

السنة الثالثة – الفصل الأول
الجهاز القلبي الوعائي
Cardiovascular System
0500331
(5) Credit Hours

Course Objectives:

By the end of the course the student should have a fundamental clinically-oriented grasp of the normal structure and function of the cardiovascular system, together with the pathological abnormalities that may afflict the system and drugs that are used in treatment.

Intended Learning outcomes :

A) Knowledge and Understanding

By the end of the course the medical student should have knowledge and understanding of the following :

1. Gross, microscopic and surface anatomy of the heart with particular reference to the heart conductive system, valves, chambers, coronary arteries and autonomic nerve supply.
2. Embryological development of the heart and blood vessels. Congenital malformations.
3. Action potential and electrical activity of the conductive system and myocardium, including the ionic events that underlie their behaviour and the relation to electrical impulses generated on the electrocardiogram.
4. Biochemical characteristics of cardiac muscle and its energy utilization including the role of Calcium. Myoglobin, cardiac enzymes and troponin, their role in diagnosis of myocardial disease.
5. Electrocardiography and the tri-axial system. Normal ECG.
6. Relation of the electrical activity of the heart to its mechanical contractility, pressure changes and blood flow through the chambers and valves and the generation of heart sounds.
7. Auscultation for heart sounds. Production of murmurs. Degenerative and rheumatic valvular disease, infective endocarditis
8. Heart rate and its humoral and nervous control. Stroke volume and cardiac output. Normal heart rhythm. Cardiac arrhythmias. Drugs used in the treatment of arrhythmias viz. sodium channel blockers, beta adrenergic blockers, drugs prolonging the refractory period and calcium channel blockers.
9. Gross and microscopic anatomy of blood vessels of the body. Surface anatomy of relevant blood vessels in particular for pulse examination and other clinical procedures. Techniques of examination of peripheral pulses.
10. Systolic, diastolic and mean systemic arterial blood pressures. Nervous, biochemical and mechanical factors that control arterial blood pressure.
11. Measurement of blood pressure.
12. Hypertension : systemic and pulmonary, their aetiology, pathology and complications. Drugs used in the treatment of hypertension viz. vasodilators, sympatholytic agents, angiotensin inhibitors, diuretics and calcium channel blockers.
13. Central venous pressure. Factors that influence CVP. Clinical inspection of jugular venous pressure.
14. Hypotension, its pathogenesis and treatment.
15. Ischaemic heart disease aetiology, risk factors, pathology and clinical manifestations, with particular reference to angina, myocardial infarction and heart failure. Drugs used in treatment.

16. Haemodynamics and clinical manifestations of heart failure and oedema.
17. Diseases of the pericardium and myocardium.
18. Drugs used in the treatment of heart diseases viz. Cardiac glycosides, diuretics, catecholamines and phosphodiesterase inhibitors.
19. Atherosclerosis pathogenesis, pathology and complications. Drugs used in hyperlipidaemic states.
20. Thrombosis and embolisation. Haemorrhage.
21. Varicose veins.
22. Types of shock, pathogenesis, clinical manifestations and drugs used in treatment.
23. Vasculitis pathogenesis, pathology and complications.
24. Microorganisms that cause infectious lesions in the cardiovascular system viz. Spirochaetes, Rickettsiae and viruses. Bacteria causing endocarditis.
25. Principles of heart transplantation.
26. Relevant X-ray examination.

B) Cognitive/intellectual skills

The student should be able to observe, interpret and correlate information to attain the right conclusions regarding normal and abnormal conditions.

C) Subject specific skills

Palpation of pulses, auscultation of heart sounds, observation of CVP, measurement of blood pressure, normal ECG interpretation, normal X-ray interpretation, recognition of gross and microscopic abnormal conditions.

D) Transferable skills

Demonstrate good command of clinical skills and knowledge of the course with the ability to impart these to colleagues and juniors.

