2\textsuperscript{nd} year Medical Students - JU

Introduction to Medical Microbiology

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Introduction to Medical Microbiology

Main Contents:

1. Quick introduction.
2. Prokaryotic vs. Eukaryotic.
3. Microbial world.
4. History of Microbiology in medicine.
5. Portal of entry and common terms.
Introduction to Medical Microbiology

• **Aim:** General understanding of the basic structure and biology of the pathogenic organisms and the principles of pathogenesis to be able to better prevent, diagnose and treat infectious diseases.

• Education atmosphere should be based on respect and caring from both, the teacher and the student, we are not out to get you!

• Science is not limited to our spoken word, lectures or handouts.

• Education does not stop with the final exam.
Professionalism

- Cheating and plagiarism.
- Disruptive behavior (late, noisy, distractive and absence).
- Disrespect and abuse.
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• Microbiology: science of microbes.
• Microorganisms can be eukaryotic, prokaryotic or subcellular:

1. Eukaryotic organisms (uni. or multi cellular.):
   a. Nucleus and nuclear membrane
   b. DNA in the form of several chromosomes.
   c. Membrane bound organelles like mitochondria.
   d. Mitotic apparatus
   e. Cell wall has no peptidoglycan but cells has sterols.
   f. Ribosome type: 80s (60s & 40s)
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2. Prokaryotic (uni.):
   a. No distinct nucleus and has no nuclear membrane (DNA floats in the cytoplasm/single circular chromosome).
   b. No membrane bound organelles.
   c. Cell wall has peptidoglycan.
   d. Ribosome type: 70s (50s & 30s).
   e. Biochemistry differing from that of eukaryotic.
   f. Not compartmentalized.
   g. No sterols.
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Microbial world:

1. Bacteria: Prokaryotic.
2. Viruses: A virus is not a cell and it is smaller than a bacteria. Cell dependent, only seen by electron microscope
3. Fungi (Mycology): Yeast and Moulds (eukaryotic).
5. Immunology & genetics (molecular & engineering).
6. Prions:
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Viruses</th>
<th>Bacteria</th>
<th>Fungi</th>
<th>Protozoa and Helminthes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cells</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Approximate diameter ((\mu m))</td>
<td>0.02-0.2</td>
<td>0.5-2</td>
<td>3-10</td>
<td>15-25</td>
</tr>
<tr>
<td>Nucleic acid</td>
<td>Either DNA or RNA</td>
<td>Both DNA and RNA</td>
<td>Both DNA and RNA</td>
<td>Both DNA and RNA</td>
</tr>
<tr>
<td>Type of nucleus</td>
<td>Non</td>
<td>Prokaryotic</td>
<td>Eukaryotic</td>
<td>Eukaryotic</td>
</tr>
<tr>
<td>Ribosome</td>
<td>Absent</td>
<td>70S</td>
<td>80S</td>
<td>80S</td>
</tr>
<tr>
<td>Mitochondria</td>
<td>Absent</td>
<td>Absent</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>Nature of outer surface</td>
<td>Protein capsid and lipoprotein envelope</td>
<td>Rigid wall containing peptidoglycan</td>
<td>Rigid wall containing chitin</td>
<td>Flexible membrane</td>
</tr>
<tr>
<td>Motility</td>
<td>None</td>
<td>Some</td>
<td>None</td>
<td>Most</td>
</tr>
<tr>
<td>Method of replication</td>
<td>Not binary fission</td>
<td>Binary fission</td>
<td>Budding or mitosis</td>
<td>Mitosis</td>
</tr>
</tbody>
</table>
1. thought to be slow viruses but not because they have no nucleic cid.
2. It is a protein PrP$^{sc}$
   - It causes ‘transmissible spongiform encephalopathies’,
   - A brain disease (dementia, sensory, motor, psychic signs and symptoms).
   - Can not be grown in culture.
   - Transmitted by ingestion.
   - Sometimes iatrogenic route e.g blood transfusion, dura mater transplants and surgery (brain, tonsils, appendix and spleen ).
• **Microbiology** has many areas of specialization including **Bacteriology**, **Mycology** (fungi), **Virology**, Medical microbiology, Immunology, Food microbiology, Biotechnology, Microbial genetics. Industry. Agriculture Veterinary.
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• (normal flora)

1. Conscious about them.
2. Passing them around to others esp. immunocompromised people.
3. One wrong organism in the wrong place may kill.

• Microbes are too small to be seen by eye, however we can see its effect.
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Normal flora

• **Resident:**
  - part of our $10^{14}$

• e.g:
  1. CoNS (Coagulase Negative staphylococci)
  2. Micrococci
  3. diptheroid species

LOW PATHOGENIC POTENTIAL
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Normal flora

- **Transient:**
  - Picked up from things/humans and other animals e.g: Enterobacteriacea.
    - *E. coli*
    - MSSA/MRSA (Methicillin sensitive/resistant S. aureus)
    - *Pseudomonas sp*

- **C. difficile spores**

* > from?

