Lec2 Summary. Innate Immunity and immune organs

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Cellular Components of the Immune System (Percentages):

- **Lymphocytes (30%)**
  - **T cells** (60% of lymphocytes)
  - **B cells** (30% of lymphocytes) – High nucleus-to-cytoplasm ratio
  - **Natural Killer (NK) cells** (10% of lymphocytes) – Low nucleus-to-cytoplasm ratio, granular
- **Mononuclear Phagocytes**
  - **Macrophages** (5.3%)
- **Granulocytes**
  - **Neutrophils** (62% of total immune cells)
  - **Eosinophils** (2.3%)
  - **Basophils** (0.4%)

Mononuclear Phagocytes (Macrophages):

- **Characteristics**: Rounded or kidney-shaped nuclei, finely granular cytoplasm.
- **Function**: Phagocytosis.
- **Origin**: Formed in bone marrow as monocytes, become macrophages when settled in tissues.
- **Differentiation**: Some differentiate into dendritic cells or form multinucleated giant cells.
- **Location (Tissue-Specific Names)**:
  - Kupffer cells (liver)
  - Histiocytes (connective tissues)
  - Langerhans cells (skin)
  - Osteoclasts (bone)
  - Microglial cells (brain)
  - Mesangial cells (kidneys)
  - Monocytes (blood)

Neutrophils:

- **Characteristics**: Granulocytes with 3-5 lobe-segmented nucleus (polymorphonuclear leukocytes).
- **Function**: Early response within 24 hours.
- **Receptors**: 20x more than macrophages; possess receptors for IgG, IgA, and complement.
- **Killing Mechanism**: Use azurophilic lysosomal and specific granules for intracellular killing.

Eosinophils:

- **Staining**: Acid-loving cells, stain brick-red with eosin.
- **Function**: Contain hydrolytic enzymes for anti-helminthic activity.
- **Major Basic Protein (MBP)**: Toxic to worms, unique to eosinophils.

Basophils and Mast Cells:

- **Characteristics**: Granulocytes with lobed nuclei and large granules that stain blue with methylene blue.
- **Forms**:
    - **Mast Cells**: Stationary form.
    - **Basophils**: Circulating form.

Dendritic Cells (DCs):

- **Function**: Antigen-presenting cells (APCs) that phagocytose antigens and present them to lymphocytes.
- **Location**: Found in skin, mucosal linings (e.g., nose, lungs, stomach, intestines), and in the blood (immature form).
- **Activation**: Activated DCs migrate to lymphoid tissues to interact with T and B cells.

Types of Dendritic Cells:

1. **Myeloid DC**: Phagocytose antigens, activate T cells.
2. **Lymphoid DC**: Recruit immune cells.
3. **Follicular DC**: Activate B cells.
4. **Plasmacytoid DC**: Respond early to viral infections with antiviral activity.

Organs of the Immune Response:

- **Primary Lymphoid Organs**:
    - **Bone Marrow**: Origin of immune cells, site of B cell maturation.
    - **Thymus**: T cell differentiation and maturation.
- **Secondary Lymphoid Organs**: Maintain mature naive lymphocytes, initiate adaptive immune response. Examples:
    - Lymph nodes
    - Spleen
    - Mucosa-associated lymphoid tissue (MALT): Peyer's patches, tonsils, adenoids

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Bone Marrow:

- **Functions**: Produces blood cells, site for B cell maturation.
- **Hematopoiesis**: Starts in childhood and continues through adulthood in the bone marrow.
- **Types**:
    - **Red Marrow**: Produces red blood cells, platelets, and most white blood cells.
    - **Yellow Marrow**: Mostly fat cells, converts to red marrow during severe blood loss.
    - **Stroma**: Non-blood-producing tissues (e.g., fat, fibroblasts, osteoblasts).

Thymus:

- **Location**: Anterior mediastinum, in front of the heart.
- **Development**: Enlarges during childhood, undergoes involution after puberty but continues functioning.
- **Structure**: Composed of two lobes, with an outer cortex and inner medulla.
- **T Cell Maturation**: Thymocytes (immature T cells) mature here before entering circulation.

Lymph Nodes:

- **Function**: Concentrate antigens and activate lymphocytes.
- **Structure**:
    - **Cortex**: Contains B cells (primary and secondary follicles).
    - **Paracortex**: Contains T lymphocytes, site of T cell activation.
    - **Medulla**: Contains plasma cells, large blood vessels.

Spleen:

- **Location**: Left upper quadrant, weighs ~150g.
- **Function**: Immune response against blood-borne antigens, destroys damaged RBCs, and stores blood cells.
- **Structure**:
    - **White Pulp**: Contains T and B cell zones (PALS and follicles).
    - **Red Pulp**: Contains blood vessels, destroys old erythrocytes.
- **Clinical Significance**: Splenectomy increases susceptibility to infections from encapsulated bacteria like pneumococci and meningococci