

BLOOD VOLUME AND ITS REGULATION

BLOOD VOLUME

The term blood volume means the total amount of blood in circulation, as well as in the blood stores. Blood volume refers to the total amount of fluid circulating within the arteries, capillaries, veins, venules and chambers of heart at any time. The components that add volume to blood include RBC, WBC, platelets and plasma. Plasma accounts for about 60% of total blood volume while formed elements make up roughly 40%. The amount of blood circulating within an individual depends on their size and weight, but the average human adult has nearly 5 liters of circulating blood. The women tend to have a lower blood volume than men.

REGULATION OF BLOOD VOLUME

Blood volume is regulated and related to multiple organ systems. It is also closely associated with sodium content and hydration status. The organ systems communicate with one another to optimally control blood volume.

→ The renal system specially the kidney is primarily responsible for regulating blood volume. The kidney's primary functions

is to modify the solute and water content of blood through filtration, reabsorption and secretion. As blood passes through the glomerulus of the kidney, solutes and water are filtered out depending on a variety of signaling molecules. As the filtrate passes through the tubules, some of the filtrates are reabsorbed along with water. The amount of water and solute reabsorbed, regulate the blood volume. If the blood volume is too low, more filtrate reabsorbs and if blood volume is too high, less filtrate reabsorbs.

The kidney is also responsible for secretion of erythropoietin. Erythropoietin is the protein that signals the bone marrow to produce RBC. Therefore the kidney is responsible for both the regulation and partial production of blood volume.

→ The cardiovascular system is hardly responsible for its regulation. Instead the cardiovascular system maintains arterial pressure for the adequate perfusion of all bodily tissues. This system detects changes in blood volume and reflects it through increasing or decreasing arterial pressure. Reduced blood volume leads to collapsing vessels, reduced

pressure. The cardiovascular system combats low volume by constricting blood vessels until the body reaches a blood pressure that restores proper perfusion pressure. Blood volume and blood pressure are interconnected through the renal and circulatory system, specially the renin-angiotensin-aldosterone system (RAAS).

→ As the skeleton skeletal system is responsible for the production of blood cells which make up blood volume. When signaled by erythropoietin, the bone marrow creates erythrocytes which are eventually released into circulation. Leukocytes, which form a small amount portion of total blood volume, are also produced by the bone marrow when stimulated by colony stimulating factors released from mature leukocytes.

→ Nervous system aids in regulating blood volume by interacting with all three other systems. It is responsible for some of the stimulus at the level of the glomerulus as well as the constriction of blood vessels through sympathetic nerve activity.

FUNCTION

Blood volume is necessary to maintain adequate perfusion to all of the tissues in the body. Nearly all cells in the body require replenishment of nutrients and a removal system for waste, both of which the blood provides.

Blood volume also functions in the maintenance of body osmolality. Osmolality refers to the balance of solutes and water within a solution. A proper functioning system maintains an osmolality of 275 to 295 mOsm/kg of water through water and sodium manipulation primarily at kidney. Changing plasma osmolality results in an imbalance between intracellular and extracellular compartments. This imbalance can cause water entry or exit from cells. Overall, it may greatly increase or decrease blood volume. Increased blood volume is called hypervolemia and decreased blood volume is called hypovolemia.

Hypovolemia can occur through hemorrhage, sodium depletion, water loss, and loss of plasma.

Hypervolemia occurs when blood volume is increased and can occur through

renal failure, congestive heart failure, liver failure, excessive sodium intake or any other dysfunction of sodium regulation.

METHODS OF DETERMINATION OF BLOOD VOLUME

- Welcker method
- Biochoff "
- Dye method
- Radio-iodine plasma Albumin method
- Radioactive iron method

CAUSES OF DECREASE AND INCREASE IN BLOOD VOLUME :-

DECREASE :-

- Haemorrhage
- Reduction in number of RBC (anaemia)
- Low of plasma
- Low of blood water
- Acute exposure to cold
- Posture.

INCREASE :-

- High temperature
- Muscular exercise
- Emotional excitement
- Pregnancy
- congestive heart failure.
- Administration of mineralocorticoid hormones.