Introduction to Circulatory System and Respiratory System

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Circulatory System; transports fluids throughout the body; it consists of the cardiovascular and lymphoid systems.

- **The cardiovascular system** consists of the heart, which pumps blood throughout the body, and the blood vessels, which are a closed network of tubes that transport the blood.

- The **lymphoid system** constitutes a sort of “overflow” system that provides for the drainage of surplus tissue fluid and leaked plasma proteins to the bloodstream, as well as for the removal of debris from cellular decomposition and infection.

Cardiovascular System

- A closed system comprises heart and blood vessels (arteries, veins, capillaries).
- The function of the cardiovascular system is **to deliver oxygen and nutrients and to remove carbon dioxide and other waste products**
- Heart pumps blood through blood vessels;
  - Receives deoxygenated blood through veins
  - Pumps oxygenated blood through arteries
- Blood vessels allow blood to circulate to all parts of the body
    - Carries oxygen and carbon dioxide
    - Also carries nutrients and wastes

Blood Vessels

- Three layers (tunics)
- Tunica intima:
- *Endothelium*
- Tunica media
- *Smooth muscle*
- Tunica adventita
  - *Mostly fibrous connective tissue*

Blood Vessels: The Vascular System

- Blood under high pressure leaves heart and is distrubuted to the body by **thick-walled arteries**.
- The final distrubuting vessels, **arterioles**, deliver oxygen-rich blood to **capillaries**.
- Capillries form a **capillary bed**, where the interchange of oxygen, nutrients, waste products wit extracelular fluid occurs.
- Blood from the capillary bed passes into **thin-walled venules**, which resemble wide capillaries
- Venules drain into **small veins** that open into **larger veins**.
- Largest veins, **superior** and **inferior venae cavae**, return low-oxygen blood to the heart

Types of Blood Vessels

- **Artery** – carries oxygenated blood away from the heart (under high pressure) (distributors)

- Large elastic arteries, Medium muscular arteries, Arterioles: small arteries

- Anastomoses (communications); important to form alternate channels (collateral circulation)

Types of Blood Vessels

- **Vein** – carries deoxygenated blood towards the heart (exception; pulmanary veins)
- Great ability to stretch (capacitance)
- Function as reservoirs: blood pools in the valves then is pushed forward from the pumping pressure
- Veins tend to be double or multible. Those that accompany deep arteries called as accompanying veins
- Venules: small veins (drain capillary beds)
- Medium veins; drain venus plexus and accompany medium arteries, have one-way valves (prevent reflux of blood distally, also break columns of blood in the veins into shorter segments….musculovenous pump!)
- Large veins
- Musculovenous pump and arteriovenous pump (‘Milks’ blood in veins toward the heart)

Veins

- Deep Veins (Accompany arteries and bear similar names)
- Superficial Veins
- Valves
- Normal direction;
  - Superficial → Deep
  - Distal → Proximal

PERFORATING VEINS

- *Penetrate the deep fascia close to their origin from the* ***superficial veins. They contain valves which normally allow the blood to flow from the superficial to the deep veins.***

- Connects Superficial to Deep vv.

Types of Blood Vessels

- **Capillaries** – arterial system switches to venous system
- Speed of blood flow decreases to increase contact time
- Microcirculation: blood flow between arterioles, capillaries and venules

Movement of Blood Through Vessels

- Most **arterial** blood is **pumped** by the heart
- **Veins** use the **milking action of muscles** to help move blood

Pulse

Pulse – pressure wave of blood

Monitored at “pressure points” where pulse is easily palpated

Thorax

- Bounded by:
  - Thoracic vertebrae posteriorly
  - Ribs anterolaterally
  - Sternum anteriorly

Thoracic apertures;

- Superior thoracic aperture
- Inferior thoracic aperture (closed by the diaphragm)

Thoracic Cavities

- The thoracic cavity contains the heart and lungs.
- The thoracic cavity is subdivided into:
  - Left and right pleural cavities (each pleural cavity contains one lung)
  - The mediastinum lies between the two pleural cavities and contains heart and other thoracic viscera except the lungs

HEART

- Heart is a four chambered, hollow muscular organ; atrium, ventricle, valves (tricuspid/bicuspid), interventricular septum, interatrial septum

