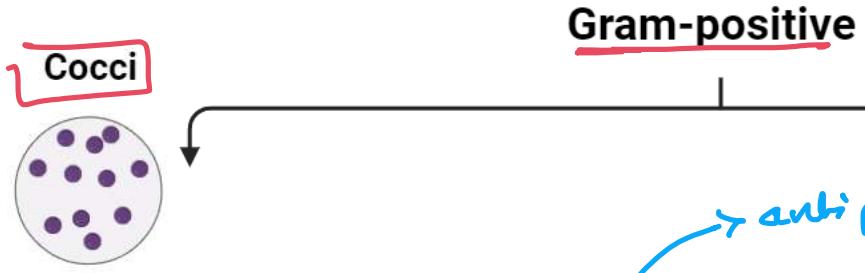
⇒ urin tract infection. eschya Coli

Shapes of Bacteria





Medically Important Gram-Positive Cocci



Staphylococcus aureus

Streptococcus:

- Group A: *S. pyogenes*
- Group B: *S. agalactiae*
- *S. pneumoniae* (diplocci)

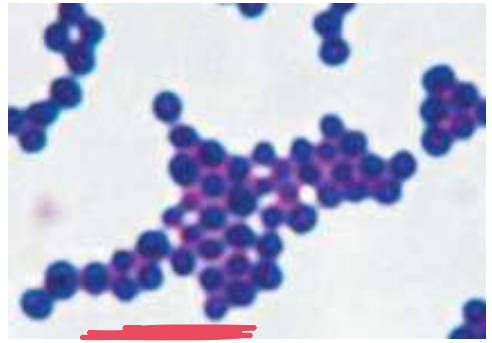
- **Bacillus** :
  - anthracis (anthrax)
  - cereus
- **Clostridium**:
  - botulinum
  - difficile
  - perfringens
  - tetani
- **Non-spore forming**
  - Listeria monocytogenes
  - Corynebacterium diphtheriae
  - Mycobacterium

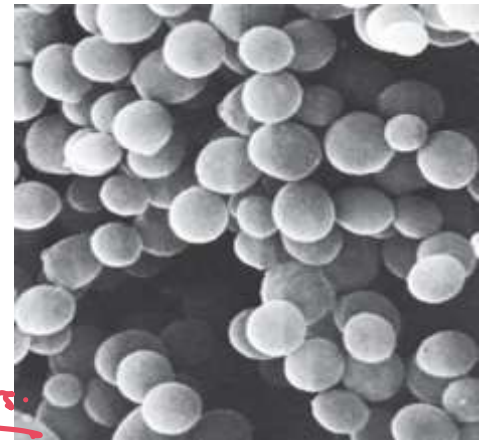
Spore forming

Medically Important Gram-Positive Cocci

⊕ Staphylococci General Characteristics

- Common inhabitant of the skin and mucous membranes.
- Spherical cells arranged in irregular clusters.
- Produces many virulence factors

