

Regulation of Red Blood Cell Production

Red Blood Cell

Red blood cells also known as erythrocytes are enucleated biconcave cells in the blood which are responsible for oxygen transport. They are the most numerous of all the formed elements of the blood counting from about 4.2-5.5 million/ μ l (women); 4.7- 6.1million/ μ l (men). they are 7 micrometers in diameter. 1/3 of their entire volume is made of haemoglobin which is a protein responsible for the binding to oxygen. Each haemoglobin has 4 iron (hemes) and proteins (globins). The 4 hemes are each attach to 1globin, which is a polypeptide chain.

Production Of Red Blood Cells (erythropoiesis)

This process takes place in the bone marrow in adults and in prenatal life it occurs in the liver. Like all blood cells, erythrocytes begin as pluripotential stem cells. The first cell that is recognizable as specifically leading down the red cell pathway is the proerythroblast . As development progresses, the nucleus becomes somewhat smaller and the cytoplasm becomes more basophilic, due to the presence of ribosomes. In this stage the cell is called a basophilic erythroblast . The cell will continue to become smaller throughout development. As the cell begins to produce haemoglobin, the cytoplasm attracts both basic and eosin stains, and is called a polychromatophilic erythroblast . The cytoplasm eventually becomes more eosinophilic, and the cell is called an orthochromatic erythroblast . This orthochromatic erythroblast will then extrude its nucleus and enter the circulation as a reticulocyte . Reticulocytes are so named because these cells contain reticular networks of polyribosomes. As reticulocytes loose their polyribosomes they become mature red blood cells. The process of erythropoiesis takes about 5 days. Each erythrocytes last in circulation for about 100-130 days.

Stimulation Of Red Blood Cell Production

Low oxygen levels (hypoxia) in specific tissue, in this case the liver and kidneys induce the production of a hormone erythropoietin. Erythropoietin is responsible for the increased production of red blood cells in the bone marrow. Cells of liver and peritubular cells of kidneys contain hypoxia induced factor which has two metabolic pathways. During levels of normal oxygen level in theses tissue, it undergoes its normal metabolic pathway but at low oxygen levels, they undergo a different metabolic pathway where they go into the nucleus of these cells and act as transcription factors for the transcription of erythropoietin. Renal erythropoietic factor is an enzyme that converts erythropoietin into its active form called erythropoiesis stimulating factor. This factor leaves the liver/kidneys and goes into the bone marrow where they reduce the level of apoptosis of erythroid colony forming cells and stimulate the division and differentiation of them. Iron, folate and vitamin B12 are important for production of haemoglobin. Lack of these requirements compromises the oxygen carrying capacity of the blood and leads to condition known as anaemia. This whole mechanism is a negative feedback mechanism.

sex hormones

Sex hormones also have an influence on the number of erythrocytes in the blood hence the difference in number in male and female blood. Male sex hormone works in the kidneys to increase the production of renal erythropoietic factor, therefore increasing the amount of active erythropoietin to act in the bone marrow. This is the indirect effect. The direct effect involves sex hormones acting directly on base cells in the bone marrow. Female sexual hormones act directly on bone marrow cells and cause a decrease in the production of DNA, RNA and proteins in the cells therefore reducing the rate of erythropoiesis.