

Exam Topics/Subtopics in Medical Microbiology

Faculties of Pharmacy

General Microbiology

1. The Science of Microbiology. Classification of microorganisms.

- 1.1. Microbes That Cause Infectious Diseases.
- 1.2. Important Features of Microbes.
- 1.3. Eukaryotes and Prokaryotes. Bacteria Compared with Other Microorganisms.

2. Structure of Bacterial Cells

2.1. Structure of Bacteria.

2.1.1. Essential components (cell wall, peptidoglycan, outer membrane of gram-negative bacteria, surface fibers of gram-positive bacteria, plasma membrane, ribosome, nucleoid, mesosome, periplasm).

2.1.2. Nonessential components (capsule, pilus or fimbria, flagellum, spore, plasmid granule, glycocalyx).

2.2. Shape and Size of Bacteria - cocci (spheres), bacilli (rods), and spirochetes (spirals). Pleomorphic bacteria.

3. Microbial Metabolism.

3.1. Role of Metabolism in Biosynthesis and Growth. Focal Metabolites and Their Interconversion. Assimilatory Pathways. Biosynthetic Pathways.

3.2. Patterns of Microbial Energy-Yielding Metabolism. Regulation of Metabolic Pathways.

4. Growth of Bacteria

4.1. Growth Cycle. Growth curve of bacteria: lag phase; log phase; stationary phase; death phase.

4.2. Obligate Intracellular Growth

- 4.3. Aerobic and Anaerobic Growth. Enzymes - superoxide dismutase and catalase.
- 4.4. Fermentation of Sugars - as the basis of the laboratory identification of some important pathogens. Beta-galactosidase in E. Coli. Krebs cycle
- 4.5. Iron Metabolism. iron-binding compounds - siderophores.

5. Cultivation of Microorganisms.

- 5.1. Requirements for Growth (anhydride bonds between building blocks, proton motive force).
- 5.2. Sources of Metabolic Energy (Fermentation, respiration, and photosynthesis).
- 5.3. Nutrition (carbon source, nitrogen source, sulfur source, phosphorus source, growth factors).
- 5.3. Environmental Factors Affecting Growth (nutrients, hydrogen Ion Concentration (pH), yemperature, aeration, ionic Strength and Osmotic Pressure).
- 5.4. Cultivation Methods. Medium. Growing Cells of a Given Species. Microbiologic Examination of Natural Materials. Isolation of a Particular Type of Microorganism. Isolation of Microorganisms in Pure Culture. Dilution.

6. Laboratory Diagnosis. Approach to Laboratory Diagnosis. Sterilization and Disinfection

- 6.1. Laboratory Diagnosis. Approach to Laboratory Diagnosis.
 - 6.1.1. Bacteriologic Methods (Blood Cultures. Throat Cultures. Sputum Cultures. Spinal Fluid Cultures. Stool Cultures. Urine Cultures. Genital Tract Cultures. Wound and Abscess Cultures).
 - 6.1.2. Immunologic Methods (Identification of an Organism with Known Antiserum. Identification of Serum Antibodies with Known Antigens)..
- 6.2. Sterilization and Disinfection.
 - 6.2.1. Modification of Proteins
 - 6.2.2. Modification of Nucleic Acids.
 - 6.2.3. Physical agents. Heat. Radiation. Filtration
 - 6.2.4. Disruption of Cell Membranes

7. Genetics.

7.1. Mutations. missense mutation; nonsense mutation. frameshift mutation. Integration of transposons or insertion sequences into the DNA. Mutations caused by chemicals, radiation, or viruses. Conditional lethal mutations.

7.2. Transfer of DNA within bacterial cells. Programmed rearrangements.

7.3. Transfer of DNA between bacterial cells

7.3.1. Conjugation. F (fertility) plasmid (F factor). Sex pilus (conjugation tube). Hfr (high-frequency recombination) . Resistance plasmids (R plasmids).

7.3.2. Transduction. Role of bacteriophages. Lysogenic conversion. Two types of transduction: generalized and specialized.