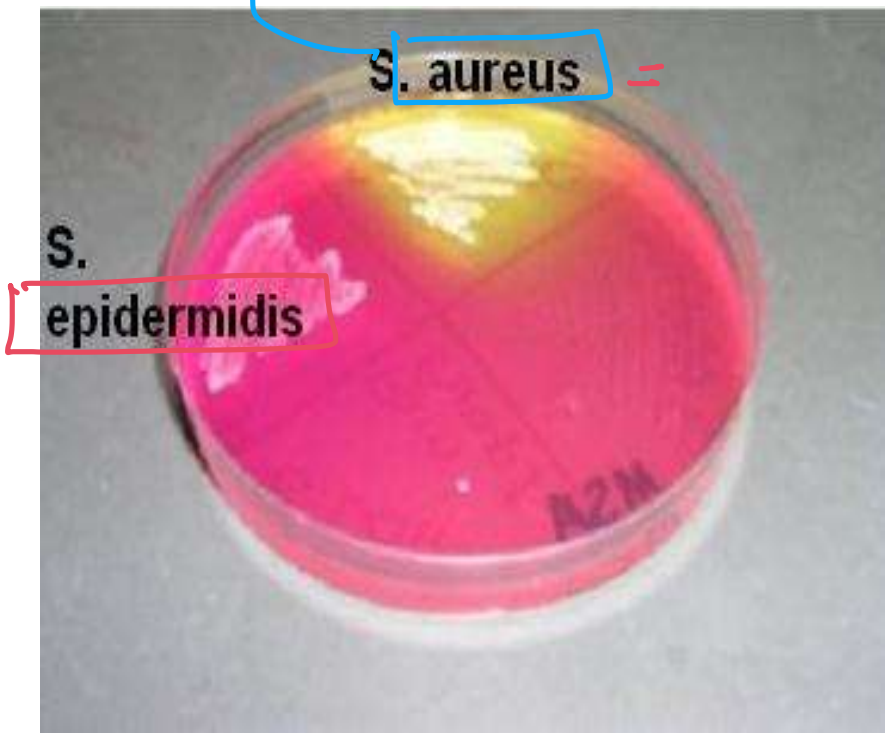




Medically Important Gram-Positive Cocci

Staphylococcus aureus

- Diseases:
  - Food poisoning.
  - Localized infections (Abscess formation).
  - Spreading infections.
  - Necrotizing infections.
  - Systemic infections (ex. Osteomyelitis).

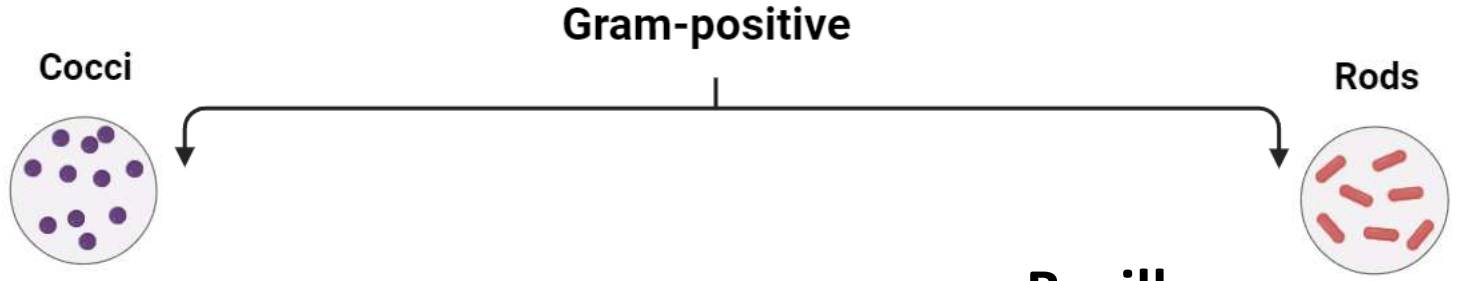


Medically Important Gram-Positive Cocci

Coagulase-negative staphylococcus (epidermis)

- Frequently involved in nosocomial (acquired in hospital) and opportunistic infections.
- *S. epidermidis* – lives on skin (a) and mucous membranes (b); endocarditis (c), bacteremia, UTI (d).
- *S. saprophyticus* – infrequently lives on skin, intestine, vagina; UTI.

Medically Important Gram-Positive Cocci



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Spore forming

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  - Listeria monocytogenes
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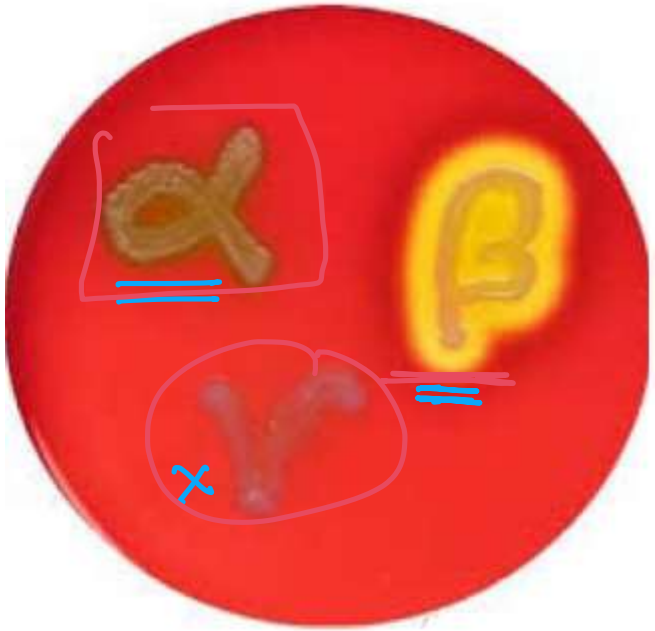
Medically Important Gram-Positive Cocci

