FREE NOTES · NCERT + NEET LEVEL

Body Fluids & Circulation

Blood composition, blood groups (ABO, Rh), coagulation, lymph, circulatory pathways, human heart, cardiac cycle, ECG, double circulation, regulation and disorders.

01 Blood
02 Blood groups and coagulation
03 Lymph and circulatory pathways
04 Human heart
05 Cardiac cycle and ECG
06 Double circulation, regulation, disorders
07 Extra + tricks
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09 Common mistakes
10 Practice (NEET style)
11 Quick revision

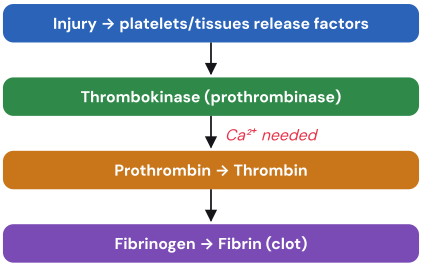
01 Blood

Component	Facts
Plasma (55%)	90–92% water, 6–8% proteins: fibrinogen (clotting), globulins (defence), albumins (osmotic balance); also glucose, amino acids, lipids, minerals. Plasma without clotting factors = **serum**
RBC (erythrocytes)	5–5.5 million/mm³; made in red bone marrow; no nucleus (most mammals), biconcave; haemoglobin 12–16 g/100 mL; life ~120 days; destroyed in spleen (graveyard of RBCs)
WBC (leucocytes)	6000–8000/mm³; nucleated. Neutrophils (60–65%, most, phagocytic), eosinophils (2–3%, allergy), basophils (least, 0.5–1%, histamine, serotonin, heparin), lymphocytes (20–25%, B and T, immunity), monocytes (6–8%, phagocytic)
Platelets (thrombocytes)	1.5–3.5 lakh/mm³; from megakaryocytes; release factors for clotting

02 Blood groups and coagulation

Group	Antigen on RBC	Antibody in plasma	Can receive from
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	none	All (universal recipient)
O	none	anti-A, anti-B	O (universal donor)

Rh factor: ~80% humans Rh+. Rh- mother with Rh+ foetus: first pregnancy fine (blood separated by placenta); mother makes anti-Rh antibodies at delivery; next Rh+ foetus can suffer **erythroblastosis foetalis** (anaemia, jaundice). Prevented by giving anti-Rh antibodies to mother after first delivery.



Cascade of coagulation

03 Lymph and circulatory pathways

- **Lymph** (tissue fluid): like plasma but fewer proteins, no large proteins; contains lymphocytes. Drains via lymphatic vessels into major veins. Carries fats absorbed via **lacteals** in intestinal villi.
- Open circulation: arthropods, molluscs. Closed: annelids, chordates.
- Hearts: fishes 2-chambered (single circulation: only deoxygenated blood); amphibians and most reptiles 3-chambered (mixed blood, incomplete double circulation); crocodiles, birds, mammals 4-chambered (complete double circulation).

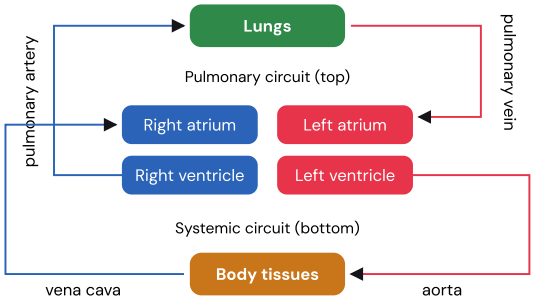
04 Human heart

- Mesodermal origin, in thoracic cavity between lungs, slightly tilted left; fist size; double-walled **pericardium** with pericardial fluid.
- 4 chambers; interatrial septum, interventricular septum, atrio-ventricular septum. Valves: **tricuspid** (right AV), **bicuspid/mitral** (left AV), **semilunar** at pulmonary artery and aorta. Valves allow one-way flow.
- Nodal tissue: **SAN** (right upper corner of right atrium, **pacemaker**, 70–75 action potentials/min), **AVN** (lower left corner of right atrium), AV bundle (bundle of His) → right and left bundle branches → **Purkinje fibres**.
- Heart muscle is autoexcitable (myogenic heart).

