

# Chapter 15 The Innate Immune Response

## Summary Outline

### 15.1 Innate Defenses

- A. Composed of first-lined defenses, toll-like receptors, complement and phagocytes.
- B. **Inflammation** is a coordinated response that involves innate defenses.

### 15.2 First-line Defenses

- A. **Physical barriers** include the skin and mucous membranes
- B. **Antimicrobial substances** such as **lysozymes, peroxidase enzymes, lactoferrin, and defensins** inhibit or kill microorganisms.
- C. **Normal Flora** competes with pathogens for the same niche and stimulates the host defenses.

### 15.3 Cells involved in host defense

- A. The granulocytes are **eosinophils, basophils and neutrophils** (PMNs).
- B. The **mononuclear phagocytes, monocytes and macrophages**, along with the **neutrophils** are **phagocytic**.
- C. **Macrophages and dendritic cells** also play essential roles in specific immune responses.
- D. **Lymphocytes**
  - 1. **Natural killer cells** are lymphocytes that kill abnormal cells in a non-antigen-specific manner.
  - 2. **T cells** are responsible for **specific cellular immune responses**.
  - 3. **B cells** are responsible for producing **antibodies**.

### 15.4 Cell communication

- A. **Surface receptors** bind ligands on the cell surface and thus signal the cell of the presence of the ligands.
- B. **Cytokines**
  - 1. **Cytokines** are **small regulatory proteins** essential for communication between cells. They have many actions in the **inflammatory response** and they contribute to **fever production** and to **development of specific immune responses**.
  - 2. **Cytokines** include **interleukins (ILs), colony-stimulating factors (CSFs), tumor necrosis factors (TNFs), chemokines, and interferons**.
  - 3. **Interferons** are **antiviral glycoproteins** important in activating macrophages and in development and regulation of specific immune responses.
  - 4. **Interleukins** are cytokines produced by leukocytes that function in the induction of fever, signaling release of PMNs, attracting leukocytes into areas of inflammation and inducing proliferation of lymphocytes.
  - 5. **Colony stimulating factors** direct immature cells into appropriate maturation pathways.
  - 6. **Tumor necrosis factors** induce fever, recruit neutrophils into areas of inflammation, and are antiviral; some can kill target cells.
- C. **Adhesion molecules** are chemicals that allow cells to adhere to other cells.

### 15.5 Sensor systems

- A. **Toll-like receptors** enable cells to detect molecules signaling an invading microorganism.
- B. The **complement system**
  - 1. Complement is a **group of blood proteins** that act in a cascading fashion, leading to an amplified effect.
  - 2. Complement is activated by a specific antigen-antibody reaction in the classical pathway, or nonspecifically by bacterial products in the alternative pathway and the lectin pathway.
  - 3. The end of complement activation may result in **inflammation, opsonization and cell lysis**.

### 15.6 Phagocytosis

A. Process of **phagocytosis** occurs in several steps:

1. **Chemotaxis**
2. **Recognition and attachment**
3. **Engulfment**
4. **Fusion of the phagosome with the lysosome**
5. **Destruction and digestion**
6. **Exocytosis**

B. **Macrophages**

1. **Macrophages** are always present in tissues, but can signal for the migration of other macrophages as needed.
2. **Macrophages** can be activated which increases their ability to kill.
3. **Macrophages, giant cells, and T-helper** cells form groups called **granulomas** that wall off microorganism and other material not destroyed by macrophages.

C. **Neutrophils** are the first cell type to arrive at an area of damage.

15.7 **Inflammation** is an innate tissue response to any injury, characterized by swelling, heat, redness, and pain.

1. It is an attempt by the body to contain a site of damage, localize the response, and restore tissues.
2. Upon injury, **cytokines** and other pro-inflammatory mediators are released that lead to
  - a. **Dilation of local small blood vessels**
  - b. **Chemotaxis of leukocytes**
  - c. **Leakage of fluids into the tissues**
  - d. **Migration of leukocytes from the bloodstream into the tissues**
3. **Acute inflammation** is local, begins immediately upon injury, and increases in intensity over a short time.
4. **Chronic inflammation** involves the formation of granulomas and may last for years.
5. **Apoptosis** is programmed cell death of “self” cells that by-passes the inflammatory response

15.8 **Interferons** induce cells in the vicinity of a virally infected cell to block protein synthesis if they become infected with a virus.

15.9 **Fever** is caused by pro-inflammatory cytokine known pyrogens that are released by macrophages and act on the hypothalamus to increase body temperature. Fever decreases the growth rate of many bacteria and increases the rate of production of host defense cells and substances.