Streptococci

- Gram-positive cocci
- Catalase & Coagulase negative
- Sensitive to drying, heat, and disinfectants
- Classification
  - **α-hemolytic:** partial hemolysis of RBCs
  - **β -hemolytic:** complete hemolysis of RBCs
  - **γ -hemolytic:** no hemolysis of RBCs



Medically Important Gram-Positive Cocci

Streptococci - *S. pyogenes*

S. pyogenes (Group A sterp):

- Group-A streptococci (GAS).
- β-hemolytic.
- Most serious streptococcal pathogen.
- Inhabits throat, nasopharynx, occasionally skin.
- Diseases:
  - Pharyngitis.
  - Skin infections.
  - Necrotizing infections.
  - Systemic infections

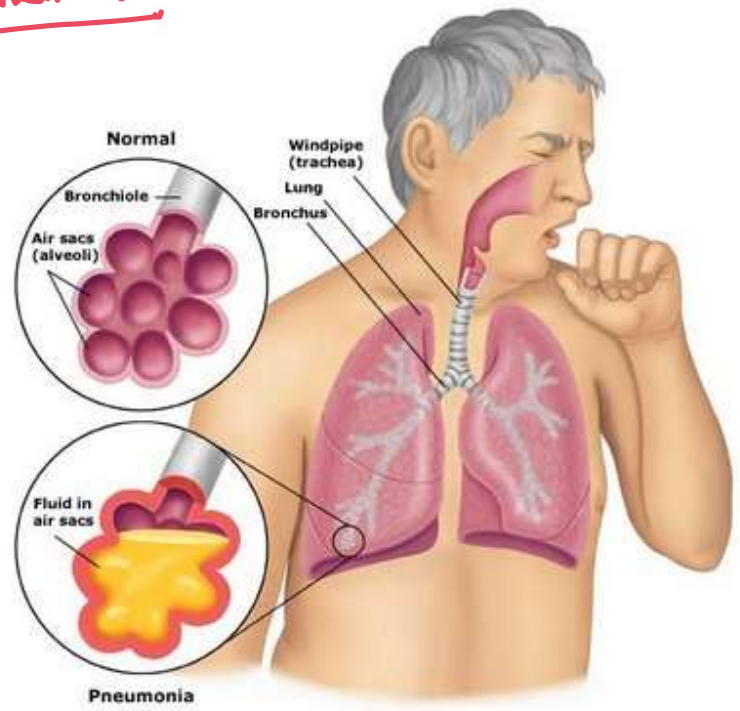
Medically Important Gram-Positive Cocci

Streptococci - *Streptococcus pneumoniae*

= diplococci

Gram hemolytic.

- Pneumonia-inflammatory condition of the lung.
- Inhabits nasopharynx of healthy people.
- May also infect brain: (pneumococcal meningitis) and blood stream (pneumococcus septicemia).→ التهاب العايا



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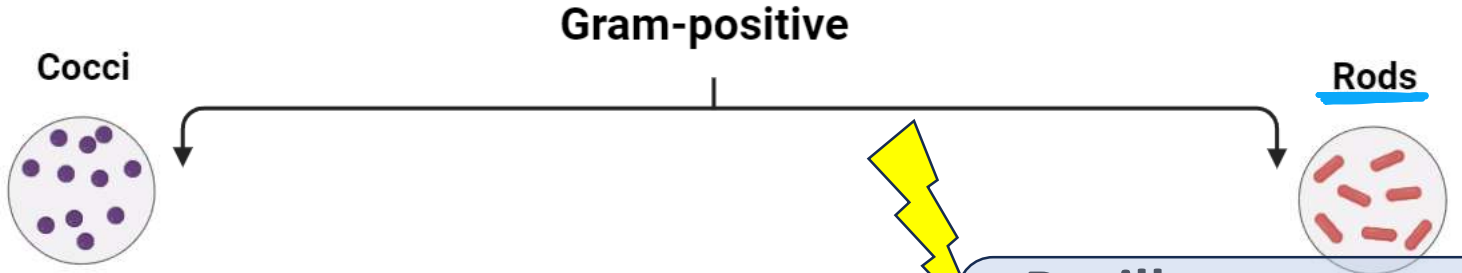

