Pathophysiology(Unit-2)

B.Pharma 2nd semester

UNIT-II

✱ Cardiovascular System :-

The Cardiovascular System, also known as the circulatory system, is a complex network responsible for transporting blood, nutrients, oxygen, carbondioxide, hormones and waste products throughout the body.

- It Consist of the heart, blood vessels and blood.

1. **Heart:** A muscular organ that pumps blood throughout the body. It has four chambers: Two atria (upper chamber) and two ventricles (Lower chambers).
   - Atria: Receive blood coming into the heart.
   - Ventricles: pump blood out of the heart.
   - The heart functions through a cycle of Contraction (Systole) and relaxation (diastole).
2. **Blood vessels:** A network of tubes through which blood flows.
   - Arteries: Carry oxygen-rich blood away from the heart to the body.
   - Veins: Return oxygen-poor blood back to the heart.
   - Capillaries: Tiny vessels where the exchange of oxygen, Carbon dioxide, nutrients and waste product occur between blood and tissue.

③. Blood :- A fluid Composed of plasma, red blood Cells, White blood Cells and platelets.

- plasma : The liquid Component of blood, Containing Water, Salt and protein.
- RBC : Carry oxygen from the Lungs to the body and Carbon dioxide from the body back to the lungs.
- WBC : part of the immune system, they help fight infection.
- platelets : Help in blood Clotting to prevent bleeding.

Functions of the Cardiovascular System :-

→ Transport of oxygen, nutrients, Hormones and waste product.
→ Regulation of body temperature, pH Levels and fluid balance.
→ provide protection by Immune Response and Clotting Mechnism.

Common Cardiovascular disorder :-

- Hypertension (High blood pressure)
- Atherosclerosis (plaque in arterial wall)
- Heart Attack (myocondial Infaraction) blockage of blood flow.
- Stroke : Stop blood Supply to the brain.
- Arrhythmias : irregular heart beat.
- Heart failure : Inability to pump blood.

✱ Hypertension :-

- Hypertension, commonly known as high blood pressure, is a chronic Medical Condition, where the force of the blood against the artery wall is Consistently too high.
- This condition Can lead to serious health problems, including heart disease, strocke and kidney faliure if not Managed properly.

Types of Hypertension :-

1. primary (Essential) Hypertension:
   - Most Common type: Accounts for about 90-95% of all Cases,
   - No Identifiable Cause: Develops gradually over many years due to a Combination of genetic and lifestyle factors such as diet, physical inactivity, and stress.
2. Secondary Hypertension :-
   - Less common: Accounts for about 5-10% of Cases.
   - Underlying Cause: Develops Suddenly and is usually the result of another Condition Such as kidney disease, hormonal disorders, or Certain medications.

Risk factor :-

- Age
- Family history
- obesity
- physical inactivity
- Diet
- Tobacco use
- stress

Symptoms of hypertension :-

- Hypertension is often called the "Silent killer" because it usually has no symptoms until significant damage has occured.
- When symptoms do occur, they may include.

- Headaches: particularly in the morning
- Shortness of breath: Due to the heart working harder.
- Nose bleeds: Can occur if blood pressure is extremely high.
- Flushing: Reddening of the face
- Dizziness: Feeling lightheaded or faint.

Diagnosis :-

1. Blood pressure Measurment: A sphygmomanometer is used to measure blood pressure in millimeters of mercury (MMHg)
   - Systolic pressure: The pressure when the heart beats
   - Diastolic pressure: The pressure when the heart is at rest

2. Multiple Reading :- Blood pressure should be measured at different times to confirm a diagnosis.

Blood pressure Categories :-

1. Normal: Systolic < 120 MMHg and Diastolic < 80 MMHg.
2. Elevated: Systolic 120-129 MMHg and Diastolic < 80 MMHg
3. Hypertention Stage 1: Systolic 130-139 MMHg or diastolic 80-89 MMHg
4. Hypertension Stage 2: Systolic ≥ 140 MMHg or Diastolic ≥ 90 MMHg
5. Hypertensive Crisis: Systolic > 180 MMHg or Diastolic > 120 MMHg. (Req. Immediate Medical actions).

