CHAPTER VII
PDL 101 HUMAN
ANATOMY & PHYSIOLOGY

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CARDIOVASCULAR SYSTEM

- Divided into two for descriptive purpose in to main parts
  - Circulatory system  Heart, blood vessels
  - Lymphatic system  lymph nodes, lymph
- Heart blood circulation  Pulmonary circulation
  Systemic circulation
- Right side to lungs, exchange of co$_2$ & O$_2$
- Left side to systemic circulation
- Tissue wastes to excretion

Continuous flow of blood to all body cells & its function is subject to continual physiological adjustments in order to maintain an adequate blood supply.

**BLOOD VESSELS:**

- There are several types

Arteries, arterioles, capillaries, venules & veins

**ARTERIES & ARTERIOLES**

- Transport blood away from heart
- Walls consists of 3 layers
  - Tunica aduentitia
  - Tunica media
  - Tunica intima
  - Muscular & elastic tissue varies in the arteries depending up on their size.

Anastomoses & end arteries:
- Anastomoses are arteries between arteries supplying areas
  
  Eg: Arterial supply to palms & hand, soles brain, joints etc...
- Collateral circulation is seen

- End arteries are with no anastomoses

  **Eg:** Branches from circulus arteriosus in brain or central artery to retina

**VEINS & VENULES:**

- Blood vessels which return blood at low pressure to heart

- Walls are thinner

- The cusps are semilunar in shape with the concavity towards the heart

- The smallest veins venules

**Capillaries & sinusoids:**

  - Break up of arterioles.
• Endothelial cells → Single layer.
• Form a vast network of tiny vessels which link the smallest arterioles to smallest venules.
• Sinusoids are wider than capillaries.
• Thin walls, slower rate of blood flow.

Vasodilation & Vaso constriction:
• Decreased nerve stimulation causes the smooth muscles to relax, thinning the vessel wall & enlarging the lumen → vasodilation.
• When nervous activity is increased the smooth muscle of the tunica media contracts & thickness → Vaso constriction.
• Arterioles provide peripheral resistance.

Autoregulation: – accumulation of metabolites in the local tissues influences degree of dilation of arterioles.

Eg:
1. Exercise-Lactic acid accumulation.
2. Hypoxia-Vasodilation.
3. Tissue damage-Inflammation.
4. Striations where circulation to vital organs.
5. Such as brain and heart is threatened.

- Blood supply through vasa vasorum.
- Internal respiration is the exchange of gases between capillary blood and local body cells.
- oxy haemoglobin is unstable compound.
- Diphospho glycerate → Present in red cells.
- Dissolved in water of blood plasma-7%.
- In chemical combination with sodium -70%.
- Remainder in cin combination with haemoglobin-23%.

**Cell nutrition:**

- Diffusion
- Osmosis
- Capillary fluid dynamics
- Diffusion of nutrients & waste products between capillaries & cells.
- Hydrostatic & osmotic pressure.

**Heart:**

- Cone shaped hollow muscular organ.
- lies in thoracic cavity in mediastinum between the lungs.
Organs associated with are

1. Inferiorly- Apex rests on central tendon of diaphragm.
2. Superiorly-the great blood vessels,aorta,pulmonary veins.
4. Laterally-lungs.
5. Anteriorly-sternum,ribs,intercostal muscles.

- composed of three layers
1) Pericardium.
2) Myocardium.
3) Endocardium.

Made of two sacs - outer fibrous tissue
- inner serous membrane.

- Serous membrane consists of flattened epithelial cells. it secrete serous fluid into space between visceral & parietal layers.

- Compound of specialized cardiac muscle found only in heart.

- Under voluntary control.
• Thickest at apex & thin towards the base.
• Forms the lining of myocardium & the heart values.