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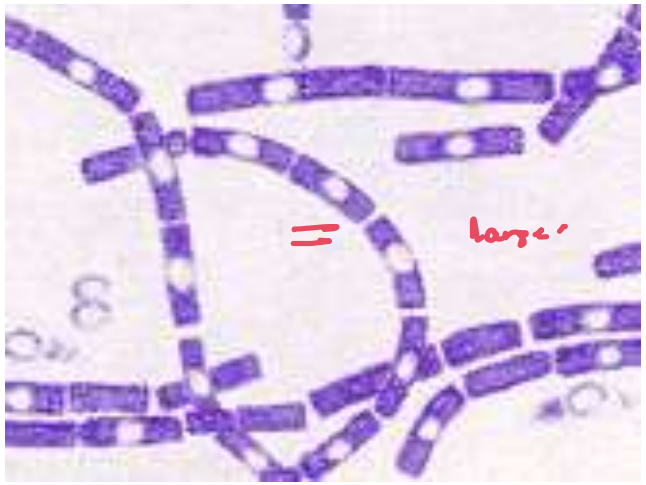
Medically Important Gram-Positive Bacilli

Bacillus - *Bacillus anthracis*

- Large, block-shaped rods
- Central spores
- Virulence factors –polypeptide capsule/exotoxins
- 3 types of anthrax:
  - Cutaneous–spores enter through skin, black sore; least dangerous.
  - Pulmonary–inhalation of spores.
  - Gastrointestinal–ingested spores.

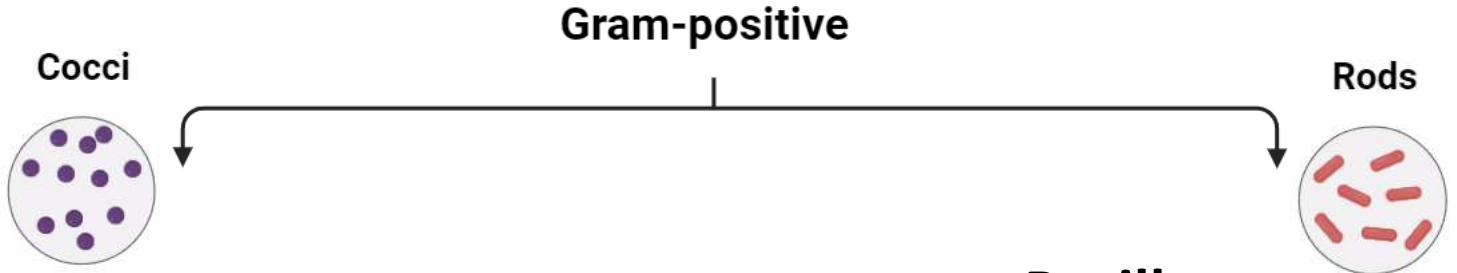


Medically Important Gram-Positive Bacilli

Bacillus - *Bacillus cereus*

- Grows in foods, spores survive cooking/ reheating.
- Ingestion of toxin-containing food causes nausea, vomiting, abdominal cramps, diarrhea; 24 hour duration.
- No treatment.
- Increasingly reported in immunosuppressed.

Medically Important Gram-Positive Cocci



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Medically Important Gram-Positive Bacilli

Clostridium - *Clostridium difficile*

- Normal flora colon, in low numbers.
- Causes antibiotic associated colitis
- Due to treatment with broad-spectrum antibiotics that kills other bacteria: *C. difficile* overgrowth
- Enterotoxins that damage intestines.
- Major cause of diarrhea in hospitals.
- Treatment: stop antimicrobials/fluid electrolyte replacement.

