

SCN1111- Health Science Exam Study Sheet

Haematological System

Blood

- Description
 - Tissue
 - Only fluid tissue in the body
 - A specialised connective tissue
 - Approx. 8% of body weight or 70 ml/kg
 - Thus in a 70kg adult there is about 4.9L
 - Average is about 5.5 L
 - pH 7.35-7.45
- Function
 - The continuous movement of blood around the body guarantees that critical components are available to carry out their functions
 - Delivery of substances needed for cellular metabolism in the tissues
 - Oxygen
 - Nutrients
 - Removal of the wastes of cellular metabolism
 - Carbon dioxide
 - Cellular waste products
 - Must be removed to avoid toxic effects
 - Defence against invading microorganisms and injury
 - By the white blood cells and the platelets
 - Maintenance of the acid-base balance
 - Carbon-dioxide is an acid
 - Hydrogen is an acid
- Organs Affecting the Blood
 - Spleen
 - Responsible for removing the majority of old or non-functional blood cells
 - Largest lymphoid organ
 - Site of fetal haematopoiesis
 - Phagocytes within the spleen filter and cleanse the blood
 - Splenic lymphocytes mount immune response to blood-borne microorganisms
 - Splenic sequestration
 - A blood reservoir storing 1/3 of blood in the venous sinus/red pulp
 - Structure
 - Located near the stomach and connected by strands of connective tissue (trabeculae) that extend from the splenic capsule
 - Splenic capsule is divided into the splenic pulp
 - White splenic pulp – contains masses of lymphoid tissue containing lymphocytes and macrophages
 - Red splenic pulp – responsible for filtering and storing blood
 - Breaks down old blood cells
 - Spleen is interlaced with many blood vessels
 - Some distend to store blood
 - Bones

- Houses the bone marrow
 - Produces the blood cells
- Consists of blood vessels, nerves, mononuclear phagocytes, blood cells in various stages of differentiation and a fatty tissue
- Types:
 - Red or active (haematopoietic) marrow
 - Produces the blood cells
 - AKA myeloid tissue
 - Found mainly in flat bones of pelvis, vertebrae, cranium, mandible, sternum and ribs, humerus and femur
 - Usually cells do not enter bloodstream until they have differentiated to a degree, but premature release can occur
 - Yellow or inactive marrow
 - Contain large quantities of fat
 - Predominates cavities of bone
- Lymphoid organs
 - Are sites of residence, proliferation, differentiation or a function of lymphocytes and mononuclear phagocytes
 - Lymph nodes are part of the lymphatic system
 - Contains large amounts of lymphocytes, monocytes and macrophages that develop or function within lymph nodes
 - Filters and cleans from foreign particles
 - Microorganisms in the lymph stimulate proliferation of macrophages and so the nodes enlarge
 - Made of a fibrous capsule with connective tissue and reticular fibres divide the compartments
 - Nodes have an inner medullary area and outer cortex
- Liver
 - Produces many clotting factors

Composition of Blood

- Plasma
 - Description
 - Blood cells are suspended in the plasma
 - Plasma accounts for 50-55% of blood volume
 - Structure
 - 92% water
 - 6% proteins
 - 2% other dissolved substances (solutes)
 - Contains organic (e.g. proteins) and inorganic (e.g. electrolytes) elements
 - Electrolytes
 - Include sodium, potassium, calcium, chloride and phosphate
 - Participate in the control of cell function, osmotic pressure and blood pH
 - Plasma proteins
 - Albumins
 - Most produced in the liver
 - Approx. 60% of total plasma protein
 - Function
 - A carrier molecule for blood components and for