Treatment and Management :-

1. Lifestyle changes :-

- Diet
- Exercise
- Weight Management
- Limit Alcohol and quit Smoking.

2. Medication :-

1. Diuretics: Help the kidney remove Sodium and water, reducing blood volume.
2. ACE Inhibitor: Relax blood vessels by blocking hormones but Constrict them.
3. Beta-blocker: Reduce the heart Rate and the heart Output of blood
4. Calcium Channel blocker: prevent Calcium from entering heart and blood vessels muscle cell, leading to relaxation of blood vessels.
5. Other: Such as alpha-blockers, Central agonist, vasodilator, depending on the specific need of patient.

✱ Congestive heart failure :-

Congestive heart failure (CHF) is a chronic progressive condition that affects the puming power of your heart muscles.

Causes :-

- Coronary artery disease (CAD): Narrowed arteries reduce blood flow to the heart.
- High blood pressure (hypertension): This can cause the heart to work harder than necessary, leading to heart muscle thickening.
- Cardiomyopathy: Damage to the heart muscle from various causes including drug or alcohol abouse and infection.
- Heart valve disease: Dysfunctional heart valves can lead to heart failure.
- Myocardial infarction (heart attack): This can damage the head muscle and impair its ability to pump effectively.

Symptoms :-

- Shortness of breath
- Fatique
- Swelling (in leg, ankels and feet)
- Rapid or irregular heartbeat
- persistent cough
- Increase need to urinate at night
- Sudden weight gain from fluid retention
- Lack of appetite and nausea.

Diagnosis :-

- physical exam: Checking for fluid in the Lungs, swelling, and other signs.
- Blood test: To Check for markers of heart failure.
- Chest x-ray: To See the Condition of the lungs and heart.
- ECG : To assess the heart's electrical activity.
- Cardiac MRI: To provide detailed image of the heart.
- Coronary angiogram: To check for blokages in the Coronary arteries.

Treatment :-

- Lifestyle Change: Reducing Salt intake, exercising regularly, quiting Smoking and Managing Weight.
- Medications:
  - ACE inhibitors: To relax blood vessles.
  - Beta-blocker: To reduce heart rate and blood pressure.
  - Diuretics: To reduce fluid buildup.
  - Aldosterone Antagonists: To Mange fluid Levels.
  - Digoxin: To strengthen heart muscle Contraction.

★ Ischemic heart disease :-

Ischemic heart disease, also known as Coronary artery disease (CAD), occurs when the Coronary arteries that Supply blood to the heart Muscles become narrowed or blocked.

- This Condition reduces blood flow to the heart Muscles, which Can lead to chest pain (angina), heart attacks, and other Complication.

① Angina :-

Chest pain or discomfort due to ~~finde~~ inadequate oxygen-rich blood Supply to the heart Muscle.

#Types :-

(i) Stable Angina :-
- Triggered by physical activity or stress.
- predictable pattern, relieved by rest or medication.

(ii) Ustable Angina :-
- occurs at rest or with Minimal exertion
- Required immediate Medical attention.

(iii) Variant Angina :-
- Caused by coronary artery Spasm.
- occurs at rest, often at night
- Relived by medication.

(iv) Microvascular Angina :-
- Affects Small Coronary arteries
- Longer-Lasting, more Severe, less responsive to typical treatment.

Symptoms of Angina :-

- Chest pain or discomfort
- pain may radiate to arms, neck, jaw, Shoulder or back
- Shortness of breath.
- Nausea
- Fatigue
- Dizziness
- Sweating

Causes :-

- Coronary Artery Disease (CAD): plaque buildup narrowing arteries.
- Coronary Artery Spasm : Temporary tightening of artery walls.
- Microvascular Disease: issues with small blood vessels in the heart.

