

Cardiovascular System

-The system contains the Heart, Blood vessels (Arteries, Veins & Capillaries) & Blood. The cardiovascular system is sometimes called the blood-vascular, or simply the **Circulatory system**. **Cardiovascular system develops first in human body.**

The Heart

-मुटु एउटा सोली (cone) आकारको माँसपेशिबाट बनेको (muscular) खोक्रो (hollow) अङ्ग हो ।

-The **busiest organ** of the body is heart. But, **Busiest Muscle**-Blinking Muscle (Orbicularis oculi)

-Human Heart is **Myogenic**. शरीरमा सबैभन्दा पहिले बन्ने अङ्ग मुटु (**Heart**) हो।

-सबैभन्दा बढि रगत खपत गर्ने अङ्ग मुटु हो । **Consumption-Heart, Distribution-Liver (27%)**

***Size**: मुटुको लम्बाई १२ से.मी, चौडाई ९ से.मी र मोटाई ६ से.मी हुन्छ । (own fist sized)

***Weight**: Male-300gm, Female-250gm

***Location**: मुटु २ वटा फोक्सोहरू बिचको space '**Mediastinum**' of Thoracic cavity मा रहेको हुन्छ ।

-1/3 part of Heart lies Rt. and 2/3 part of Heart lies to the Median Plane.

-At the Level of **T5-T8 vertebrae**, Below diaphragm, Within 2nd to 6th Left Costal Cartilages.

-**Apex** of the heart is situated in the **left 5th intercostal space**.

-मुटुको माथिल्लो भागलाई **Base** र तल्लो भागलाई **Apex** भनिन्छ । (**Base**-Upward, **Apex**-Downwards)

-The Heart is 4-Chambered Muscular Organ.

-Its function is to maintain a constant circulation of blood throughout the body by **Pumping blood**

-Heart works as a **compression Pump**.

-Heart receives Blood during **Diastolic Phase**. And Pumps blood during **Systolic Phase**.

-The Minerals needed for the contraction of heart are

Sodium (Na⁺), Potassium (K⁺), Calcium (Ca⁺⁺).

-**Precordium/Praecordium** is the Area of chest that overlies the Heart.

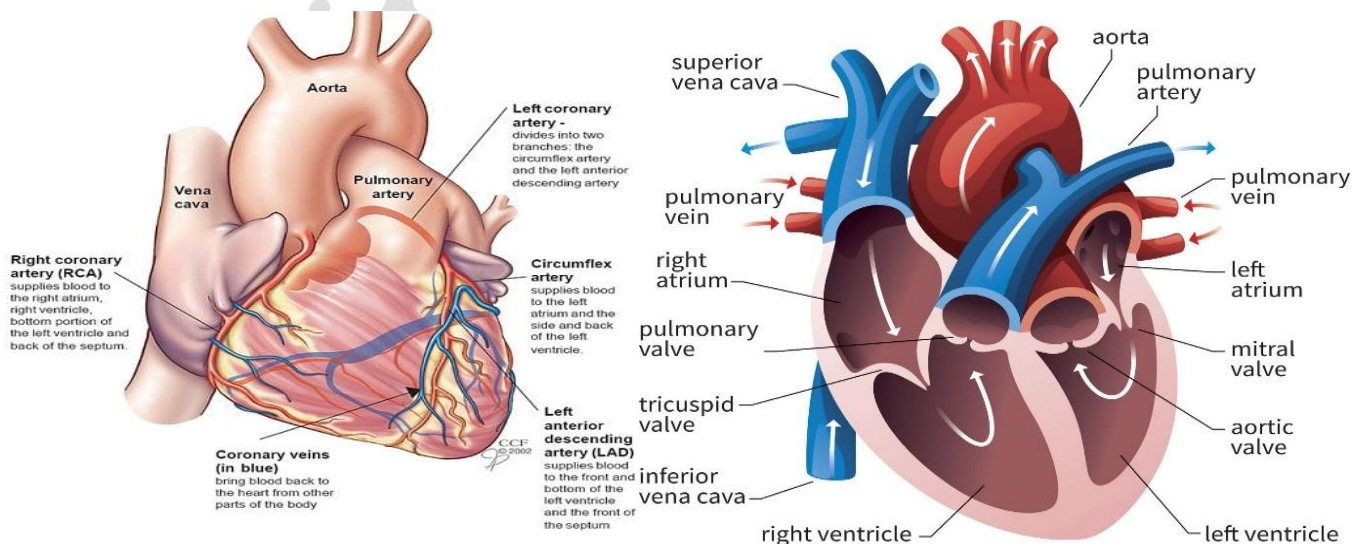


Fig:-The Heart

Layers:-

There are 3 layers of heart. From Outer to Inner, these are as-

1. Outermost Layer- It is **Pericardium Layer**. It has 2 layers.

i. Outer/parietal pericardium-made up of Fibrous tissue, Pain sensitive layer.

ii. Inner/Visceral pericardium-made up of serous tissue.

***Pericardial Cavity/Space**-parietal र Visceral pericardium layerको बीचमा रहेको खाली ठाँउ, Filled with Pericardial Fluid. This fluid serous type. Normal pericardial fluid volume is 15ml. The Fluid is secreted by inner/Visceral/serous layer of pericardium.

Exn-it reduces(कमगर्नु)the friction within the pericardium at the heart beating time.

