Blood composition, function and viscosity

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Blood composition

- TBW= 60% of TBW
- ECF 1/3 of TBW
- Plasma ¼ of ECF

Plasma 3L of plasma

90% water

Inorganic sub 0.9%

cation : Na+

Anion : CL-

plasma lipids , lipids and protein lipoprotein

Miscellaneous : glucose and vitamins

Gases

Organic sub 9.1% plasma protein

Albumin, Globulin, Fibrinogen, Prothrombin

In the liver

Albumin/Globulin 1.2 – 1.6 normal lower cirrhosis and nephrosis

gamma globulin B lymphocytes

Apha 1 anti trypsin

Alpha2 Angiotensinogen

B coagulation factors transferrin

Gamma anti bodies

❖ Blood volume = The blood cells 3% of body weight + blood plasma 5% of body weight =8% of our body weight expressed in kg

❖8% × 70kg = to 5.6L = 5.6 kg

❖Total Blood Volume (TBV) = Plasma Volume / 1- Hematocrit (PCV)

- Total Blood Volume (TBV)= 2.8 / 1- 45%= 5.6L

❖One pint (blood unit)= 500ml or half a court (one quart = 2 pints)

❖In this example you got 10pints in your blood . So when you donate 1 pint you giving less than 1/10 of your blood body.

❖If you gave twice that you will lose a litre of blood, half a court of blood then you need a medical attention.

❖So the person who less than 100 bound doesn't give blood. In other word when you donate blood you given 10% or less

❖Blood Plasma =55% × 5.6L

❖Blood cell =45% × 5.6L

- Amino acid source
- Buffering
- Blood viscosity 1.5 times than water resistance
- Coagulation
- Defense Osmosis
- Transport

RBCS

- Biconcave
- Non nucleated
- 120days

Hgb A1C blood sugar over 3 to 4 months

Pluripotent

- Stem cells in the bone marrow
- Multipotent stem: produce different cells Myeloid and lymphoid
- Myeloid: proerythroblast, Normoblast, reticulocyte, erythrocyte

Erythropoietin EPO

Normal cell: interstitial cells of the peritubular capillary bed in the cortex

Cancer cell: Renal cell and hepatocellular carcinoma

hypoxemia

decrease O2 sat

high altitude

left shift

Except polycythemia vera low EPO

Artificial EPO to increase energy

Erythrocyte indices

RBCS count No of tubes

- Male 4.5-6 million M/L
- Female 4-5 million M/L

Hgb Conc weight of air in tubes

Hgb Conc amount/ volume g/dl

Male 14- 17 15

Female 12-15 13

Hematocrit (Hct)

Vol of RBCS/ Volume of blood volume of tube

Male 45%

Female 40%

Mean corpuscular volume (MCV) size of tube

Small cells low MCV mic

Large cells High MCV mac

Normal 80-100 fl

Mean corpuscular hemoglobin (MCH) average weight in every tube

Average content of Hgb per red cells

MCH= Hb g/dl mass / RBC conut /ML X 10 picograms

Male: 30 picograms

Mean corpuscular hgb conc .(MCHC) average density

average content of Hb per unit volume of RBCS mass/volume density

MCHC= Hb/ Hct X100 Male: 33 g/dl

Red blood cells distribution width (RDW)

variation in diameter Anisocytosis

11.5-14.5%

Significant if it elevated

Normocytic to

Microcytic iron deficiency anemia

Macrocytic anemia V B12

RDW in nutritional anemia not genetic like thalassemia

Reticulocytes

Network and cells

Large cells with bluish cytoplasm

Normally < 3%

Everyday 1-2%

Splenic macrophage Maturation 24hrs

Anemia increase the number of retic (good response or eff erythropoiesis)

Corrected reticulocyte count (CRC) = HCT/Normal hematocrit X reticulocyte count

Additional correction of polychromasia (baby retics) 2-3 days RBCS

CRC/2

- Retics index=3% HCT= 15% Normal= 45% 1%
- 1/2.5= 0.4 reticulocyte production index
- The bone marrow is not putting enough retics

- Retics index=18% HCT=15% Normal=45% 6%
- 6/2.5 =2.4 the bone marrow is putting enough retics

Anemia

- Decreased O2 carrying capacity of blood

Hb concentration decrease

SaO2 bound normal

PaO2 free normal

- Decreased total RBCs mass
- Decreased Hgb, RBCs or Hct indicators

RBCS nuclear scan to measure mass literally

Signs and symptoms

Tired and pale

Dizziness

Dyspnea

Flow murmur low viscosity and flow fast

Causes of Anemia

- Production defect

Bone marrow or kidney damage (EPO) low retic

- Maturation defects

  Hgb: Iron , globin, DNA

- Survival defects

Intrinsic defect

Membrane Spherocytosis

Enzyme G6PD deficiency

Glycolysis ; phosph to pyruvate 2ATP , 2,3BPG increase right shift

NADPH reduced glutathione reduced H_2O_2

Fenton reaction

converting met fe+3 into Fe +2 and convert oxygen into superoxide

Hgb sickle disease

Extrinsic attack RBCs

- Sequestration (hypersplenism) portal hypertension
- Blood loss peptic ulcer disease