Diagnosis :-

- Medical history and physical exam.
- Electro cardiogram (ECG)
- Stress test
- Coronary Angiography.
- Blood test.

Treatment :-

- Life style change : Healthy diet, regular, quitting Smoking, stress management.
- Medications :-
  - Nitrates
  - Beta-blocker
  - Antiplatelet agent (e.g aspirin)
  - Calcium channel blocker
  - Statins

(2) Myocardial infarction :-

Myocardial infarction, commonly known as a heart attack, occurs when blood flow to a part of the heart is bocked for a long enough time that part of the heart muscle is damaged or dies.

#Causes :-

- Atherosclerosis - Jatty deposition
- Blood clot
- Coronary spasm - Costriction.

#Risk factor :-

- High blood pressure
- High Cholestrol
- Smoking
- Diabetes
- obesity
- Physical Inactivity
- Family history.
- Stress.

#Symptoms :-

- chest pain or discomfort (anging)
- pain or discomfort in other areas such as the arms, back, neck, jaw or stomach.
- Shortness of breath
- Sweating
- Nausea or vomiting.

Diagnosis:-

- Electro Cardiogram – Measure electrical activity of the heart to detect heart muscle damage.

- Blood test - Look for Cardiac biomakers like troponins that indicate heart ~~attack~~ muscle damage.

- Imaging tests:- Echocardiogram, stress test, or Coronary Angiography.

Treatment:-

• Medication:-

- Antiplatelet agent (Aspirin, Clopidogrel)
- Anticoagulants (Heparin)
- Thrombolytics
- Beta-blocker
- ACE inhibitor

• procedure:-

- Angioplasty and Stenting: open blocked arteries
- Coronary artery bypass Grafting: Bypass blocked Coronary arteries using vessels from another part of the body.

• Lifestyle change:-

- Quiting Smoking
- Eating a heart healthy ~~diet~~ diet.
- Exercise regularly
- Maintaining a healthy weight
- Managing Stress

③ Atherosclerosis :-

Atherosclerosis is a condition where the arteries become narrowed and hardened due to a buildup of plaque on their inner wall.

Causes :

- High Cholesterol : Elevated levels of LDL (Low density lipoprotein) Cholesterol contribute to plaque formation.
- High blood pressure : Can damage the inner lining of arteries, making them more susceptible to plaque buildup.
- Smoking : Damage the lining of the arteries and increase plaque form.-
- Diabetes : High blood sugar levels can damage the arteries and promote atherosclerosis.

Risk factor :-

- Age
- ~~Faim~~ Family history
- Hypertension
- High cholestrol levels
- Smoking
- Diabetes
- Obesity
- Physical activity

Symptoms :-

Atherosclerosis often develops gradually and may not cause symptoms until an artery is significantly narrowed or blocked. Symptoms depends on the affected arteries.

- Coronary Arteries : Chest pain or angina, Shortness of breath, heartattack

- Carotid Arteries: Sudden numbness or weakness in limbs, difficulty Speaking temporary Loss of vision, Stroke.
- peripheral Arteries: Leg pain when Walking, numbness or Weakness in leg.
- Renal Arteries: High blood pressure, kidney failure.

Diagnosis:-

- Blood test: Measure cholesterol, blood Sugar, and other Markers of heart disease risk.
- Imaging tests: Ultrasound, CT Scan, MRI, Angiography.
- Electrocardiogram (ECG): detect abnormalities in heart function.
- Stress test: Evaluate heart function under Stress.

Treatment:-

- Medication:
  - Statins (to Lower Cholestrol)
  - Antihypertensive (to Lower blood pressure)
  - Antiplatelet agent (e.g aspirin)
  - Diabetes Medication (to Control blood Sugar level)

procedure:-

- Angioplasty and Stenting
- Bypass Surgery.

Lifestyle change:-

- Healthy diet
- Regular physical activity
- weight management
- quitting Smoking
- Managing Stress

(4) Arteriosclerosis :-

Arteriosclerosis refers to the thickning, hardening and loss of elasticity of the walls of arteries. This condition leads to restricted blood flow to organs and tissue.