2. Middle Layer-The middle layer is called **Myocardium**. it is a **muscular layer**. it is made up of **involuntary & Striated muscle**. यसलाई Cardiac Muscles पनि भनिन्छ । यसका गुणहरू Automacity, Excitability, Contractibility र Conductivity हुन् ।

-**Tetany** रोगले cardiac muscle मा असर गर्दैन । (Cardiac Muscle can't be **Tetanized**-अर्रो)

Tetanus-Clostridium tetani

3. Endocardium-Endothelial layer

-Inner Layer of Heart.

-Made up of epithelial tissue.

-It also covers the heart valves that provides smooth surface.

Chambers of Heart:

-Heart मा ४ वटा कोठा(Chambers)हरू हुन्छन् ।

1. Right atrium(RA) 2. Right ventricle(RV) 3. Left atrium(LA) 4. Left Ventricle(LV)

-माथिल्लो २ वटा कोठाहरूलाई Atria(Sing. Atrium) तथा तल्लो २ वटा कोठाहरूलाई Ventricles भनिन्छ ।

-Coronary Sulcus/Atrioventricular groove ले Heart लाई बाहिरी रूपमा Atrial र Ventricular Parts मा divide गर्छ । (माथिल्लो र तल्लो भागमा बाड्ने गरी)

-**Cardiac Septum**ले Heart लाई **भित्री** रूपमा **Right** र **Left** गरी २ भागमा बाड्ने गर्छ ।

Cardiac Septum को पनि २ Part हुन्छ ।

*Upper(Inter-atrial) Part-यसले मुटुको माथिल्लो भागलाई Right र Left गरी २ वटा Atria मा बाँड्दछ ।

*Lower(Inter-ventricular)Part- यसले मुटुको तल्लो भागलाई Right र Left गरी २ वटा Ventricles मा बाँड्दछ ।

-मुटुको दायाँ भागमा Deoxygenated रगत हुन्छ तथा बाँया भागमा Oxygenated रगत हुन्छ ।

Atria/Atrium

Right and Left Atria are separated by inter-auricular septum. Right auricle is Bigger than left one.

In embryonic stage, in place of septum, septum primum and septum secundum are present having gap called Foramen ovalis.

Eustachian flap is present at the opening of inferior vena cava upto foramen ovalis which prevent Pulmonary circulation as lungs are not functional in fetal body.

At the time of birth, there is Closure of foramen ovalis but there remains depression on both side. On right atrium is called **Fossa ovalis** and on left side called **fossa lunata**.

Right auricle receives deoxygenated blood via superior venacava, inferior venacava and coronary sinuses, and Left auricle receives oxygenated blood from pulmonary vein.

Ventricles

Right and left ventricles are separated by an interventricular septum which is obliquely curved toward right ventricle.

The left ventricle is larger than the right one but the cavity of left ventricle is relatively smaller because the myocardium of left ventricle is 3 times thicker than right ventricle.

Walls of the ventricles are internally raised into a number of thick, muscular, columnar projection called **columnae carnae**.

And few large muscular elevation called **Papillary muscles which** are 3 in right ventricle and 2 in left ventricle.

Strong, inelastic thread like tendons called **Chordae Tendinae** are present in ventricles whose one end is attached to cusps of atrioventricular valves and other end to papillary muscles of ventricles.

They help to open, close and hold the valve in place.

Conduction system of Heart

Transmission of impulse in heart. Human heart is myogenic (Impulse are generated by heart muscles)

1. Sinuatrial node

SA Node is a neuromuscular tissue, lies near the opening of superior venacava in right auricle.

SA node generates impulse so called Pacemaker of heart. (Heart of heart).

The impulse are transmitted to wall of auricle and causes its contraction.

Impulse generation rate; **70-80/min.** Velocity of conduction; **0.05m/s**

2. AV node

It lies near the junction of interauricular and inter ventricular septum close to the opening of coronary sinus. It is called pace setter.

Impulse generation rate:-**40-60/min.** Velocity of conduction:-**0.12 m/s**

3. Bundle of HIS/AV Bundle

It arises from AV node and descends into interventricular septum, bifurcates into two branches innervating the wall of right and left ventricles respectively.

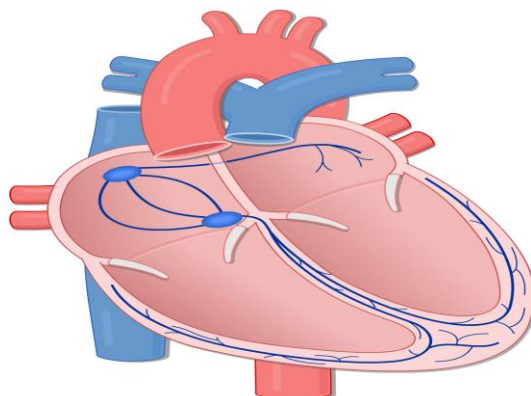
Impulse generation rate:-**30-36/min.** Velocity of conduction :-**1m/sec**

Purkinje fibres

They arise from the branches of bundle of HIS and provide impulse to myocardium of ventricles.

Finally the impulses are transmitted to wall of ventricles and they contract.