- Location:
  - Thorax (in the mediastinum) between the lungs
  - Superior surface of diaphragm
  - Left of the midline

HEART

- Anterior to the vertebral column, posterior to the sternum
- Pointed apex directed toward left hip

The Heart's Cardiac Cycle

- **Cardiac cycle** – events of one complete heart beat

- **Systole** = contraction
- **Diastole** = relaxation

- Atria contract simultaneously
- Atria relax, then ventricles contract

Coverings of the Heart

- **Pericardium** – a double serous membrane , loose fitting sac surrounding the heart
- **Fibrous pericardium** – tough, loose-fitting, inelastic
- **Serous pericardium**
- **Parietal layer**: lines the inside of the fibrous pericardium
- **Visceral layer**: adheres to outside of the heart
- **Pericardial space**: between parietal and visceral layer
- Filled with 10-15mL of pericardial fluid
- Decreases friction

The Heart: Associated Great Vessels

- **Aorta** - leaves left ventricle
- **Pulmonary arteries** - leave right ventricle
- **Vena cava (superior/inferior)-** enters right atrium
- **Pulmonary veins (four)** - enter left atrium

Major Vessels of the Heart

- Vessels **returning blood to the heart** include:
  1. Superior and inferior venae cavae
  2. Right and left pulmonary veins
- Vessels conveying **blood away from the heart** include:
  1. Pulmonary trunk, which splits into right and left pulmonary arteries
  2. Aorta

- **Superior** vena cava;
  - receives venous blood from head, neck, thorax and upper limb
- **Inferior vena cava;**
  - **venous blood from abdomen and lower limb drain here**

- **Superior Vena Cava**
- Internal jugular vein; head and neck
- Subclavian vein; upper limb
- Union of internal jugular and subclavian form Brachiocephalic veins
- Union of the brachiocephalic veins forms Superior Vena Cava

Circulatory Routes

- **Systemic Circulation** – the flow of blood between the heart and the cells of the body.
  - Blood flow from the L ventricle to the body & back to the R atrium

- **Pulmonary Circulation** – the flow of blood between the heart and lungs.
  - Blood flow from the R ventricle to the lungs and back to the L atrium

How does the blood flow through the Heart?

RİGHT SİDE OF HEART

- Blood enters the heart through two large veins, the inferior and superior vena cava, emptying oxygen-poor blood from the body into the right atrium of the heart.

- As the atrium contracts, blood flows from your right atrium into right ventricle through the open tricuspid valve.

- When the ventricle is full, the tricuspid valve shuts. This prevents blood from flowing backward into the atria while the ventricle contracts.

- As the ventricle contracts, blood leaves the heart through the pulmonic valve, into the pulmonary artery and to the lungs, where it is oxygenated and then returns to the left atrium through the pulmonary veins.

How does the blood flow through the Heart?

LEFT SİDE OF HEART

- The pulmonary veins empty oxygen-rich blood from the lungs into the left atrium of the heart.
- As the atrium contracts, blood flows from your left atrium into your left ventricle through the open mitral (bicuspid) valve.
- **When the ventricle is full, the mitral valve shuts. This prevents blood from flowing backward into the atrium while the ventricle contracts.**
- As the ventricle contracts, blood leaves the heart through the aortic valve, into the aorta and to the body.

Pathway of Blood Through the Heart and Lungs

- Right atrium → tricuspid valve → right ventricle
- Right ventricle → pulmonary arteries → lungs
- Lungs → pulmonary veins → left atrium
- Left atrium → bicuspid(mitral) valve → left ventricle
- Left ventricle → aorta
- Aorta → systemic circulation

The Aorta

- After originating from left ventricle, it ascends for a short distance, arches backward and to the left side, descends within the thorax, pass through diaphragm, reaches abdomen.

