Chapter 31: Defense Against Diseases: The Immune Response

BI 103 Midterm 2

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How Does a Body Defend Against Invasion?

**Microbes:**
- Viruses
- Bacteria
- Fungi
- Protists

**Chapter 31: Immune System**

**Barriers (1st Line of Defense):**
- Prevent microbes from entering body
  1. **Skin:**
     - Inhospitable environment:
       - Dry, nutrient-free zone
       - Sweat/oil gland secretions (antibiotics)
       - Skin sloughed off
  2. **Mucous Membranes** (digestive, respiratory, urogenital tracts):
     - Secrete mucus (traps microbes):
       - Antibacterial enzymes
     - Cilia sweep up mucus (swallowed)

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**Non-specific Internal Defenses (2nd Line of Defense):**
- Attack wide variety of microbes that penetrate barriers
  1. **Phagocytic Cells** (leukocytes):
     - Macrophages (“big eaters”)
       - Ingest microbes via phagocytosis
     - Natural Killer Cells
       - Attack virus-infected / cancer cells
  2. **Inflammation** (“to set on fire”)
     - Wounded region → red, swollen and warm:
       - Damaged cells 1) release histamine (‘leaky vessels’-swelling)
       2) initiate blood clotting
       3) attract macrophages (Clean area)
  3. **Fever** (↑ body temperature)
     - Combats large-scale infections (turn up thermostat - hypothalamus)
     - Function: 1) increases macrophage activity
       2) slows bacterial reproduction

(Figure 31.4)
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Specific Immune Response (3rd Line of Defense):
- Complex attack against specific target (organism / toxin)
- **Immune System**: Cells / molecules that work together to combat the microbial invasion
- Key Players (leukocytes : lymphocytes):
  - **B cells** = Mark / inactivate foreign invaders in blood
  - **T cells** = Destroy foreign invaders in cells
  - **Table 31-1** (Overview of cell types...)

Fundamental Steps in Immune Response:
1) **Antigen**: Molecule located on cell surface which triggers an immune response.
   - **B cells produce antibodies** which recognize antigens
   - **Antibody structure**:
     - Y-shaped
     - 4 chains (2 light; 2 heavy)
     - Variable / constant regions
     - Antigen binding site
     - High specificity

Why doesn’t our immune system destroy our own cells?
**Answer**: Major Histocompatibility Complex (MHC):
- Unique set of proteins / polysaccharides which identify “self” cells of body
- Act as antigens in other individual’s bodies

Fundamental Steps in Immune Response:
2) **Humoral Immunity** (B cells / circulating antibodies):
   - Attacks invaders (bacteria, protists, fungi) prior to cell entry
     1) B cell antibody receptor binds antigen
     2) Activated B cell divides rapidly (clonal selection):
        a) **Memory cells** (Future immunity)
        b) **Plasma cells**: ↑ antibodies (released into blood)

Clonal Selection:
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Fundamental Steps in Immune Response:

2) Immune system must launch attack...

A) Humoral Immunity (B cells / circulating antibodies):
- Attacks invaders (bacteria, protists, fungi) prior to cell entry
  1) B cell antibody receptor binds antigen
  2) Activated B cell divides rapidly (clonal selection):
     a) Memory cells (Future immunity)
     b) Plasma cells: ↑ antibodies (released into blood)
  3) Antibodies destroy invaders:
     - Inactivate invader (binding)
     - Cause invaders to clump together
     - Coat invaders with blood proteins

B) Cell-mediated Immunity (T cells):
- Attacks invaders (viruses, cancers) after they enter body cells
  1) Cytotoxic T cells:
     - Release proteins → disrupt plasma membrane
  2) Helper T cells:
     - Stimulate immune cells (via hormones)
     - Destroyed by AIDS virus
  3) Suppressor T cells:
     - Activated following infection; shut down B / T cells
  4) Memory T cells:
     - Protect body against future invasion

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Medical Care Augments Immune Response:

1) Antibiotics: Slow down microbial reproduction (not viruses)
   - Problem: Antibiotic resistant strains
2) Vaccinations: Injection of killed microbes to confer immunity
   - Stimulates development of memory cells

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Malfunctions of Immune System:

1) Allergies: Adverse reaction to harmless substances
   - B cells recognize substance as antigen (histamine release)
     - Anaphylactic Shock
2) Autoimmune Disease: Body mistakes own cells as invaders
   - Diabetes mellitus (Type I): Destruction of pancreatic cells
   - Multiple Sclerosis: Destruction of neuron insulation (myelin)
3) Immunodeficiency Disease:
   - Severe Combined Immune Deficiency (SCID): ("Bubble Boy")
   - Acquired Immune Deficiency Syndrome (AIDS)
4) Cancer: Unchecked growth of tumor cells
   - Cells evade / overwhelm immune system