Impulse generation rate:-**15-20/min.** Velocity of conduction:-**4 m/sec**



Units of Heart Conduction System	Location	Impulse Generation Rate	Velocity of Conduction
SA Node	near the opening of superior venacava in right auricle	70-80/min	0.05m/sec
AV Node	near the junction of interauricular and inter ventricular Septum	40-60/min	0.12m/sec
Bundle of His	into interventricular septum	30-36/min	1m/sec
Purkinje's fibre	into the myocardium of ventricles	15-20/min	4m/sec

Highest- RS-Rate in SA node

Highest-PV-Velocity in Purkinje's fibre

Valves of Heart:

मुटुमा २ वटा **Atrioventricular** र २ वटा **Semilunar** गरि जम्मा ४ वटा valve हरु हुन्छन्।

A. Atrioventricular valve :

- Right AV valve (Tricuspid valve) : Located between right atrium and right ventricle.
- Left AV valve (Bicuspid or mitral valve) : Located between left atrium and left ventricle.

B. Semilunar valve :

- Pulmonary valve : Located between the right ventricle and pulmonary artery.
- Aortic valve : Located between the left ventricle and aorta.

Heart sounds: S1, S2, S3 & S4

- Bicuspid / tricuspid valve बन्द हुने बेलामा पहिलो Heart sound /Lub(S1) उत्पन्न हुन्छ ।
- Pulmonary / aortic valve बन्द हुने बेलामा दोस्रो Heart sound/Dub (S2) उत्पन्न हुन्छ
- तेस्रो र चौथो Heart sound (S3 & S4) हरुलाई Stethoscope बाट सून सकिदैन, यसलाई Phonocardiograph बाट मात्र रेकर्ड गर्न सकिन्छ ।
- S4 is always pathological. (स्वस्थ व्यक्तिमा **absent** हुन्छ) ।

Heart Sound	Produced during	Closure of	Duration	Frequency
S1(LUBB)	-	AV Valves	0.10-0.17sec	25-40Cycles/Sec
S2(DUBB)	-	Semilunar Valves	0.10-0.14sec	50Cycles/Sec
S3	Lamillar Blood flow	-	0.02-0.04sec	1-6Cycles/Sec
S4	Turbulent Blood flow	-	0.10-0.17sec	1-4Cycles/Sec

*Blood supply :मुटुलाई Rt & LT Coronary Artery हरुले शुद्ध रगत supply गर्दछ ।

*Venous Drainage:मुटुबाट अशुद्ध रगत Coronary Sinuses ले बाहिर निकाल्दछ ।

*Nerve supply to heart by : Sympathetic & parasympathetic nervous system and vagus nerve.

A) Sympathetic : Increase heart rate.(मुटुको गती बढाउने)

B) Parasympathetic (vagus nerve) : Decrease heart rate.(मुटुको गती घटाउने)

-सबैभन्दा बढि रगत खपत गर्ने अङ्ग मुटु आफै हो ।

-मुटुलाई नियन्त्रण गर्ने cardiac center मस्तिष्क को medulla oblongata मा रहेको हुन्छ ।

-Inflammation of the heart :-Carditis

***Stroke volume:** मुटुले एक धडकन(Each beat)मा Pump गरेको रगतको मात्रालाई stroke volume भनिन्छ । 70ml

***Cardiac output** :मुटुले एक मिनेटमा Pump गरेको रगतको मात्रालाई Cardiac output भनिन्छ ।i.e 5litres/min
(Cardiac output = Stroke volume × Heart Rate)

*Factors affecting CO:-Venous return,Force of Contraction,Heart Rate,Peripheral Resistance

* **Peripheral Resistance**:-It is the resistance offered to blood flow at the peripheral blood vessels. The resistance is offered at **arterioles**. So, the arterioles are known as resistance vessels. The maximum peripheral resistance is offered at the **Spalncnic region**.

* **Blood pressure** (रक्तचाप) : रगतले रक्तनलिको भित्तामा दिने चापलाई रक्तचाप भनिन्छ । Normal BP:-120/80mm of Hg(16/11kpa)
(Pressure exerted by blood on the wall of blood vessels)

BP = Peripheral resistant X Cardiac output

* **Korotkoff's sound** are related to BP.

-Umbilical cord consists of **2 arteries and 1 vein**.

-Most common cardiovascular disorder is '**Hypertension**'.

-Most common cause of hypertension is '**Essential**' (95%) -unknown cause

-Hypertension affects brain, kidney, eye, liver, heart and blood vessels.

-The commonest heart disease in children(5-15 year) is '**rheumatic fever**'.

-Rheumatic fever is caused by **Group A β-Hemolytic streptococci**.

-The commonest congenital heart disease is '**Ventricular Septal Defect**'.

-**Vericose vein** : Abnormally dilated and tortuous veins , common in doctors, porters, bus conductors and who stands for prolong period.

-**Edema** : Abnormal and excessive accumulation of fluid in the interstitial space.

-**Thrombus** : Intravenous blood clot attached to vessel wall.

-Common source of thrombus is **Deep Vein Thrombosis (DVT)**.

-**Embolus** : Any solid or gaseous mass carried in blood stream. Commonest is thromboembolism.

-**Aneurysm** : Abnormal dilatation of blood vessels.

-**Palpitation** : Self awareness of heart beat.

-**Burger's disease** is related to arteries, common in smokers age 20-40 years.