7.3.3. Transformation. Transfection.

7.3.4. Recombination. Homologous recombination. Nonhomologous recombination,

8. General Properties of Viruses.

8.1. Classification of Viruses. Structure and Replication of Viruses.

8.2. Pathogenesis. Laboratory Diagnosis. Antiviral Drugs. Viral Vaccines

9. Human Microbiome. Normal Flora.

9.1. Permanent residents. Commensals. Carrier state. Colonization. Colonization resistance.

9.2. Normal Flora of the Skin. Normal Flora of the Respiratory Tract.

9.3. Normal Flora of the Intestinal Tract. Normal Flora of the Genitourinary Tract

10. Pathogenesis of Bacterial Infection.

10.1. Principles of Pathogenesis. Opportunistic pathogens. Virulence. Infectious dose. Obligate intracellular parasites.

10.2. Types of Bacterial Infections (communicable, contagious, epidemic, pandemic, subclinical, latent, chronic state).

10.4. Stages of Bacterial Pathogenesis

10.5. Determinants of Bacterial Pathogenesis.

10.5.1. Transmission. Fomites. Human to human transmission (direct contact, no direct contact, transplacental, Bloodborne). Nonhuman to human transmission (soil source, water

source, animal source, via insect vector, via animal excreta). vertical transmission. Horizontal transmission. Infection source (reservoir) and vector.

10.5.2. Adherence to Cell Surfaces. Specialized structures (pili), production of substances (e.g., capsules or glycocalyxes). Quorum sensing. Curli.

10.5.3. Invasion, Inflammation, & Intracellular Survival. Opsonization. Two types of inflammation: pyogenic and granulomatous. Pathogenicity islands. Pseudomembranes.

10.5.4. Toxin Production. Comparison of exotoxins and endotoxins. A–B subunit structure of exotoxins. Important bacterial toxins and their mode of action. Bacterial Secretion systems. Mode of action of endotoxin. Effects of Endotoxin.

10.5.5. Immunopathogenesis

10.6. Bacterial Infections Associated with Cancer

10.7. Different Strains of the Same Bacteria Can Produce Different Diseases

10.8. Typical Stages of an Infectious Disease. The incubation period. The prodrome period. The specific-disease period. The recovery period.

11. Host Defenses. Bacterial Vaccines. Antigen-antibody reactions.

11.1. Principles of Host Defenses

11. 2. Innate (nonspecific) immunity. Skin and Mucous Membranes. Inflammatory Response & Phagocytosis. Fever.

11.3. Adaptive (Specific) Immunity

11.4. Failure of Host Defenses Predisposes to Infections

11.5. Bacterial Vaccines. Active Immunity. Passive Immunity

11.6. Antigen-antibody reactions in the laboratory.

11.6.1. Agglutination Precipitation (Precipitin)

11.6.2. Radioimmunoassay (RIA)

11.6.3. Enzyme-Linked Immunosorbent Assay (ELISA)

11.6.4. Immunofluorescence (Fluorescent Antibody)

11.6.5. Complement Fixation

11.6.7. Neutralization Tests

11.6.8. Immune Complexes

11.6.9. Hemagglutination Tests

- 11.6.10. Antiglobulin (Coombs) Test
- 11.6.11. Western Blot (Immunoblot)
- 11.6.12. Fluorescence-Activated Cell Sorting (Flow Cytometry)
- 11.7. Antigen–Antibody Reactions Involving Red Blood Cell Antigens
 - 11.7.1. The ABO Blood Groups and Transfusion Reactions
 - 11.7.2. Rh Blood Type and Hemolytic Disease of the Newborn

12. Antimicrobial Drugs: Mechanism of Action.

- 12.1. Inhibition of Cell Wall Synthesis. Antibacterial activity inhibition of cross-linking (transpeptidation) of peptidoglycan. Inhibition of other steps in peptidoglycan synthesis. Antifungal activity inhibition of β -glucan synthesis
- 12.2. Inhibition of Protein Synthesis. Action on 50S ribosomal subunit. Action on 30S ribosomal subunit.
- 12.3. Inhibition of Nucleic Acid Synthesis. Inhibition of nucleotide synthesis. Inhibition of DNA synthesis. Inhibition of mRNA synthesis.
- 12.4. Alteration of Cell Membrane Function. Antibacterial activity. Antifungal activity.
- 12.5. Additional Drug Mechanisms. Antibacterial activity. Antifungal activity.
- 12.6. Chemoprophylaxis. Probiotics

13. Antimicrobial Drugs: Resistance.

- 13.1. Genetic Basis of Resistance
 - 13.1.1.. Chromosome-Mediated Resistance
 - 13.1.2. Plasmid-Mediated Resistance
 - 13.1.3. Transposon-Mediated Resistance
- 13.2. Specific Mechanisms of Resistance
- 13.3. Nongenetic Basis of Resistance
- 13.4. Selection of Resistant Bacteria by Overuse & Misuse of Antibiotics
- 13.5. Antibiotic Sensitivity Testing. Antibigram. Minimal Inhibitory Concentration. Minimal Bactericidal Concentration. Serum Bactericidal Activity. beta-Lactamase Production
- 13.6. Use of Antibiotic Combinations