- Portions of aorta

1. **Ascending aorta**
2. **Arch of the aorta and**
3. **Descending aorta (thoracic and abdominal aorta)**

AORTA

1. Ascending aorta; coronary arteries
2. Arch of the aorta;
   - Brachiocephalic trunk (Innominate artery);
     - Right common carotid artery
     - Right subclavian artery
   - Left common carotid artery; head&neck
   - Left subclavian artery; upper limb
3. Descending aorta (thoracic and abdominal aorta)

Ascending Aorta (Aorta Ascendens)

- Only branches of the ascending aorta are the two **coronary arteries** which supply the heart

Arch of the Aorta

Branches;

- **Brachiocephalic artery** (Innominate artery)
- **Left common carotid artery**
- **Left subclavian artery**

Descending Aorta;

Has two parts; Thoracic Aorta and Abdominal Aorta

Descending in front of the vertebral column

Ends on L4 , bifurcates (bifurcation of aorta) into common iliac arteries (R/L)

Common Iliac Arteries

- Gives 2 branches ;
  - External Iliac Artery; supply lower limb
  - Internal Iliac Artery (Hypogastric Artery); supply pelvic wall and pelvic organs

Blood Supply of Lower Limb

Femoral Artery

- **It is the continuation of the External Iliac artery.**

Femoral Vein

Continue proximally as external iliac veins

External+Internal iliac veins= Common iliac veins (R/L)

Common iliac veins (R+L)= Inferior vena cava

Blood supply of Head

- The arterial supply of the head is derived from the common carotid arteries.
- The right common carotid arises from the brachiocephalic trunk.
- The left common carotid arises from the aortic arch directly.

Blood supply of Head

- The common carotid runs upwards in the neck and divides into external and internal carotid arteries.

Blood supply of Head

I The external carotid artery provides the major blood supply for the face and neck

II The internal carotid artery supplies brain(not all segments), the optic nerve, eye, orbit and scalp.

- Veins;
- Internal jugular vein; drains head and neck region

Blood Supply of Upper Limb

Axillary artery

- Continuation of subclavian artery
- Becomes brachial artery which supply arm
- Brachial artery divides into radial and ulnar arteries; supply forearm and hand

Veins;

Ulnar/Radial veins…Brachial vein….Axillary vein…..Subclavian vein

LYMPHOID SYSTEM

- What is lymph ?

Tissue fluid (interstitial fluid) that enters the lymphatic vessels

- The main function; collect excess large particles and tissue fluid

LYMPHOID SYSTEM

The important components of the lymphoid system;

Lymph (clear, watery, slightly yellow tissue fluid)

Lymphocytes (circulating cells of the immun system)

Lymphoid organs (part of body that produce lymphocytes; spleen, tonsils, thymus, lymph nodes)

Lymphatic capillaries (orginate blindly in the intercelular space and forms Lymphatic plexuses)

Lymphatic vessels (thin walled vessels with valves)

Lymph nodes (small masses of lymphatic tissue located along the course of lymphatic vessels)