Medically Important Gram-Positive Bacilli

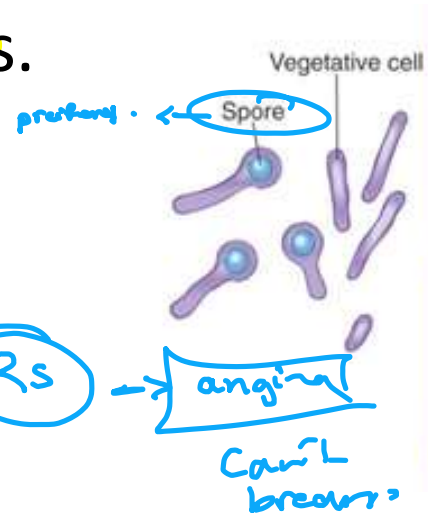
Clostridium - *Clostridium perfringens* (Gas Gangrene)

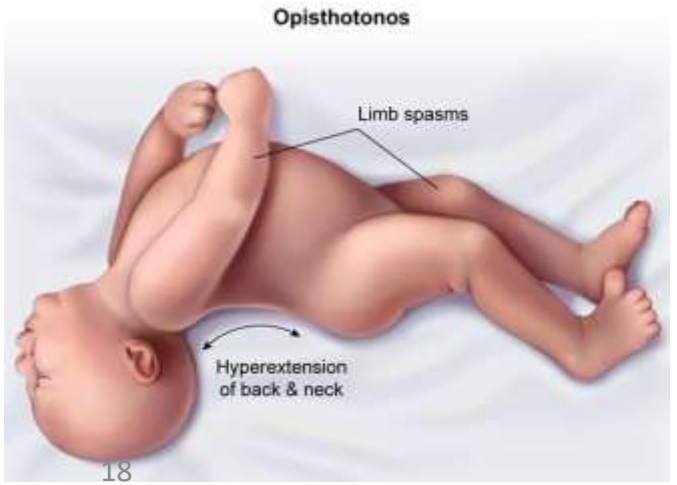
- Soft tissue :wound infections: myonecrosis
- Predisposing factors: infection of all types of wounds.
- Virulence factors (lytic enzymes)
- Treatment: antibiotics/amputation

Medically Important Gram-Positive Bacilli

Clostridium - *Clostridium tetani* : Tetanus

- Common resident :of soil and GI tracts of animals.
- Causes tetanus or lockjaw, a neuromuscular disease.
- Most commonly among IV drug abusers and neonates in developing countries.

