

General microbiology

Lecture-17

Antimicrobial Agents and Immunology

Content

➤ Antimicrobial agents

- Definitions
- Physical antimicrobial control
- Chemical Antimicrobial Control

➤ Immunology

- Cells and Organs of the Immune System
- Types of immunity: Innate Immunity and Adaptive Immunity
- Inflammation

Definitions

➤ Sterilization

The killing or removal of all viable organisms within a growth medium

➤ Inhibition

Effectively limiting microbial growth

➤ Decontamination

The treatment of an object or surface to make it safe to handle.

➤ Disinfection

Directly targets the removal of all pathogens, not necessarily all microorganisms

Antimicrobial agents

Physical antimicrobial control

1- Heat sterilization is the most widely used method of controlling microbial growth.

- High temperatures **denature** macromolecules
- Amount of time required to reduce viability tenfold is called the **decimal reduction time**
- Some bacteria produce resistant cells called **endospores**, Can survive heat that would rapidly kill vegetative cells.
- The **autoclave** is a sealed device that uses steam under pressure
 - **Pasteurization** is the process of using precisely controlled heat to reduce the microbial load in heat-sensitive liquids
 - Does **not** kill all organisms, so it is different than sterilization

Antimicrobial agents

Physical antimicrobial control

2. Radiation Sterilization

- Microwaves, UV, X-rays, gamma rays, and electrons can reduce microbial growth
- UV has sufficient energy to cause modifications and breaks in DNA
 - UV is useful for decontamination of surfaces
 - Cannot penetrate solid, opaque, or light-absorbing surfaces



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Antimicrobial agents

Physical antimicrobial control

3. Filter Sterilization

Filtration avoids the use of heat on sensitive liquids and gases

- Pores of filter are too small for organisms to pass through
- Pores allow liquid or gas to pass through
- Includes 2 types
 - Depth filters.
 - Membrane filters.

Antimicrobial agents

Chemical antimicrobial control

Minimum inhibitory concentration (MIC) is the smallest amount of an agent needed to inhibit growth of a microorganism

- Varies with the organism used, inoculum size, temp, pH, etc.

➤ Antimicrobial agents for external use: can be divided into two categories

- Products used to control microorganisms in commercial and industrial applications
 - Examples: chemicals in foods, air-conditioning cooling towers, textile and paper products, fuel tanks
- Products designed to prevent growth of human pathogens in inanimate environments and on external body surfaces
 - Sterilants, disinfectants, sanitizers, and antiseptics.

Antimicrobial agents

Chemical antimicrobial control

Antimicrobial Drugs

- Naturally Occurring Antimicrobial Drugs: Antibiotics.
- Example:
 - β -Lactam Antibiotics (from eukaryotes; fungi): Penicillins and Cephalosporins
 - Antibiotics from Prokaryotes; Colistin

Immunology

Immunology

- Cells and Organs of the Immune System
- Types of immunity: Innate Immunity and Adaptive Immunity
- Inflammation

Cells and Organs of the Immune System

- **Immunity** is active mechanism used by multicellular organisms to resist pathogens infections and disease.
- Immunity results from the actions of cells that circulate through the blood and lymph.
- **Lymph** is a fluid similar to blood that contains lymphocytes and proteins, but lacks red blood cells.

Cells and Organs of the Immune System

- Whole blood is composed of plasma and cells (red blood cells and white blood cells or **leukocytes**)
- plasma is a liquid containing proteins and other solutes.
- 0.1% of blood cells are **leukocytes**, include monocytes and lymphocytes

Types of immunity

Innate immunity (nonspecific immunity)

- The non-inducible ability to recognize and destroy an individual pathogen or its products
- Does not require previous exposure to a pathogen or its products

Example: phagocytes

Adaptive immunity

- The acquired ability to recognize and destroy a particular pathogen or its products
- Dependent on previous exposure to the pathogen or its products
- Directed toward an individual molecular component of the pathogen (antigen)
- Example: B-cells, T-cells, antibodies
- **Antibodies (immunoglobulins)** are soluble proteins made by B cells in response to exposure to non self antigens

Inflammation

- **Inflammation** is a nonspecific reaction to noxious stimuli such as toxins and pathogens.
 - Inflammation causes redness, swelling, pain, and heat localized at site of infection.
 - Effective inflammatory response isolates and limits tissue damage, destroying damaged cells and pathogens
 - In some cases, inflammation can result in considerable damage to healthy tissue.