Distribution of blood (Total cardiac output) to different organs:

- Brain – 14%
- Heart – 4%
- Kidney – 22%
- Liver – 27%
- Muscles - 20%

मुटुमा हुने रक्तसंचार प्रक्रिया (Flow of blood through heart)

मानव शरीरमा निम्न प्रकार ४ किसिमको रक्तसंचार हुने गर्दछ ।

A. Pulmonary circulation : The circulation occurs between heart and lungs.

B. Systemic Circulation : The circulation occurs between Heart and body tissues & cells.

C. Portal circulation : The circulation between GI tract, Liver, Heart etc.

D. Fetal Circulation: Placenta को माध्यमबाट गर्भवती आमा र शिशुको बिचमा हुने रक्तसञ्चारलाई Fetal circulation भनिन्छ ।

Overview of Pulmonary and systemic circulation

शरीरमा रहेका सबैभन्दा ठुला **vein** हरू Superior Venacava(SVC)ले शरीरको माथिल्लो भाग ,Inferior venacava(IVC) ले शरीरको तल्लो भाग तथा Coronary Sinuses ले मुटुबाट अशुद्ध रगत(Deoxygenated blood) मुटुको Right atrium सम्म पुर्‍याउँदछन् ।

- सो रगत Right AV valve (Tricuspid vale) हुँदै Right ventricle सम्म पुग्दछ ।

- Right ventricle मा भएको रगत pulmonary valve बाट रगतलाई pump गरि २ वटा pulmonary artery मार्फत दुवै फोक्सोमा पठाउछ। मुटुबाहिर पुगिसकेपछि pulmonary artery दुईवटा branch(right & left) मा विभाजन हुन्छ।
- फोक्सो मा ग्याँसको आदान प्रदान हुन्छ। CO₂ लाई बाहिर फाल्दछ र अक्सिजन लाई रगतसम्म पुर्‍याउदछ। अक्सिजनयुक्त सुद्ध रगत ४ वटा pulmonary vein को बाटो हुदै मुटुको left atrium सम्म पुग्दछ।

Portal Circulation :

GI tract, spleen र pancreas बाट निस्केका vein हरू मिलेर portal vein बन्दछ। Portal vein ले सो रगत कलेजोमा पुर्‍याउदछ। कलेजोबाट उक्त रगत inferior venacava मा पुग्दछ। यसरी portal vein बाट liver हुदै रगत inferior venacava सम्म पुग्ने प्रक्रियालाई Portal circulation भनिन्छ।

पाचनमार्गको भित्ताहरुमा शोषण भएको nutrients हरू portal vein मार्फत कलेजोमा पुग्दछन र आवश्यक प्रसोधन (Detoxification) भै रगतमार्फत शरिरको विभिन्न भागमा पुग्दछन।

Fetal Circulation

आमाको uterus भित्र रहेको बच्चाको हुने रक्तसञ्चारलाई foetal circulation भनिन्छ। Fetal circulation प्रक्रिया गर्भावस्थाको करीब १६ दिनको उमेरदेखि सुरु हुन्छ भने करिब ३ हप्तादेखि मुटुले पनि काम गर्न थाल्दछ। Embryo लाई चाहिने आवश्यक तत्व र अक्सिजन Placenta बाट umbilical vein ले लैजान्छ भने अशुद्ध रगत unilical arteries ले Placenta सम्म पुर्‍याउदछन। जब umbilical vein, placenta बाट निस्केर umbilicus हुदै fetus को शरिरमा प्रवेश हुन्छ, त्यसपछि यो portal vein संग मिल्दछ, जसले गर्दा यसले ल्याउने रगतको केहि मात्रा कलेजोमा पुग्दछ र कलेजोबाट hepatic vein मार्फत inferior venacava मा पुग्दछ। यसका अतिरिक्त umbilical vein सिधै Ductus venosus मार्फत inferior venacava संग जोडिएको हुन्छ। यसले ल्याउने धेरैजसो रगत Ductus venosus मार्फत सिधै inferior venacava हुदै मुटुको right atrium मा पुग्दछ। मुटुको right atrium र left atrium को भित्तामा एउटा प्वाल हुन्छ, जसलाई Foramen ovale भनिन्छ, करिब 75% रगत यहि foramen ovale हुदै right atrium को रगत left atrium मा पुग्दछ। यसपछि left atrium को रगत left ventricle मा पुग्दछ र aorta को माध्यमबाट मुटु र मस्तिष्कलाई शुद्ध रगत प्रदान हुन्छ। Right atrium को करिब 25% रगत tricuspid valve को बाटो हुदै Right ventricle मा पनि जान्छ। Right ventricle को रगत यसपछि pulmonary artery मा पुग्दछ। Pulmonary artery र aorta बीच एउटा नशा (Shunt/connection) हुन्छ, जसलाई Ductus arteriosus भनिन्छ। यहि ductus arteriosus मार्फत pulmonary artery को सबै रगत aorta मा मिसिन्छ। Pulmonary artery बाट केहि रगत फोक्सोमा पनि पुग्दछ, तर fetus मा फोक्सो ले स्वास नफेर्ने हुदा सो रगत Pulmonary vein हुदै मुटुको left atrium → Left ventricle → Aorta मा पुग्दछ।

Aorta बाट स-साना arteries हरू निस्केका हुन्छन जसले शरिरलाई सुद्ध रगत प्रदान गर्दछन। यसरी सुद्ध रगत प्रदान गर्ने क्रममा अशुद्ध रगत पनि अलि अलि जम्मा हुदै २ वटा umbilical arteries हरू मार्फत Placenta मा पुग्दछन। Placenta मा शुद्ध भई पुनः umbilical vein हुदै शुद्ध रगत Fetus को शरिर सम्म पुग्दछ।