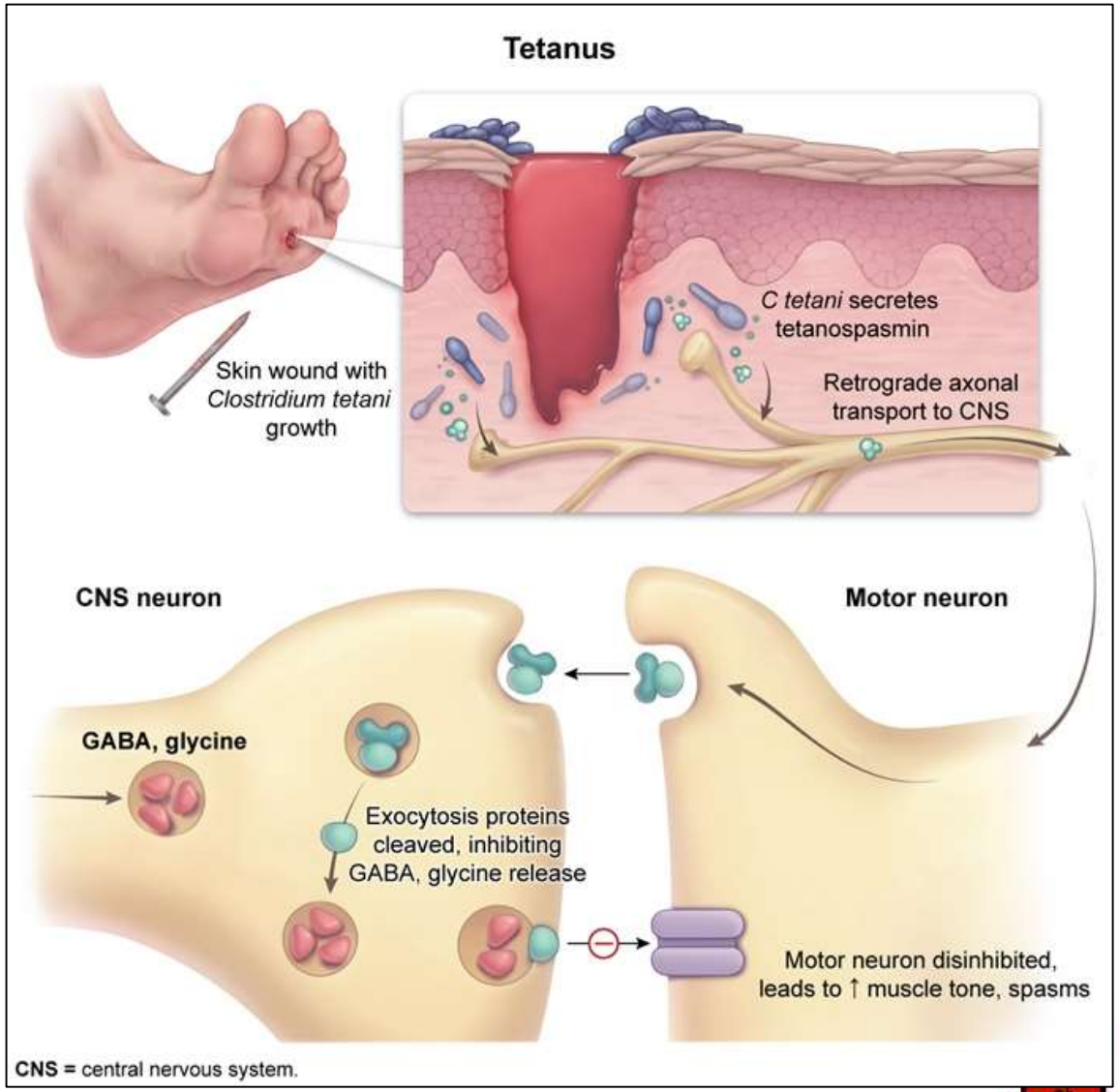




Medically Important Gram-Positive Bacilli

Clostridium - *Clostridium tetani* : Tetanus

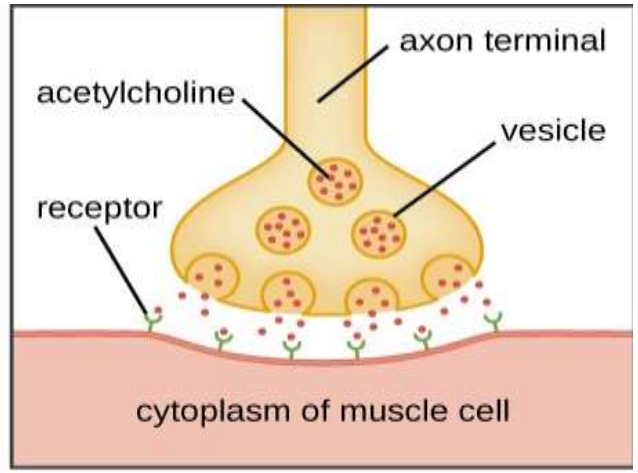
C tetani causes disease not through tissue invasion but by producing a potent metalloprotease **exotoxin** (tetanospasmin) that is deadly in nanogram quantities. The toxin first binds to receptors on the presynaptic membranes of peripheral motor neurons. From there, it migrates by **retrograde axonal transport** to central inhibitory neurons in the spinal cord and brain stem and prevents release of the **inhibitory** neurotransmitters **glycine** and **gamma-aminobutyric acid (GABA)**. Suppression of inhibitory nerve activity results in **increased activation** of motor nerves, causing **muscle spasms** and **hyperreflexia**.



