CHAPTER 9
THE CLINICAL SIGNIFICANCE OF BACTERIAL ANATOMY

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THE BACTERIAL CELL WALL

- Many of the structures associated with the bacterial cell wall are involved in the infection process
- The cell wall is the protective outer structure of the bacterial cell
- The wall is thicker in Gram-positive bacteria than in Gram-negative ones

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THE BACTERIAL CELL WALL - PEPTIDOGLYCAN

- The cell wall is made of peptidoglycan, which is a series of repeating disaccharides and polypeptide pieces
- Peptidoglycan is constructed inside the cell and transported to the outside of the cell
- Peptidoglycan forms a meshwork foundation for the cell wall and is a target for antibiotics

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THE BACTERIAL CELL WALL - TEICHOIC ACID

- Gram-positive cells have many layers of peptidoglycan and also contain teichoic acid
- Teichoic acid is a glycoprotein that can be found in two forms: wall teichoic acid and lipoteichoic acid
- Gram-negative organisms have no teichoic acid and very little peptidoglycan but have an outer membrane layer made up of phospholipids and lipopolysaccharides

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THE BACTERIAL CELL WALL- CLINICAL SIGNIFICANCE

- Gram-positive teichoic acid is involved with the production of inflammation
- Some Gram-positive bacteria incorporate virulence factors known as M proteins in their cell walls

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THE BACTERIAL CELL WALL

- *Mycobacterium* species are Gram-positive bacteria that incorporate mycolic acid (a waxy substance) in their cell walls, which makes them resistant to antibiotics
- In Gram-negative organisms the outer membrane layer:
  - protects against disinfectants and antibiotics
  - functions as an endotoxin

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STRUCTURES OUTSIDE THE BACTERIAL CELL WALL

- Structures found outside the cell wall are all involved in the infection process
- The glycocalyx can be found in either the capsule or slime-layer form and can satisfy the requirement of staying in by facilitating adherence to host cells
- In many cases, an organism is not pathogenic unless it has a capsule

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STRUCTURES OUTSIDE THE BACTERIAL CELL WALL

- Fimbriae also satisfy the requirement to stay in by adhering to host cells
- Pili can be used to adhere to host cells but also allow the transfer of genetic information between bacteria in the process known as conjugation

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STRUCTURES OUTSIDE THE BACTERIAL CELL WALL

- Flagella permit movement, which helps organisms stay in
- There are four forms of flagella seen in bacteria:
  - monotrichous
  - amphitrichous
  - lophotrichous
  - peritrichous

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STRUCTURES OUTSIDE THE BACTERIAL CELL WALL

- Axial filaments allow organisms to penetrate tissues by means of rotational movement
- The host cell's cytoskeleton can be used for intracellular movement during the infection

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STRUCTURES INSIDE THE BACTERIAL CELL WALL

- The plasma membrane surrounds the cytoplasm in bacterial cells
- This membrane is composed of a phospholipid bilayer, which is selectively permeable
- The membrane contains many different types of protein that are either localized on the inner or outer side of the membrane (peripheral proteins) or span the entire membrane (integral proteins)

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STRUCTURES INSIDE THE BACTERIAL CELL WALL

- The membrane in bacteria is involved with energy production (ATP is formed here) and also in the replication of the bacterial chromosome
- Membrane transport can involve osmosis and passive transport (which require no energy) or active transport (which requires ATP)

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STRUCTURES INSIDE THE BACTERIAL CELL WALL

- There is no nucleus in bacteria: the DNA is found freely floating in the cytoplasm in an area referred to as the nuclear region
- Bacteria can contain extrachromosomal DNA segments known as plasmids
- Plasmids are very important in clinical disease because they can carry genes for antibiotic resistance as well as genes for the production of toxins

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STRUCTURES INSIDE THE BACTERIAL CELL WALL

- Ribosomes of bacteria are different from those found in eukaryotic cells and are consequently a selective target for antibiotic therapy
- Endospore formation can protect bacteria from environmental pressures and are also very resistant to antibiotics and disinfectants

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STRUCTURES INSIDE THE BACTERIAL CELL WALL

- After environmental pressures subside, endospores can undergo germination into the original bacteria
- Endospore formation makes pathogens extremely difficult to deal with

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