Change in fetal circulation after birth

Blood Vessels	Ductus Venosus	Foramen ovale	Ductus arteriosus	Umbilical vein	umbilical artery
Connection/Shunt between	umbilical vein and inferior venacava. (Vein+vein)	Right atrium & Left atrium.	Pulmonary artery and Aorta. (Artery+artery)		
Bypassing organ	liver.	lungs	lungs.		
Physiological Change	5 minute after birth.	5 minute after birth .	5 minute after birth.		
Anatomical closure	7 days.	1 year.	3 months after birth.		
Reminent	Ligamentum venosum.	Fossa ovalis.	Ligamentum arteriosum	Ligamentum teres	Median umbilical Ligament

Blood

Hematology is the study of blood and related disorders.

Lipid/fluid connective tissue, consists of blood cell (45%) and Plasma (55%).

Average volume : 5.5 liters, 7-8% of body weight, in a 70kg man.

Blood cell (45%) constitute of 44% RBC + 1% WBC and Platelets.

Plasma = Serum + Clotting factors.

PH of Blood: 7.35-7.4 (+ 0.05),

Specific Gravity: 1.092,

Temperature : 36°C to 38°C

Viscosity : Salty

Oncotic Pressure : 25 bmm of Hg, due to plasma protein, mainly due to Albumin.

Function:- Transportation of nutrients, Hormones and wastes, Maintain temperature, Homeostasis, Immunity, PH maintenance .

Plasma

comprises 55% of blood volume.

Transparent, Alkaline, Straw colored fluid.

Plasma = 92% water + 8% solid .

Solid- Proteins, minerals, nutrients, urea, uric acid, Creatinine etc.

Proteins are :- Albumin, Globulin, and Fibrinogen.

Total amount of proteins: -6.4- 8.4gms/ 100ml.

Liver produces 30gm of proteins per day.

Albumin	Globulin	Fibrinogen
3.5gms/100mg	2.5gms/100ml	0.3gms/100ml
Most Abundant, Maintains Oncotic Pressure	Needed for Ab and Hb formation	For Clotting
Synthesized by – Liver	Lymphoid Tissue	Liver

- Electrolytes:- Na^+ , K^+ , Ca^{++} , Cl^- , HCO_3^-
- Waste products:- Urea, Uric acid, Creatinine.

Blood Cells

Comprises 45% of blood volume [44% RBC + 1% WBC and Platelets] 3 Types:- RBC, WBC, Platelets.

Erythropoiesis/Hemopoiesis:- Process of blood cell productions from myeloblasts.

Average durations:- 7 days.

Needs:- Folic acid, Iron, VitB₁₂, Erythropoietin @ **FIBEr**.

Sites:-

Yolk sac- 1-2 months of IUL (Intra Uterine Life).

Liver and Spleen- 3-7 month – till birth

Adults- Bone marrow of Irregular bones like upper end of Humerus and Femur.

Hypoxia induces Erythropoietin production and in turn Erythropoiesis.

RBC/Red Blood Cell/ Erythrocyte

Biconcave disc like with diameter of 7 micrometer.

Biconcave shape is due to protein spectrin.

Derived from Reticulocytes.

Normal count:- 4.5-6.5 millions/mm³ of blood. Measured by Haemocytometer.

Increased count (Polycythemia) – Increased Viscosity.

Especially in High Altitude (Physiological).

Life span:- 120 days, 1% day Hemolysed in Spleen.

Life span of Fetal RBC:- 80-90 days (90 days best ans.)

Camel and Llama's RBCs are nucleated.

WBC/White Blood Cell/leucocyte

Normal count:-4000-1100

WBC is the largest blood cell. The life span of WBC is 7-10 days. [7-21days], But may be different according to types.

The main function of WBC is to provide protection against diseases by phagocytosis.

WBCs are of two types:-Granulocyte&Agranulocyte

Leukocytosis: increased WBC count. Occurs in many chronic infections

Leukopenia: Decreased WBC count. Occurs in folic acid deficiency

Leukaemia: Abnormal and excessive production of WBC, the condition is known as Blood cancer.

1. Granulocyte -

They are Polymorphonuclear leucocytes with multilobulated nuclei having granules in cytoplasm. They are:-

- WBC) Neutrophils, normal count : 40-75%(most numerous)
- Eosinophils, normal count :1-6%
- Basophils :normal count :<1%

2. Agranulocytes-

a. Lymphocyte, Normal count:20-50%(smallest WBC)

b. Monocyte, Normal count:2-10%(Largest WBC)

The count of Neutrophils is increased in Most Acute infections, Called Neutrophilia.

- Like Appendicitis, Pancreatitis, peritonitis.

Neutrophil is called Policeman of the Blood. Pus contains dead neutrophils.

The count of Eosinophil is increased in Allergic conditions and Parasitic infestations, called Eosinophilia.

Basophil contains heparin and histamine.

Basophil is also responsible for allergic or immune or anti-inflammatory response

Humoral immunity is produced by B-Lymphocytes and cellular immunity is produced by T-Lymphocyte

Maturation or Activation of T-Lymphocytes occurs in Thymus gland.