05 Cardiac cycle and ECG

- Cardiac cycle = 0.8 s (72 beats/min). Joint diastole → SAN fires → atrial systole (adds ~30% more blood to ventricles) → ventricular systole (AV valves close: **lub**; semilunar open) → ventricular diastole (semilunar valves close: **dub**).
- **Stroke volume** ~70 mL; **cardiac output** = stroke volume × heart rate ≈ 70 × 72 ≈ 5000 mL/min (5 L). Athletes have higher output.
- **ECG** (electrocardiograph): **P wave** = atrial depolarisation (atrial contraction); **QRS complex** = ventricular depolarisation (ventricular contraction starts); **T wave** = ventricular repolarisation (end of systole). Counting QRS per minute gives heart rate.

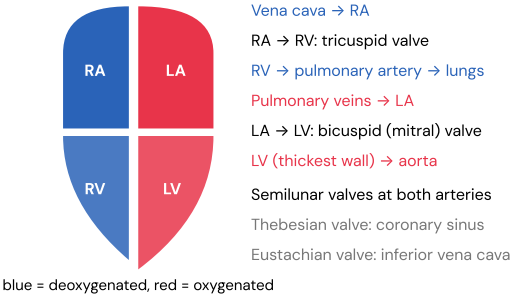
06 Double circulation, regulation, disorders



Double circulation in humans

- **Hepatic portal system**: hepatic portal vein carries blood from intestine to liver. Coronary system supplies heart muscle.
- Regulation: neural centre in medulla oblongata; sympathetic nerves increase rate and strength; parasympathetic decrease; adrenal medullary hormones increase output.
- Disorders: **hypertension** (≥140/90; normal 120/80), **coronary artery disease**/atherosclerosis (deposits of Ca, fat, cholesterol, fibrous tissue), **angina** (chest pain from insufficient O_2 to heart muscle), **heart failure** (not pumping enough; congestion of lungs; not same as heart attack or cardiac arrest).

07 Extra + tricks



Flow of blood through the heart

Phase	Time (0.8 s cycle)
Atrial systole	0.1 s
Ventricular systole	0.3 s
Joint diastole	0.4 s

- Granulocytes (neutrophil, eosinophil, basophil) vs agranulocytes (lymphocyte, monocyte). Trick for WBC order (high to low): "**N**ever **L**et **M**onkeys **E**at **B**ananas" = Neutrophils, Lymphocytes, Monocytes, Eosinophils, Basophils.
- **Myocardial infarction** (heart attack): heart muscle damaged by sudden lack of blood supply. **Cardiac arrest**: heart stops beating. **Heart block**: impulse from SAN/AVN blocked; artificial pacemaker used.
- Anti-Rh injection given to Rh- mother after first delivery = **RhoGAM** (anti-D).

- Blood vessels: arteries (thick, elastic, away from heart), veins (thin, valves, towards heart), capillaries (one cell thick).

08 Important Q&A

Q1. Why is O the universal donor?

O RBCs have no A or B antigens, so recipient antibodies do not agglutinate them.

Q2. Calculate cardiac output if stroke volume 70 mL and heart rate 72/min.

70 × 72 = 5040 mL ≈ 5 L/min.

Q3. What does the QRS complex represent?

Depolarisation of ventricles, which starts ventricular contraction.

09 Common mistakes

- Saying lub is due to semilunar valves (it is AV valves closing; dub = semilunar).
- Writing basophils as most abundant WBC (neutrophils are).
- Confusing heart failure with cardiac arrest.
- Saying serum contains fibrinogen.

10 Practice (NEET style)

1. Pacemaker of heart?
2. Duration of cardiac cycle?
3. Universal recipient?
4. Ion needed in clotting?
5. Graveyard of RBCs?

ANSWERS

1) SA node · 2) 0.8 s · 3) AB · 4) Ca^{2+} · 5) Spleen

11 Quick revision: 5 minutes before the exam

BLOOD

- RBC 120 days
- Neutrophils most, basophils least
- Serum = plasma − clotting factors

GROUPS

- O donor, AB recipient
- Rh− mother: erythroblastosis

HEART

- SAN → AVN → His → Purkinje
- Lub AV, dub semilunar
- CO ≈ 5 L/min

ECG

- P atrial
- QRS ventricular depol.
- T ventricular repol.

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.