**INTERIOR OF HEART**

• Divided into right & left side by septum. A partition consisting of mycardium covered by endocardium.
• Atrioventricular value.. flow of blood through the heart - superior & inferior venecava.
• Semilunar cusps.
• Pulmonary veins, oxygenated blood left atrium.
• Opening of aorta is gaurded by arotic valve, formed by three semilunar cusps.
• Contraction of both ventricles.
• Arterial supply - right & left coronary arteries venous drianage - coronary sinus.

**CONDUCTING SYSTEM OF HEART**

• Neuro muscular cell conduct impulses causing synchronised contractions.

a) Synoatrial node(SA node)
• In wall of right atrium.
• pace maker.
b) Atrioventricular node (AV node)

- Stimulated by impulses that sweep over the atrial myocardium.
- c) Atrioventricular bundle - right & left bundle branches, Purkinje fibres

**CARDIAC MUSCLE:**

- Atrial systole - contraction of atria
- Venticular systole - contraction of ventricles.
- Complete cardiac diastole - relaxation of atria & ventricles.
- SA node triggers wave of contraction.
- When reaches AV node it is stimulated to emit impulse.

**HEART SOUND:**

- lub dub.
- lub loud - closure of atrioventricular valve.
- dub softer - closure of aortis & pulmonary valves.
- electrical changes - electrocardiograph, tracing an electrocardiogram.
  
  P, Q, R, S, T} relaxation of ventricular muscle
  
  Q, R, S} impulse from AV node.
P>impulse of SA node.

- Sinus rythum from SA node.

**CARDIAC OUTPUT:**

- Amount of blood ejected from heart.
- Stroke volume
- Cardiac output = stroke volume X heart rate.
- Heart rate = 72/min
- Cardiac output = 51/min
- Exercise 25l/min & athletes 35l/min.
- Increased blood supply need to meet increased tissue requirement of O2.

**STROKE VOLUME:**

- Volume of blood in ventricles before contraction
- VEDV - Ventricular End - Diastolic Volume.
- Increased stimulation of sympathetic nerves.
- Harmones.. ex- adrenaline, etc......
- Atrial blood pressure.
- Blood volume.
- Venous system.
• Position of the body.
• Muscular contraction - communicating veins respiratory pump.

**BLOOD PRESSURE:**
• Force or pressure that blood exerts on the walls of blood vessels.
• Left ventricle contracts & pushes blood to aorta systolic blood pressure.
• Complete cardiac diastole - ejection of blood diastolic blood pressure.
• Sphygmomanometer - instrument.

BP = 120/180mmHg or BP = 16/11Kpa.
• Elasticity of artery walls - large arteries.

blood pressure = cardiac output X peripheral resistance.
Summary of main mechanisms in BP control:

- \([\text{H}^+]\) stroke volume increases

PCO₂ } chemoreceptor’s CVC \{heart rate increases \} BP

\(\text{PO}_2\) vasoconstric increases

- \([\text{H}^+]\) stroke volume decreases

PCO₂ } chemoreceptor’s CVC\{ heart rate decreases \} BP

\(\text{PO}_2\) vasoconstric decreases

- Relation between stimuli of chemoreceptor’s and arterial B.P:

Pulmonary circulation:
• Pulmonary artery or trunk carrying deoxygenated blood.
• Left pulmonary artery runs to root of left lung.
• Pulmonary veins leave each lung.
• Aorta begins at upper part of left ventricle and passing upwards for a short way.
• Common iliac arteries.
• Thoracic aorta-ascending, descending, thorax.
• Circulation of blood to the head and neck arterial supply.
• Carotid arteries  external carotid artery
• Internal carotid artery
• Superior thyroid artery supplies thyroid gland.
• Lingual artery supplies to tongue and mouth.
• Facial arteries to mandibles, jaw etc.
• Occipital to scalp.
• Temporal to zygomatic processscalp.
• Maxillary artery  mastification.
• Middle meningeal artery  skull.
• Circulus arteriosus – circle of ucillis.
• 2 anterior cerebral arteries
• 2 internal carotid arteries
• 1 anterior communicating arteries
• 2 posterior communicating arteries
• 2 posterior cerebral arteries
• 1 basilar artery.

