Medical Microbiology

Dr. Waleed Eldars
Lecturer of Medical Microbiology and Immunology
Faculty of Medicine
Mansoura University

Medical microbiology

- The science which is concerned with the study of microbes and the interaction between microbes and hosts leading to infectious diseases.

- Microbes are living organisms that can only be seen by microscopes and they are sometimes called microorganisms although viruses are not true organisms.
Microorganisms

**Prokaryotes**

**Eukaryotes**

Pro = premature  Eu = true

---

### Differences between prokaryotes and eukaryotes

<table>
<thead>
<tr>
<th></th>
<th>Prokaryotes</th>
<th>Eukaryotes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nuclear membrane</strong></td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td><strong>Chromosomal N.</strong></td>
<td>One copy (Haploid)</td>
<td>Two copies (Diploid)</td>
</tr>
<tr>
<td><strong>Ribosome</strong></td>
<td>70 S</td>
<td>80 S</td>
</tr>
<tr>
<td><strong>Mitosis</strong></td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td><strong>Peptidoglycan</strong></td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td><strong>Examples</strong></td>
<td>Bacteria, viruses</td>
<td>Fungi</td>
</tr>
</tbody>
</table>
### Classes of pathogenic microorganisms

<table>
<thead>
<tr>
<th></th>
<th>Viruses</th>
<th>Bacteria</th>
<th>Fungi</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
<td>0.02-0.2 μm</td>
<td>1-5 μm</td>
<td>3-10 (yeast)</td>
</tr>
<tr>
<td><strong>nucleus</strong></td>
<td>No nucleus</td>
<td>Nuclear body</td>
<td>True nucleus</td>
</tr>
<tr>
<td><strong>Ribosome</strong></td>
<td>No ribosome</td>
<td>70 S</td>
<td>80 S</td>
</tr>
<tr>
<td><strong>Nucleic acid</strong></td>
<td>Either RNA or DNA</td>
<td>Both</td>
<td>Both</td>
</tr>
<tr>
<td><strong>replication</strong></td>
<td>Intra cellular replication cycle</td>
<td>Binary fission</td>
<td>Budding or Mitosis</td>
</tr>
<tr>
<td><strong>Motility</strong></td>
<td>None</td>
<td>Some</td>
<td>None</td>
</tr>
<tr>
<td><strong>Cell wall</strong></td>
<td>Protein or lipoprotein</td>
<td>Peptidoglycan</td>
<td>Chitin</td>
</tr>
<tr>
<td><strong>Growth</strong></td>
<td>Intracellular</td>
<td>Intra and extra cellular</td>
<td>The same</td>
</tr>
</tbody>
</table>

### Morphology of bacteria

**Size of bacterial cell:**
The size of bacterial cell is measured by micron (micron = 1/1000 mm)

**2- Gram staining:**
Bacteria are stained with Gram stain that can differentiate bacteria into: Gram positive bacteria appearing violet or Gram negative bacteria appearing pink.
(3) Arrangement of bacteria:-

(*) **Single** as Gram negative bacilli (E. coli)
(*) **Pairs.** As Neisseria and pneumococci.
(*) **Tetrads** as staphylococci.
(*) **Grape like** as staphylococci.
(*) **Chains** as streptococci, Anthrax bacilli.
(*) **Angular** as Diphtheria bacilli.

**Shape of the bacterial cell:-**

- (a) **Cocci** or spherical. e.g. Staphylococci
- (b) **Bacilli** or cylindrical e.g. Diphtheria.
- (c) **Spiral**
- (d) **curved or comma shaped.**
Bacterial structure

The basic components of bacterial cells include:

**A)- Cell envelope:**
- Cell wall.
- Cytoplasmic membrane.
- Capsule.

**B)- Cytoplasmic components:**
- Nuclear body.
- Plasmid.
- Ribosomes.

**C)- Cell appendages:**
- Flagellae.
- Fimbriae "Pilli".
A) Cell envelope

(1) Cell wall

- It is the layer that lies outside the cytoplasmic membrane.

- All bacterial cells, the cell wall composed of peptidoglycan.

- The peptidoglycan layer present in both Gram positive & negative bacteria.
Differences between Gram positive & Gram negative bacteria cell wall:

<table>
<thead>
<tr>
<th></th>
<th>Gram positive</th>
<th>Gram negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peptidoglycan</td>
<td>Thick.</td>
<td>Very thin</td>
</tr>
</tbody>
</table>
Functions of the cell wall

- Preservation of the shape of the cell.
- Protective function
- Permeability of the cell
- Antigenic character
- Staining reaction
- Toxicity.
- Target action of antibiotics: as penicillin and cephalosporins.

(2) Cytoplasmic membrane

**Def:**
It is a thin elastic membrane that lies immediately under the cell wall

**Nature:** protein and phospholipids.

**Functions**
- Transport and permeability function.
- Excretion of hydrolytic enzymes and toxins
- Biosynthetic function.
- Chemotactic function.
- Energy Production (by mesosomes)
(3) Capsule.

**Def:**

It is gelatinous material surrounding bacterial cells produced by some pathogenic bacteria inside the host tissue.

**Chemical structure:**

- All bacteria is complex polysaccharides e.g. *Streptococcus pneumoniae*.
- Polypeptides e.g. *bacillus anthracis*.

**Functions:**

1) Protect bacterial cell against phagocytosis.
2) Determining virulence of the organism.
3) Antigenic.
B) Cytoplasmic components

(1) Ribosomes:
- The factory of protein synthesis in the cell.
- Complex structures composed of RNA & proteins.
- It is a target for some antibiotic as tetracycline and chloramphenicol.

Bacterial ribosomes consist of (70S):
- Large subunit: 50S.
- Small subunit: 30S.
- S value = Svedberg unit.
(2) Nuclear body (Nucleoid):
• No nuclear membrane.
• DNA molecules folded on itself.
• Single chromosome is double stranded circular DNA carries genetic characters.

(3) Plasmids:
• Extrachromosomal genetic elements.
• Circular double stranded DNA.
• Carry certain function: antibiotic resistance.

C) Cell appendages

I- Flagellae:
• They are long helical filaments attached to cytoplasm and pass out the cell wall.
• Formed of contractile protein "Flagellin".

Demonstration:
• Motility test: Hanging drop, semisolid agar
• E/M.

Functions:
• 1) Motility
• 2) Antigenicity: H antigen.
2- Fimbriae (Pili):

- They are short, hair like filaments.
- They are shorter and thinner than flagella straight and not originating from cytoplasm.
- They are formed of protein "pilin".

**Functions:**
- Organs of adhesion to host cell "common pili".
- Sex pili “conjugation”.
- Virulence.
**Bacterial spores**

- Bacterial endospores are resting body phase formed under unfavorable conditions. They are highly resistant forms produced outside the body by some organisms like Bacillus and Clostridium groups.

- **Shape**: Spores may be spherical or oval.
- **Site**: They may be Central, sub-terminal or terminal.
Thank You