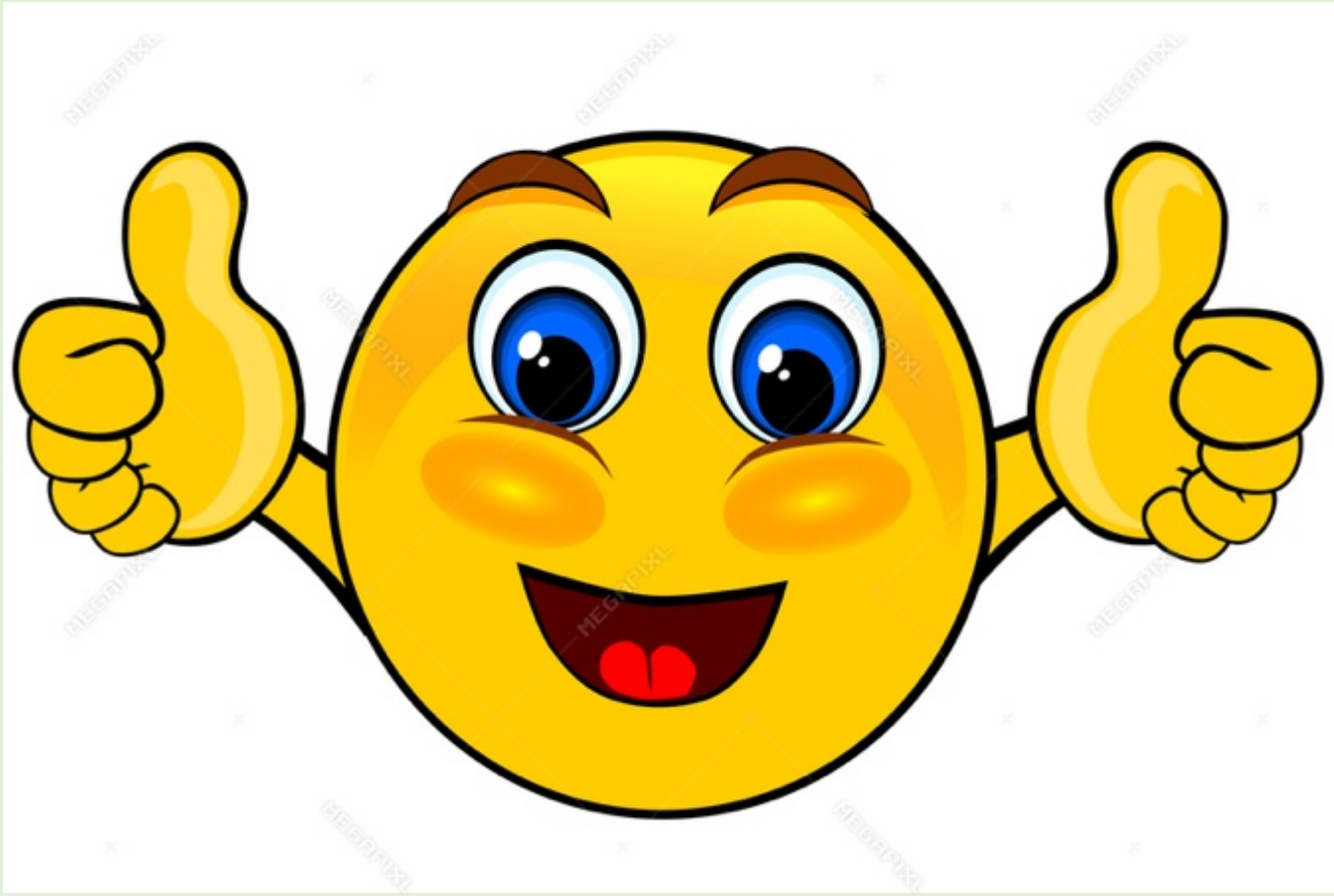
Lymphatic trunks (large collecting vessels)- Lymphatic ducts

LYMPHOID SYSTEM

Superficial lymphatic vessels…Deep lympahic vessels…traverse lymph nodes….reach Lympahatic ducts;

Right lymphatic duct…drains right subclavian veins (right side of head, neck, and thorax plus the right upper limb)

Thoracic duct….drains left subclavian veins (remainder of body)



RESPIRATION

❖ The exchange of gases between the atmosphere, lungs, blood, and tissues

- Respiratory system; supply the body with oxygen and dispose of carbon dioxide, Passageways to the lungs purify, warm, and humidify the incoming air

RESPIRATION

- Respiration – four distinct processes must happen
  - **Pulmonary ventilation**=“breathing”, moving air into and out of the lungs
  - **External respiration**=occurs within the lungs, gas exchange between the lungs and the blood
  - **Transport of respiratory gases**=via the blood, transport of oxygen and carbon dioxide between the lungs and tissues
  - **Internal respiration**=occurs within the tissues, gas exchange between systemic blood vessels and tissues

Respiratory System

- Structurally
  - **Upper respiratory system**
    - Nose, pharynx and associated structures,larynx
  - **Lower respiratory systemr**
    - achea, bronchi and lungs

- Functionally
  - **Conducting zone** – conducts air to lungs
    - Nose, pharynx, larynx, trachea, bronchi, bronchioles and terminal bronchioles
  - **Respiratory zone** – main site of gas exchange
    - Respiratory bronchioles, alveolar ducts, alveolar sacs, and alveoli

Respiratory System

- ***Upper respiratory***

- Nose
- Pharynx
- Larynx (voice box)

- ***Lower respiratory***

- Trachea (Windpipe)
- Bronchial tree
- Lungs

Function of the Nose

- The only externally visible part of the respiratory system that functions by:
  - Providing an airway for respiration
  - Moistening (humidifying) and warming the entering air
  - Filtering inspired air and cleaning it of foreign matter
  - Serving as a resonating chamber for speech
  - Housing the olfactory receptors, (I. cranial nerve), smelling