Lymphocytes count is increased in acute viral infections, chronic bacterial infections like TB, Leprosy

Helper T-Cell (Lymphocytes) affects HIV, called CD₄ Cell.

Platelets/Thrombocyte

The smallest blood cell. Normal count:-1.5 lakhs/cumm Life:-7-11 days.

They are non- nucleated cells.

Its main function is Hemostasis (Clot formation).

Thromboplastin is secreted by platelets during blood clotting.

Platelets also release serotonin that constricts blood vessels.

They aggregate to form Temporary plug.

The purpose of fresh blood transfusion in Thrombocytopenia is to recover platelet.

Thrombocytosis - increased number of platelets.

Thrombocytopenia – Decreased number of platelets.

Abnormal cell count

cell	Increased Count	Decreased
RBC	polycythemia/Erythrocytosis	Anemia
WBC	Leucocytosis or leukemia	Leukopenia
Platelets	Thrombocytosis	Thrombocytopenia
All cells	Pancytosis	Pancytopenia

Blood coagulation, Blood grouping & Blood Bank

Hemostasi -The process of clotting of blood.

Steps- There are 3 steps of Hemostasis process. These are:-

- A. vasoconstriction
- B. temporary blockage of a break by a platelet plug
- C. Blood coagulation or formation of fibrin clot.

vitamin K, vitamin C, blood clotting factors / platelets are needed for blood clotting.

Blood clotting Factors:

- Factor I Fibrinogen
- Factor II Prothrombin
- Factor III Thromboplastin
- Factor IV Calcium
- Factor V Labile factor
- Factor VI stable factor
- Factor VII Antihemophilic factor A
- Factor VIII Christmas factor
- Factor IX Stuart factor
- Factor X plasma Thromboplastin antecedent (PTA)
- Factor XI Hageman factor

Vitamin K is required for the synthesis of factor II, VI, IX, X.

Normal Values of some coagulation test:

- Bleeding time: 2-6 minutes
- Clotting time: 10 minutes
- Prothrombin time -12 seconds

Coagulation Test include:-BT, CT, PT.

Heparin is natural anticoagulant found in human body.

Most cell & basophil contains Heparin & Histamine.

CPDA (Citrates Dextrose Adenine) Is the Anticoagulant used in Blood Bank.

Blood Grouping

ABO Blood grouping system is discovered by Karl Landsteiner based on blood group Antigen present in RBC surface.

Blood group is of 4 types:-A, B, AB & O.

Blood grouping is important in Blood Transfusion & Medico legal cases. (paternity suit).

Blood group is of 2 types on the basis of Rh-factor:- Positive & Negative

Ag/Agglutininogen	Blood group	Rh factor +nt	Rh factor -nt	Frequency
A	A	A+	A-	42%
42%	B	B+	B-	9%
AB	AB	AB+	AB-	3%
None	O	O+	O-	46%

Most common blood group – Group O, 46%

Least common blood group _Group A⁺, 42%

Universal Donor:- O negative

Universal Receiver:- AB positive

Peptic ulcer is most common in blood group 'O'.

Gastric carcinoma (stomach cancer) is most common in blood group 'A'.

85% population has Rh positive blood.

Blood is stored at the temperature of 2-8 degree Celsius.

1 pint blood = 480 ml [US unit = 473.18 ml] 1 Unit blood = 350 ml

Blood stored in blood bank should be used within 35 days.

A healthy person can donate 4 times in a year. A person should be more than 50 kg in weight and with normal BP.

Anemia

WHO criteria for diagnosis Anemia: (According to Hb level)

- Adult male : Hb < 13 gm/dl
- Adult female : Hb < 12 gm/dl
- pregnant female : Hb < 11 gm/dl
- 6-14 years : Hb < 12 gm/dl
- 6 months-6 years : Hb < 11 gm/dl

Aetiological types of Anemia:- I AM HA PTS

I-Iron Deficiency Anemia

A-Aplastic Anemia

M-Megaloblastic Anemia

H-Hemolytic-Anemia A-Anemia due to Blood loss

P-Pernicious Anemia

T-Thalassemia

S-Sickle cell Anemia

Most common anemia in Nepal-Iron Deficiency Anemia (IDA)

Main cause of IDA in Nepal-Hook Worm infestation

IDA is also called Microcytic Hypochromic anemia.

Degree/Severity of Anemia

Mild Anemia: Hb level 10-12 mg/dl

Moderate Anemia: Hb level 6-9 mg/dl

Severe Anemia: Hb level < 6 mg/dl

Anemia on the Basis of cell size of RBC

Microcytic Anemia: < 80 fl (Diameter < 6 mm) –IDA

Normocytic Anemia: 80-100 fl (Diameter 6-9 mm)-Aplastic, Hemolytic, Anemia due to Blood Loss

Macrocytic Anemia: > 100 fl (Diameter > 9 mm)-Megaloblastic Anemia

Blood Vessel

-There are 3 type. These are Artery, Vein & Capillaries.

-Blood Vessels (Artery & Vein) are made of up 3 layers. @AMI-from outer to inner.

a. Tunica Adventitia:- Outermost Fibrous Layer.

b. Tunica Media:- Middle smooth Muscular layer & elastic tissue.

- Capillaries have only tunica Intima.
- Largest Artery Aorta
- Longest Vein-Long Saphenous Vein
- Largest Vein-IVC (Inferior Venacava).