Risk factor :-

- Non-modifiable: Age, gender (more common in men), family history.
- Modifiable: High blood pressure, high Cholestrol, smoking, diabetes, obesity, physical inactivity, unhealthy diet.

Symptoms :-

- often asymptomatic until significant artery narrowing or blockage occurs.
- Coronary Arteries: Chest pain (Angina), heart attack.
- Carotid Arteries: Stock transient ischemic attacks.
- peripheral Arteries: Leg pain, perpheral artery disease.

Diagnosis :-

- Blood test (Cholestrol Level)
- Imaging: Ultrasound, CT angiography, MRI, Coronary Angiography
- Ankle-~~brachial~~ brachial index for PAD

Treatment :-

- Lifestyle change: Diet, exercise, smoking cessation.

- Medication: Statins (Lower cholestrol), antihypertensives, antiplatletes agent (aspirin).
- Surgical intervention: Angioplasty, stent placement, Coronary artery bypass grafting for sever case.

☆ Respiratory System :-

The respiratory system is Responsible for gas exchange, supplying oxygen to the body and removing Carbon dioxide. It consists of the following main Components.

- Nose and Nasal Cavity
- Pharynx
- Larynx
- Trachea
- Bronchi and Bronchioles
- Lungs
- Alveoli
- Diaphragm

#Gas Exchange process :-

- Inhalation: Diaphragm Contract, thoracic Cavity expands, air is drawn into the lungs.
- oxygen Transport: oxygen diffues from alveoli into the blood, binds to hemoglobin in Red blood Cells.

- Exhalation: Diaphragm relaxes, thoracic cavity contracts, air is expelled from the lungs.
- Carbon Dioxide Removal: CO_2 diffuses from blood into alveoli to be exhaled.

Common Respiratory Conditions:-

- Asthma: Airways become inflamed and narrowed, causing difficulty breathing.
- Bronchitis: Inflammation of the bronchi.
- Pneumonia: Infection causing inflamation in the alveolis.
- Chronic obstructive pulmonary disease (COPD): Group of lungs disease that block airflow and make breathing difficult.
- Lungs Cancer: Malignant growth in lung tissue, often associated with Smoking.

① Asthma:-

A chronic inflammatory disease of the airways characterized by variable and recurring symptoms, reversible airflow obstruction, and bronchospasm.

Symptoms:-

- Wheezing
- Shortness of breath
- Chest tightness
- Coughing, especially at night or early Morning.

Triggers :-

- Allergens (e.g pollen, dust mites, pet dander)
- Respiratory Infections.
- physical activity (excercise induce asthma)
- Cold air
- Air pollutant and irritant (e.g Smoke, strong odors)
- Stress and strong emotions

Diagnosis :-

- Medical history : Listing for wheezing and other Signs
- Physical examination : Measure airflow and lungs function.
- Spirometry : Measure the airflow and lungs function.
- peak flow Meter : Measures the peak expiratory flow rate.
- Allergy testing : Identifies Specific allergen triggering asthma.

Management of asthma :-

- Avoid Triggers : Identifying and avoiding asthma triggers.
- Medications :-
  - Relievers (Bronchodilator) : short acting beta-agonists (e.g albuterol) for immediate relif of symptoms.
  - Controller (Anti-inflammatory drug) : Inhaled Corticosteroids (e.g fluticasone) to reduce inflamation.
  - Combinations Inhalers : Contain both Long-acting bronchodilat and Corticosteroids.

(2) Chronic obstructive pulmonary Disease (COPD) :-

A progressive lung disease characterized by persistent respiratory symptoms and airflow limitation, typically due to emphysema and chronic bronchitis.

Symptoms :-

- persistent Cough with mucus
- Shortness of breath - especially during physical activities.
- Wheezing
- Chest tightness
- Fatigue.