Structure of the Nose

- The nose is divided into two regions
  - The external nose, including the **root**, **bridge**, **dorsum nasi**, and **apex, nares**
  - The internal **nasal cavity;** Ducts from **paranasal sinuses and nasolacrimal ducts(tears)** open into internal nose. Opens posteriorly into the **nasal pharynx** via internal nares (choanae)

Paranasal Sinuses

- Cavities within bones surrounding the nasal cavity
  - **Frontal bone**
  - **Sphenoid bone**
  - **Ethmoid bone**
  - **Maxillary bone**

- Function of the sinuses
  - Lighten the skull
  - Act as resonance chambers for speech
  - Produce mucus that drains into the nasal cavity

Pharynx

- Passageway for **air and food**
- Extends from the base of the skull to the level of the sixth cervical vertebra
- It is divided into three regions
  - **Nasopharynx**; l**ies posterior to the nasal cavity**
  - **Oropharynx; lies posterior to the oral cavity, common passageway for food and air**
  - **Laryngopharynx;**Lies posterior to the larinx, **common passageway for food and air**

Structures of the Pharynx

- **Auditory tubes** enter the nasopharynx
- Tonsils of the pharynx (Houses tonsils)
  - **Pharyngeal tonsil** (adenoids) in the nasopharynx
  - **Palatine tonsils** in the oropharynx
  - **Tubal tonsils** where **Auditory tubes** enter the nasopharynx

Larynx (Voice Box)

- Continuous with the trachea posteriorly
- The three functions of the larynx are:
  - To provide a **patent airway (**Cartilages (hyaline/elastic))
  - To **act as a switching mechanism to route air and food into the proper channels**
  - To function in **voice production (vocal cords take part here)**

Trachea (Windpipe)

- Connects larynx with bronchi
- Extends from larynx to superior border of T5
  - Divides into right and left primary bronchi
- Walls are reinforced with C-shaped hyaline cartilage

Features of the Bronchial Tree

- **Primary Bronchi:**
  - Formed by division of the trachea. Right bronchus is wider, shorter, and straighter than left (Aspiration)
- **Secondary Bronchi:**
  - Each primary divides into secondary (3 on right and 2 on left) bronchi that service each lung
- **Tertiary Bronchi:**
  - Secondary bronchi branch into tertiary which branch into smaller and smaller tubes
- **Bronchioles:**
  - Tiniest of tertiary bronchi, less than 0.5 mm in diameter; smallest are terminal bronchi

Features of the Lower Bronchial Tree

- **Terminal Bronchioles:**
  - The smallest bronchioles that feed directly into:

- **Respiratory Bronchioles:**
  - Feed into each lung which lead into (gas exchange):

- **Alveolar ducts:**
  - Contain rings of smooth muscle and **alveoli** which is the structure gases are exchanged in.

Respiratory Tree Divisions

- Primary bronchi
- Secondary bronchi
- Tertiary bronchi
- Bronchioli
- Terminal bronchioli

Respiratory Zone

- Respiratory bronchioli
- Alveolar duct
- **Alveoli**
- **Site of gas exchange!!!**

Gross Anatomy of the Lungs

- **Lungs occupy all of the thoracic cavity except the mediastinum**
- **Left lung** – separated into **upper and lower lobes** by the oblique fissure
- **Right lung** – separated **into three lobes** by the oblique and horizontal fissures

LUNGS

- Lungs are organs of respiration
- Their main function is to oxygenate the blood by bringing the inspired air into close relation with the venous blood in the pulmonary capillaries

Pleurae

- Thin, double-layered serosa
- **Parietal pleura**
  - Covers the thoracic wall and superior face of the diaphragm
- **Visceral, or pulmonary, pleura**
  - Covers the external lung surface
  - Pleural cavity is space between layers
    - Contains a capillary layer of serous fluid
    - Lubrication of the pleural surfaces allow the two layers slide on each other smoothly during lung movements

Breathing

- Breathing, or pulmonary ventilation, consists of two phases
  - **Inspiration** – air flows into the lungs
  - **Expiration** – gases exit the lungs

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