IMMUNOLOGY AND THE IMMUNE SYSTEM

By:
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• **Immunology**
  – Study of the components and function of the immune system

• **Immune System**
  – Molecules, cells, tissues and organs which provide non-specific and specific protection against
    • Microorganisms
    • Microbial toxins
    • Tumor cells
  – Crucial to human survival

  – The immune system characterized by:
    • It can respond to the vast number of antigen
    • Discriminate between self and non self
    • It has memory
• IMMUNE SYSTEM CONSIST OF:
  – Primary (central) Lymphoid Organs in which Leukocytes develop (Bone marrow & Thymus)
  – Secondary (peripheral) Lymphoid Organs & Tissues in which Immune Response occur which include:
    - Lymph Nodes and Spleen
    - Mucosa-Associated Lymphoid Tissue (MALT) Waldeyers Ring (Tonsil)
    - Gut- Associated Lymphoid Tissue (GALT) Peyer’s patch
  – Leukocytes in Blood
• Mature in Marrow (B cell) or Thymus (T-cell)
The role of stem cells

• Myeloid Stem cell give rise to:
  – Monocyte $\rightarrow$ Macrophage
  – Eosinophil
  – Basophil
  – Megakaryocyte $\rightarrow$ Platelet
  – Erythroblast $\rightarrow$ Erythrocyte

• Lymphoid Stem cell give rise to:
  - Pre-B cell $\rightarrow$ Late pre-B cell $\rightarrow$ Immature B cell $\rightarrow$ Mature B cell $\rightarrow$ Plasma cell $\rightarrow$ Abs
  - Pre-T cell (enters Thymus) $\rightarrow$ Helper T cell $+$ Cytotoxic T cell $+$ TDTH cell
  - NK cell

• After maturation in Thymus or Bone marrow, Lymphocytes migrate to Spleen + LN + MALT
CELLS OF THE IMMUNE SYSTEM

- **MONOCYTES & MACROPHAGES**
- Control infections not overcome by Neutrophils
- Associated with chronic infections
- Main role in cell-mediated immunity
- Act as Ag presenting cell to T-Lymphocyte
- Monocytes $\rightarrow$ Macrophage with different names:
  - Kupffer cell in sinusoid of Liver
  - Alveolar macrophage in Lung
  - Microglial in Brain

- Multinucleated Giant Cells formed by fusion of Macrophages
MACROPHAGES & NEUTROPHILS
– Phagocytize Bacteria coated with Complement

DENDRITIC CELLS

• Present in Blood, LNs, Epithelial cells
• Digest & process Ag to present to T-cells
Examples:
  Langerhans cells (resides within Epithelium)
  Veild cells (Afferent Lymphatics)
  Interdigitating reticular cells (Spleen & LNs)
GRANULOCYTES

• **NEUTROPHILS** (PMNs)
• 60% of leukocytes (white blood cells)
• Have receptor for IgG & C3b
• Release Matrix Metalloproteinase (MMP)
• **First to arrive in acute inflammation**, actively **killing bacteria**, by generation of **Hydrogen peroxide & Oxygen free radicals** releasing LPS.
• Cytoplasm contain Lysosomal Peroxidase + Acid Hydrolases
• Cytoplasmic granules contain digestive enzyme (Myeloperoxidase) & Lactoferrin (binds Fe)
- **EOSIONPHILS** (1–3% of leukocytes)
- Have receptors for Complement
- Mostly in parasitic & allergic conditions
- **Contents & Functions:** Histaminase Pyrogen (fever)
  Peroxidase (kill bacteria)

- **BASOPHILS** (1% of leukocytes)
- Contain Histamine (hypersensitivity mediator)
- Have receptors for Fc portion of IgE
- IgE binding → degranulation → Histamine → allergic reactions
• **LYMPHOCYTES** (30% of circulating WBC)
  • B Lymphocytes:
  • Differentiate into **Plasma cells** → Antibodies
  • Memory B cells: generated after exposure to Ag
  • Mature B cell: have surface IgM & IgD that bind Ag → cause B cell → Ab

• **T LYMPHOCYTES:**
  • **Helper T cells** (CD4 positive)
  • Stimulate B-Lymphocytes → Plasma cell → Ab
  • Promote cytotoxic T-cell (CD8) response

• **Cytotoxic T cell (CD 8 +)**
  • Recognize Foreign Ag & Class 1 MHC
  • Lyse virus infected cells & tumor cells
• Natural killer (NK) cells (10-15% of Lymphocytes)
• Kill Tumor cells
• Defend against Viral infections
• Recognize Foreign Ag independent of MHC