Causes :-

- primary Cause: Long-term exposure to irritating gases or particulate Matter, Most Commonly from cigarette smoke.
- Other Causes: Air pollution, chemical fumes, dust, genetic factors. (e.g Alpha-1 antitrypsin deficiency).

Diagnosis :-

- Medical History :- Assessment of symptoms, Smoking history, and exposure to lungs irritants.
- Physical examination :- Checking for signs of COPD.
- Spirometry: Measuring lung function.
- Chest x-ray / CT scan :- Imaging to look for emphysema and other changes in the lungs.

Management of Copd :-

- Smoking Cessation: The most Crucial Step in Managing COPD.
- Medications:
  - Bronchodilator: Short acting (e.g albuterol) and long-acting (e.g tiotropium) to relax airway muscles.
  - Inhaled Corticosteroids: To reduce inflammation (e.g fluticasone)
- oxygen therapy: For patient with Severe copd and low blood oxygen levels.

☆ Renal System :-

- The renal system, also known as the urinary system, is responsible for filtering blood, removing waste, and Maintaining homeostasis of water, electrolytes, and pH balance.
- It Consist of the kidneys, ureters, bladder and urethra.

① Acute Renal Failure :

A Sudden loss of kidney function, typically developing over hours to days, resulting in the inability to maintain fluid, electrolyte and acid base balance.

#Causes :-

- pre-renal : Due to decreased blood flow to the kidney (e.g Heart failure, Shock).
- Intra-renal : Direct damage to the kidney (e.g acute tubular necrosis, glomerulonephritis, toxins).
- post-Renal : obstruction of urine flow (e.g kidney stones, Tumors, enlarged prostate).

Symptoms :-

- Decrease urine output or no urine output.
- Swelling (edema) due to fluid retention.
- Fatigue and Confusion
- Shortness of breath
- Nausea and vomiting.

Diagnosis :-

- Blood test: Elevated Serum Creatinine and blood urea nitrogen Levels
- Urinalysis: presence of abnormal substances (e.g protein, blood)
- Imaging: Ultrasound or CT Scan to detect obstructions or structural abnormalities.
- Biopsy: In some Cases, to identify the underlying Cause.

Treatment :-

- Address Underlying Cause: E.g restore blood flow, remove obstruction, treat infections.
- Supportive Care: Manage fluid and electrolyte imbalances.
- Dialysis: Temporary Measure to filter blood in severe Cases.
- Medications: To Manage Symptoms and prevent Complication.

(2) Chronic Renal Failure :-

A gradual loss of kidney function over months to years, leading to irreversible damage and decreased ability to perform essential functions.

Causes :-

- Diabetes Mellitus: Leading Cause, due to prolonged high blood Sugar.
- Hypertension: High blood pressure damages blood vessels in kidney.
- Chronic Glomerulonephritis: Inflammation in kidney filtering unit.
- polycystic kidney disease: Genetic disorder Causing Cysts to form in the kidneys.

Symptoms :-

- Early ~~AA~~ Stages may be asymptomatic.
- Fatique and weakness
- Swelling, especially in the legs and ankles.
- persistent itching.
- Nausea and vomiting.
- Loss of appetite
- Change in urine output and appearance.

Diagnosis :-

- Blood test: Elevated Serum Creatinine Levels, decrease GFR.
- Urinalysis: presence of protein, blood or abnormal Cell.
- Imaging: Ultrasound, CT Scan, or MRI to assess kidney size and structure.
- Biopsy: To determine the Cause and extent of damage.

Treatment :-

- Medications:
  - To control blood pressure (ACE inhibitor, etc)
  - To Manage blood Sugar Level in diabetes.
  - To Treat anemia (erythropoiesis-stimulating agent)
  - To Mange bone health (Phosphate binder, vit. D supplement)
- Dietary change: low protein, low Sodium and low-potessium die
- Lifestyle modification: Regular excercise, SMoking Cessation, and weight Management.
- Dialysis: Hemodialysis or peritoneal dialysis for advanced stage
- Kidney transplant: For end-Stage renal disease