hormones or drugs

- Other proteins also carry specific substances
 - E.g. Transferrin carries iron
 - E.g. Lipoproteins carries lipid and steroid hormones
 - E.g. Retinol-binding protein carries vitamins
- Controls plasma oncotic pressure (AKA critical colloidal osmotic pressure)
 - Due to control on passage of water and solutes into the surrounding tissue
 - If lacking causes excessive movement of water into tissues causing oedema
- Globulins
 - Carrier proteins that are produced in the liver
 - Immunoglobulins that are produced in plasma cells of lymphoid tissue
 - Plasma cells develop from stimulated B lymphocytes
 - Have immune function
- Clotting factors
 - Are proteins that promote coagulation
 - Function to stop bleeding of damaged blood vessels
 - Mainly fibrinogen (is a precursor of the fibrin clot)
- Plasma vs Serum
 - Plasma is the fluid in which blood cells are suspended
 - Serum can be separated from blood cells after blood has been allowed to clot
 - Serum is similar to plasma except that the clotting factors have been consumed in the process of clot formation
 - To prevent plasma becoming serum in blood tubes, they have anti-coagulants in it
- Red Blood Cells (Erythrocytes)
 - Most numerous blood cell
 - Approx. 48% of blood volume in men and 42% in women
 - The volume of blood that is occupied by the red blood cells is known as haematocrit or packed cell volume
 - Lifespan in 120 days
 - Structure
 - Haemoglobin (Hb) is a specialised protein that carries gases
 - Do not have a nucleus (in mature RBC)
 - Suited to function as:
 - Biconcave shape
 - Provides large surface area for gas diffusion
 - Capacity to be reversibly deformed
 - Can fit through capillaries that are only 2µm in diameter even though the RBC is 6-8µm in diameter
 - Function
 - Tissue oxygenation
 - Removal of CO₂
- White Blood Cells (Leucocyte)
 - Defend the body against infection and remove debris
 - Transported in circulation but act mainly in the tissues

- Leucocytosis – Raised white blood cell count
- Types
 - Granulocytes
 - Membrane-bound granules in their cytoplasm
 - Granules contain enzymes capable of destroying microorganisms
 - Inflammatory and immune functions
 - Capable of amoeboid movement (diapedesis), which enables migration through vessel walls
 - Types
 - Neutrophils
 - Protect against bacterial infection and are phagocytes in early inflammation
 - 55% of total leucocytes
 - Either are in the:
 - Marginating storage pool where they adhere to blood vessel walls
 - Circulating storage pool where they circulate the blood
 - Immature neutrophils can be released during infection
 - Eosinophils
 - Ingest antigen-antibody complex
 - Induced by IgE-mediated hypersensitivity reactions to attack parasites
 - Contains enzymes to control inflammatory processes
 - Circulate the blood for 8 hrs then become located next to mucosal surfaces
 - 1-4% of total leucocytes
 - If an individual has a parasitic infection, then they may have raised number of eosinophils (eosinophilia)
 - Basophils
 - Structurally and functionally similar to mast cells
 - Cytoplasmic granules contain vasoactive amines (histamines)
 - 1% of total leucocytes
 - Mast cells
 - Inflammatory process
 - Contain granules containing histamine and heparin
 - Agranulocytes
 - Monocytes and macrophage make up the mononucleosis ear phagocyte system (MPS)
 - Involved in immune and inflammatory response
 - Types
 - Monocytes
 - Macrophage
 - Lymphocytes
 - Natural killer (NK) cell
- Granulocytes signal, agranulocytes ingest and work together
- Platelets (Thrombocytes)
 - Disc-shaped cytoplasmic fragments and megakaryocytic

- Essential for blood coagulation and control of bleeding
- Survive for 10 days then are removed by macrophages
- Have no DNA and no nucleus
- An additional 1/3 of body's available platelets are stored in the spleen which can be released if necessary

Mononuclear phagocyte system

- Consists of cells that originate in the bone marrow, differentiate to monocytes that are transported by bloodstream to tissues as mature macrophages
- The cells of this system:
 - Are mainly macrophages and monocytes (in tissues monocytes differentiate into macrophages)
 - In the liver and spleen
 - Function:
 - Ingests and destroys foreign substances
 - Cleans the blood of injured or dead blood cells, coagulation products, antigen-antibody complexes and macromolecules
 - Process and present foreign antigens to the immune system