Difference between Artery & Vein

Artery	Vein
Carry blood away from heart to the body part.	Carry blood towards the heart from body parts.
Carry oxygenated blood except pulmonary & umbilical artery	Carry Deoxygenated blood except pulmonary & umbilical vein
Thick walled	thin walled
Narrow lumen	Wide lumen
Deeper in the body	Superficial in the body
Bright red blood flows	Dark red blood flows
Bleeding occurs heavily, forcefully & projectile	Bleeding occurs lightly, less forcefully & non-projectile.
Largest artery in aorta	Largest vein in IVC(Inferior venacava)
Smaller branch is called arteriole	Smaller branch is called venule.
No valves are present	present valves, semilunar Type except@PISS
Inflammation is called arteritis	Inflammation is called phlebitis
They are not collapsible	They are collapsible

@PISS-Pulmonary vein, internal jugular vein, superior venacava& sinuses of brain.

- Valves in the veins prevent the backflow of blood.
- Carotid body-chemoreceptors, Detects PH change in blood. Present at the Bifurcation of the common carotid artery.
- Aorta is the largest artery & starts from left ventricle of the heart.
- The diameter of arterioles is less than 0.5mm.
- Aneurism-Abnormal dilatation of blood vessels.
- Varicose vein-abnormally dilated and tortuous vein, especially in lower. Common in porters, conductors, Doctor, Rickshaw puller who Stand for a prolonged period.
- Angiography-Radiographic view of blood vessels after injecting a Radio-Opaque Dye in the blood stream.
- Angioplasty-Reconstruction of injured vessels for removal of blockage of an artery like thrombus

Aorta

The **largest artery** of the human body.

Begins from left ventricle. (Aortic valve)

Passes downwards through diaphragm at T12.

Branches of Aorta are:-

1. Thoracic aorta : Lies above the diaphragm

A)Ascending aorta : The right and left coronary arteries.

B) Arch of the aorta :

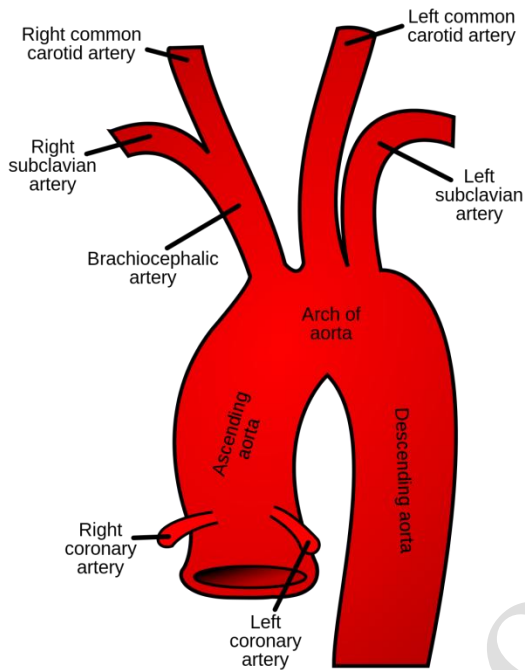
a. Brachiocephalic artery

b. Left common carotid artery

c. Left subclavian artery

C) Descending aorta

2. Abdominal aorta : Thoracic aorta लाई नै diaphragm लाई cross गरेपछि abdominal aorta का नामले चिनिन्छ । यो right & left common iliac arteries मा विभाजन हुन्छ ।



MCQs

1.The word **Cardio-vascular** refers to:-

A.Heart,Blood& Blood Vessels B.Blood & Blood Vessels C.Heart & Blood D.Heart & Blood Vessels

2.The Cardiovascular Systems contains:-

A.Heart,Blood& Blood Vessels B.Blood & Blood Vessels C.Heart & Blood D.Heart & Blood Vessels

3.The size of heart is: a. Own fist sized b.12X9X6cm c.Both d.None

4.The size of heart is a. Own fist sized b.12X9X6cm c.7.5X5X2.5cm d.None

5. Which of the following valves prevents backflow of blood into the left atrium?

A) Pulmonary valve B) Aortic valve C) Mitral valve D) Tricuspid valve

6. Which part of the heart is responsible for initiating the electrical impulse that causes heart contraction?

A) Atrioventricular (AV) node B) Purkinje fibers C) Sinoatrial (SA) node D) Bundle of His

7. During which phase of the cardiac cycle does ventricular filling primarily occur?

A)Atrial systole B)Ventricular systole C)Ventricular diastole D)Isovolumetric contraction