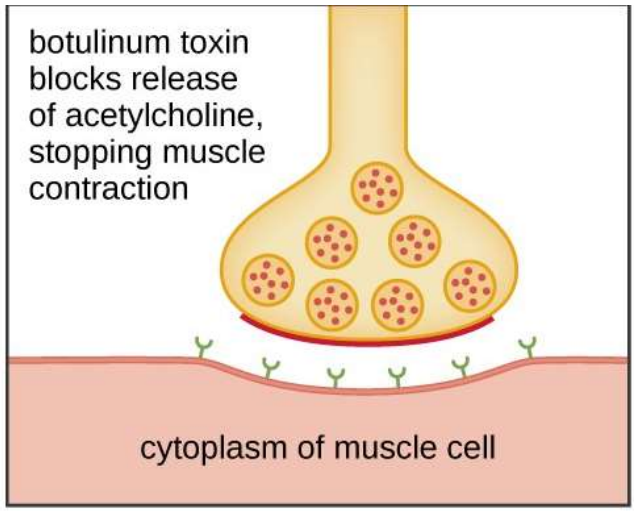
Medically Important Gram-Positive Bacilli

Clostridium - *Clostridium Botulinum:* Flaccid paralysis

- Botulism–intoxication associated with inadequate food preservation
- Toxin carried to neuromuscular junctions: blocks the release of acetylcholine: necessary for muscle contraction to occur.
- Clinically
  - a. Double or blurred vision
  - b. Difficulty swallowing
  - c. Neuromuscular symptoms

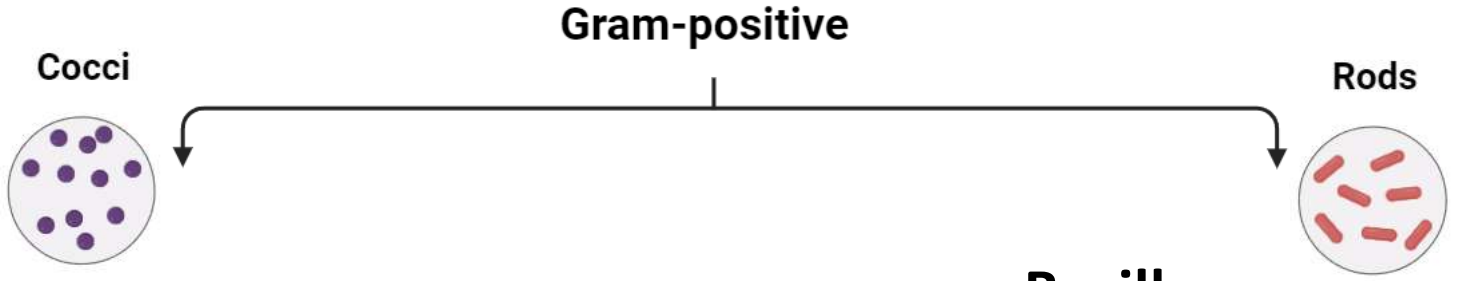


normal mechanism



abnormal mechanism

Medically Important Gram-Positive Cocci



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Spore forming

- **Non-spore forming**
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  - Mycobacterium

No details just classification.

Medically Important Gram-Positive Bacilli

Gram Positive Non-Spore-Formers

Listeria monocytogenes

- Found in soil, water, luncheon meats, hot dogs, cheese.
- Resistant to long storage and refrigeration, heat, salt, pH extremes and bile.

Medically Important Gram-Positive Bacilli

Gram Positive Non-Spore-Formers

Corynbacterium diptheriae

- Virulence factors: diphtherotoxin.
- Vaccine (DPT).
- Causes a pseudomembrane which can cause asphyxiation.
- Acquired via respiratory droplets from carriers or actively infected individuals.

Medically Important Gram-Positive Bacilli

Gram Positive Non-Spore-Formers

Mycobacterium

- Gram-positive irregular bacilli.
- Acid-fast staining: mycolic acids.
- Strict aerobes.
- Grow slowly.
- Virulence factors -contain complex waxes that prevent destruction by lysosomes or macrophages.