

2010(a)10: Describe how white blood cells defend the body against infection

WBCs form part of the body's immune system, represent both innate and acquired systems and can be divided into 2 groups

Phagocytes

- granulocytes (neutrophils, eosinophils, basophils)
- monocytes

Immunocytes

- lymphocytes -T-helper, cytotoxic, T-regulatory
- plasma cells (originate from B lymphocytes)
- NK cells
- Both are important for defence against infection and work with Ig's and complement

Phagocytes

- Part of the **innate** immune system - derive from pluripotential haemopoietic stem cells (PHSCs). Differentiation under control of growth factors

Neutrophils

- 6-12 hour transit time in peripheral blood once released from marrow, divided into circulating and marginating pools. Migrate into tissue and survive for 4-5 days before destruction either through senescence or involvement in defence

Monocytes circulate in blood for 20-40 hours, after which they enter tissues and survive for months to years. They are found in the RES throughout the body and are named depending in their site, e.g. Kupffer cells in liver, Langerhans' cells in skin, and alveolar macrophages in lung.

Neutrophils and monocytes - attracted to infection site by **chemotaxis**, and arrive there by initially by diapedesis (traversing the capillary endothelium) and amoeboid movement through tissue

→ **phagocytose** foreign material (bacteria, fungi), i.e. ingest + destroy them with lipase, proteolytic enzymes and reactive oxygen species

- interaction with **antibody** and **complement** here, as neutrophils and monocytes have Fc and C3 receptors, allowing to recognise 'opsonised' foreign material

- **Eosinophils** circulate in blood for 3-8 hours, then enter tissues, primarily epithelial, where they stay for 8-12 days. They are also phagocytic and are important for parasitic diseases

- **Basophils** present in small numbers in blood, mostly in tissues as mast cell with binding sites for IgE → release histamine on degranulation. Also defend against parasites

Immunocytes

- Part of the **acquired** immune system (except for NK cells – innate) meaning that immunity is **specific** to certain antigens, and has **memory**

- Subsequent exposure → rapid + more powerful response

- Lymphocytes, plasma cells and natural killer (NK cells) make up this group

- **T-lymphocytes** arise from bone marrow, and migrate to the thymus, → differentiate to CD-4 (T-helper), CD-8 (cytotoxic), and CD-4 T-suppressor cells

- **T-helper cells (CD4)**: important in coordinating other elements of the immune system. Recognise foreign antigen presented on MHC-2 on antigen presenting cells (macrophages, monocytes, dendritic cells, plasma cells), APCs travel through lymphatic system to nodes where antigen presentation takes place. Activated T-helper cells secrete cytokines to activate other lymphocytes

- **Cytotoxic T-cells(CD8)**: recognise antigen bound to MHC-1 (present on all nucleated

cells) and attack it - important in fighting viral infection

The cells release perforin, granulysin, granzymes → perforation of target cell membrane

- Caspase cascade is activated → apoptosis

- **NK cells:** not specific immune cells but can recognise the Fc portion of antibody → can lyse antibody-coated foreign cells by ADCC – antibody dependent cell-mediated cytotoxicity → also important in killing virus-infected and tumour cells

- **Plasma-cells:** derived from B-lymphocytes, “antibody factories” secrete large quantities of antibody into circulation, after activation by T-cells

Antibody has numerous functions, opsonisation of bacteria, activation of complement

A subset of B-cells “B-memory cells” persist in lymph nodes → respond to future exposure to the same antigen with rapid antibody production