8. What is the main ion responsible for the plateau phase in the cardiac action potential?
 A) Sodium (Na⁺) B) Potassium (K⁺) C) Calcium (Ca²⁺) D) Chloride (Cl⁻)
9. Which blood vessel carries oxygenated blood from the lungs to the heart?
 A) Pulmonary artery B) Pulmonary vein C) Aorta D) Superior vena cava
10. Viscosity of the blood is mainly due to : A. RBC B. WBC C. Platelets D. Plasma proteins
11. Right Atrium & Right Ventricle तथा Left Atrium & Left Ventricle बीचमा रहेका valve हरू क्रमशः कुन-कुन हुन ?
 a. Bicuspid valve & Tricuspid valve b. Tricuspid valve & Bicuspid/Mitral valve
 c. Pulmonary valve & Aortic valve d. Aortic valve & Pulmonary valve
12. The Pericardial fluid is secreted by:
 a. Visceral pericardium b. Parietal pericardium c. Myocardium d. None
13. Blood supply to blood vessels by:
 a. Vasa vasorum b. Vasa nervorum c. blood following through the vessels d. both a & c above
14. Donated blood should be used within: i. 35 days ii. 10 wks iii. 4 months iv. 10 months
15. The Cradle as well as Graveyard for Red Blood Cells is:
 a. Yolk Sac b. Liver c. Bone marrow d. Spleen
16. Blood Serum contains: a. Antibodies b. Immunoglobulins c. Plasma proteins d. All of above
17. How many pulmonary veins are present in human body ? A)1 B)2 C)3 D)4
18. Which of the following is the largest/longest artery of the human body ?
 (A) Brachial artery (B) Carotid artery (C) Femoral artery (D) Aorta
19. The largest vein of the human body is :
 (A) Superior vena cava (B) Inferior vena cava (C) Long saphenous (D) Femoral vein
20. The average weight of the human heart is : A) 150gm B) 300gm C) 480gm D) 500gm
21. The valve located between Left atrium and left ventricle is :
 (A) Bicuspid valve (B) Mitral valve (C) Left Atrioventricular valve (D) All of the above
22. Which of the following is not a layer of heart ?
 (A) Myocardium (B) Pericardium (C) Mesocardium (D) Endocardium
23. The most important layer of the heart
 (A) Pericardium (B) Myocardium (C) Endocardium (D) NOTA
24. Pulmonary valve is situated between :
 (A) Right atrium and right ventricle (B) Right atrium and left atrium
 (C) Left ventricle and pulmonary artery (D) Right ventricle and pulmonary artery
25. Most commonly affected valve in rheumatic heart disease is :
 (A) Bicuspid valve (B) Tricuspid valve
 (C) Aortic valve (D) Pulmonary valve
26. First heart sound (S₁) or LUB sound is produced during :
 (A) Opening of bicuspid & tricuspid valve (B) Closure of bicuspid and tricuspid valve
 (C) Opening of pulmonary & aortic valve (D) Closure of pulmonary & Aortic valve
27. Which artery supplies blood to the heart?
 (A) Carotid artery (B) Subclavian artery (C) Coronary artery (D) cardiac artery
28. Cardiac center is located at :
 (A) Cerebrum (B) Cerebrum (C) Medulla (D) Pons
29. Which of the following is sympathetic action in heart?
 (A) Increase heart rate (B) Decrease heart rate (C) Balance the heart rate (D) No any action
30. Which nerve supplies the heart ?
 (A) Vagus nerve (B) Trigeminal nerve (C) Accessory nerve (D) Abducent nerve
31. The circulation of blood between heart and lungs is called :
 (A) Pulmonary circulation (B) Systemic circulation
 (C) Portal circulation (D) Fetal circulation
32. Fetal circulation starts to develop after..... days of implantation.

- (A) 7 days (B) 16 days (C) 14 days (D) 21 days
33. When heart starts to work in embryo ?
 (A) 1 weeks (B) 2 weeks (C) 3 weeks (D) 4 weeks
34. The duration of one cardiac cycle is about :
 (A) 0.4 second (B) 0.8 second (C) 0.1 second (D) 8 second
35. Pacemaker of the heart is :
 (A) SA node (B) AV node (C) Bundle of His (D) Purkinje Fiber
36. Which of the following drug increases the heart rate ?
 (A) Atropine (B) Adrenaline (C) Salbutamol (D) All of the above
37. Amount of blood pumped by heart in each minute is called :
 (A) Stroke volume (B) Cardiac output (C) Tidal volume (D) Pulse rate
38. The total cardiac output is about :
 (A) 2 liter (B) 3 Liter (C) 5 Liter (D) 7 Liter
39. The pressure exerted by blood on the wall of blood vessel is called :
 (A) Pulse pressure (B) Blood pressure (C) Systolic pressure (D) Diastolic BP
40. Korotkoff's sound are related to :
 (A) Pulse (B) BP (C) Respiration (D) Auscultation
41. Most common cardiovascular disorder is :
 A)Hypertension B)Myocardial infraction C)Deep Vein Thrombosis D)Rheumatic fever
42. The amount of blood pumped by heart in each beat is called :
 A)Stroke volume B)Cardiac output C)Tidal volume D)Pulse rate
43. The commonest heart disease in school children :
 A)Hypertension B)Myocardial infraction C)Deep Vein Thrombosis D)Rheumatic fever
44. All of the following are the target organ for hypertension, except :
 (A) Eye (B) Brain (C) Spleen (D) Heart
45. How much blood of cardiac output reaches to liver ? (A)14% (B)20% (C)22% (D)27%
46. Blood is composed of :
 (A) 45% Plasma & 55% cells (B) 55% Plasma % 45% cells
 (C) 50% Plasma % 50% Cells (D) 60% Plasma & 40% cells
47. The most abundant plasma protein is :
 (A) Albumin (B) Globulin (C) Fibrinogen (D) Prothrombin
48. Which of the following blood cell is non nucleated ?
 (A) RBC (B) Platelets (C) WBC (D) Both A & B
49. The smallest blood cell is : A)Erythrocytes B)Leukocytes C)Thrombocytes D)None of these
50. The commonest Blood group is : (A) A (B) B (C) AB (D) O