Circulation of blood to upper limb:
• Subclavian arteries – from branchio cephalic artery axillary arteries.
• Bronchial artery – axillary, radial artery – fore arm.
• Ulnar artery, superficial palmar arches, palmer metacarpal an palmar igital arteries.

Venous return from upper limb:
• Palmer metacarpal veins
• Deep palmer venous arch
• Ulnar and radial veins
• Subclavian vein.
• Superficial veins begin in the hand and consists of following
• Cephalic vein
• Basophilic vein
• Median vein
• Median cubital vein
• Venous return from thoracic cavity
• Abdominal aorta
• Paired branches
• Unpaired branches.

**Portal circulation:**
• Venous blood passes from the capillary beds of abdominal part of digestive system.
• Portal vein- splenic vein
• -inferior mesenteric vein
• -superior mesenteric vein
• -cystic vein
• Circulation of blood to the pelvis and lower limb common iliac arteries – internal iliac arteries
• --External iliac arteries
• Venous return – communicating veins
• Deep veins
• Digital veins
• Plantar venous arch
• Posterior labial vein
• Anterior labial vein
• Popliteal vein
• Femoral vein
• External iliac vein
• Internal iliac vein
• Common iliac vein.

• Superficial veins- two main superficial veins draining blood from lower limbs are- 1. Small saphenous vein  2. Great saphenous vein.

• Behind ankle joint – small.
Shock:

- When metabolic needs of cells are not being met because of inadequate blood flow.

Different types of shock

- Hypovolaemic
- Cardiovolaemic oegenic
• Septic
• Neurogenic
• Anaphylactic

Immediate or reactive changes vasoconstriction

Long term changes associated with shock hypoxia, low blood pressure.

**Diseases of blood vessels:**

• Atheroma – patchly changes.
• -causes- fatty streales, arterssclerosis
• Hereditary, gender, age, hyper tension, diabetes, smoking, exercise, diet, obesitis, sedentary life style, excessive alcohol consumption.
• Artherosclerosis, thromboangitis, obliterans.
• Polyarteritis nodosa.
• Aneurysms – bulging, haemorrhphage, pressure, thrombosis, and embolism.
• Venous thrombosis – superficial thrombophlabitis.
  • Deep vein thrombosis.
• Reduced rate of blood flow.
• Changes in blood.
• Damage to blood vessel wall.
• Thrombosis, embolism and infarction:
  • An abnormality of normally smooth endothelium,

  **Eg**- ruptured atheromatous plaque

  • Abnormal blood flow.
  • Increased coagulability of blood.
  • Fragments of atheromatous plaques.
  • Fragment of vegetations.
  • Tumour fragments.
  • Pus from an abscess.

**Oedema:**

• Cardiac failure
• Inhalation of gases
• Inflammation
• Intravenous infusion of excess fluid.
• Increased venous hydrostatic pressure, ascites an effusions.
• Liver diseases, obstruction of lymph vessels in abdominal cavity.
• Acute inflammation.

Diseases of heart:

• Cardiac failure- complementary mechanism.
• Acute and chronic cardiac failure.
• Right sided cardiac failure.
• Left sided cardiac failure.
• Ischemia heart disease.
• Myocardial infarction.
• Due to arrythmial, cardiac failure.
• Pulmonary or cerebral embolism.
• Pericarditis, angina pectoris, recurrence.
• Rheumatic heart failure due to rheumatic fever.
• Injectable endocardditis- acute, subacute.
• Cardiac arrhythmias.
• Heart block.
• Congenital abnormalities
  • Patent ductus arteriosus
  • Atrial septal defect
• Coarctation of aorta
• Fallots tetralogy
• Disorders of B.P – hypertension – essential
  • Secondary
  • Pulmonary
  • Hypotension shock adison’s disease.