**HIGH PATHOGENIC POTENTIAL**

### NORMAL FLORA

**NASOPHARYNX**
- Streptococci
- *Haemophilus*
- Neisseria
- Mixed anaerobes
- Candida
- Actinomycetes

**SKIN**
- Staphylococci
- Streptococci
- Corynebacteria
- Propriobacteria
- Yeasts

**UPPER BOWEL**
- *Enterobacteriaceae*
- Enterococci
- Candida

**LOWER BOWEL**
- Bacteroides
- Bifidobacteria
- Clostridium
- Peptostreptococci

**VAGINA**
- Lactobacilli
- Streptococci
- Corynebacteria
- Candida
- Actinomycetes
- *Mycoplasma hominis*
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If you could see the germs, you’d wash your hands.

Many germs can be spread by hand contact. Just wash your hands regularly with soap and warm water, and you’re more likely to stay healthy. For more information visit www.washyourhands.org.com.

Germs. Wash your hands of them.
Nurses, doctors and other healthcare workers can get 100s or 1000s of bacteria on their hands by doing simple tasks, such as:

- pulling patients up in bed
- taking a blood pressure or pulse
- touching a patient’s hand
- rolling patients over in bed
- touching the patient’s gown or bed sheets
- touching equipment like bedside rails, over-bed tables, IV pumps

Culture plate showing growth of bacteria 24 hours after a nurse placed her hand on the plate.
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Exudative Pharyngitis
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Streptococcal lymphadenitis
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Chest infection (Pneumonia)
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Significance

• In the UK: 25% of doctors consultations are infection related.
• 10% of these infections are hospital acquired.
• Worldwide, 10 million young child die from infectious diarrhea, measles, malaria, tetanus and whooping cough. Also, 20% of deaths are infectious related.
• 12000 deaths from HIV yearly.
• Millions with hepatitis C.
• Multidrug resistant tuberculosis.
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History

• Antony van Leeuwenhoek 17th c: observed live microorganisms (animalcules) in water mud and saliva.

• John Hunter 18th c: Syphilis and Gonorrhea can be transmitted.

• Edward Jenner 18th-19th c: Established vaccination concept, Cow pox and Small pox.
  • Smallpox (virus)
    - 30-40% mortality
  • Last naturally occurring case in Africa, 1976.
  • Eradicated: Role of WHO + humans are the only smallpox host.
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History (Epidemiology & Prevention of Infection)

• John Snow 19\textsuperscript{th} c:
  Physical measures to limit and inhibit transmission of \textit{Cholera} in London epidemic (sewage leaking into drinking water).

• Ignas Semelweis 19\textsuperscript{th} c:
  Puerperal sepsis can be prevented if the attending nurses apply hygienic measures.
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History

Louis Pasteur 19\textsuperscript{th} c:

1. Fermentation of alcohol by microorganisms.
2. Pasteurization: heat liquid is enough to kill bacteria.
3. Vaccine development – \textit{rabies}, \textit{Bacillus anthrax}.
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• Robert Koch 19th c:
  − Developed **microbiological media** & streak plates for **pure culture**.
  − **Germ theory** (Koch’s postulates):
    ➢ Microorganism must be present in every case of the disease.
    ➢ Organism must be grown in pure culture from the diseased host.
    ➢ Inoculation of above into host must give same disease.
    ➢ Organism must be recovered from experimentally infected host.
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• 1917-1921. Influenza Pandemic. Best estimates are 25 – 30 million confirmed dead, millions more suspected.


• Kary Mullis 1986: Polymerase Chin Reaction.

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Portal of entry

• Respiratory: via inhalation.
• Alimentary (GIT): by ingestion.
• Genital tract: sexual contact.
• Skin: abrasions, bites…
• Others: Conjunctiva, blood transfusion, injections and organ transplants.
• Congenital or vertical.
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Common terms

• Incubation period: time from infection-symptoms- important for outbreaks.
• Period of communicability: the time during which the infectious agent may be transmitted- important for infection control.
• Incidence: new cases over a period of time (e.g. a year) expressed as a ratio e.g per 1000 or 100,000 in the population concerned (e.g. TB, DM).
• Prevalence: proportion of population affected or infected at a specific point in time (TB, DM)
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• Infection vs. Colonisation.

• Mortality rate: ratio of number of deaths from a disease in a given year to the total population at mid year.

• Case fatality rate: the proportion of the patients with the disease who die from it.
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- **Endemic infection**: the constant presence of the infectious disease or its agent within a population.

- **Epidemics**: a rise in the number of cases/appearance of new infectious agent in a country or region.

- **Pandemic**: A worldwide epidemic.
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Summary/Take home message

We and our Hands must be Part of Infection control

Hands are dangerous!
Wash your hands! Before and after each clinical contact!

Do not wear wrist watch or rings…bare above elbow+ no ties?
The End