Content Summary:

Duration : 5 credit hours (75 contact hours excluding exams).

Contact hours are distributed as follows

1. Anatomy : 15 hours.
2. Histology : 4 hours.
3. Physiology : 18 hours.
4. Biochemistry : 3 hours.
5. Pathology : 16 hours.
6. Microbiology : 5 hours.
7. Pharmacology : 8 hours.
8. Clinical Medicine : 6 hours.

Teaching Methods :

Teaching methods comprise lectures, practicals and seminars.

Tests and evaluations :

MCQ ; OSCE ; Assignments

Course Content:

Histology (4 contact hours)

1- Introduction

2- Capillaries

- a. Types and structures
- b. Capillary permeability
- c. Metarteriols

3- Arteries

- a. Arterioles
- b. large arteries (elastic arteries)
- c. Arteriovenous anastomosis

4- Veins

- a. Venules
- b. Small – sized veins
- c. Large veins

5- Heart

Special features

Physiology (20 contact hours)

1. Introduction

- Functions of the Cardiovascular System
- Functions of the Cardiovascular Components, Cardiac Output
- Cardiovascular System Circuitry
- General Features of the Heart Circuitry

2. Cardiac Physiology

- Structure
- Cell-Cell connections: Gap Junctions
- Membrane Properties: Cardiac Action Potential
- Ionic Conductance Changes during the Action Potential
- The Absolute and Relative Refractory Periods
- Excitation-Contraction Coupling
- Calcium Entry across Sarcolemma
- Calcium Release from the Sarcoplasmic Reticulum
- Calcium Activation of Contraction
- Role of Sarcoplasmic Reticulum and Sodium-Calcium Exchange in Relaxation
- Mechanics
- Force-Length Relation
- Grading of Force
- Force-Velocity Relation
- Energetic

3. Conduction System of the heart

- Transmembrane Potentials
- Types of Action Potentials
 - a. Fast
 - b. Slow
 - Ionic Conductance Changes During the Action Potential
 - The Absolute and Relative Refractory Periods
 - Pacemakers and the conduction System
 - Effect of Autonomic Stimulation
 - Agents which Mimic Autonomic Neurotransmitters
- Electrical conduction in the Heart
 - a. Spread of Depolarization in the Atria
 - b. Spread of Depolarization via AV Node
 - c. Spread of Depolarization via the HIS-Purkinje System
 - Intrinsic Cardiac Rates
 - Reentry as a Cause of Cardiac Arrhythmia's
 - The Electrocardiogram (ECG or EKG)
 - a. Measuring Electrical Activity
 - b. Bipolar leads

c. Unipolar Leads

4. Electrocardiography

- The Triaxial Lead System
- Cardiac Vectors
- Vector Loops
- The Mean Electrical Axis of the Heart
- The V Leads
 - a. Axis
- b. Chest Leads
 - The Normal ECG
 - Cardiac Arrhythmia's
 - Ectopic Pacemakers
 - Defects in Electrical Conduction of the His-Purkinje System
 - a. Normal 21 Lead ECG
 - b. Left Ventricular Hypertrophy
 - c. Right Ventricular Hypertrophy
 - d. Left Bundle Branch Block

5. Heart as a pump & cardiac cycle

- Electro-Mechanical Coupling
 - Cardiac Chambers
 - a. Atria
 - b. Ventricles
 - The Ejection Fraction
 - Phases of the Cardiac Cycle
 - a. Ventricular Systole
 - b. Ejection
 - c. Diastole
 - Volume Changes During the Cardiac Cycle
 - Pressure Changes in the Right Heart
 - Summary of Pressures in Cardiac and Major Vessels
 - Normal Oxygen Levels during the Cardiac Cycle
 - Valve Closure and Heart Sounds
 - a. First Sound
 - b. Second sound
 - c. Third Sound
 - d. Fourth Sound
 - e. Other Sounds
 - Heart Rate Alterations and Tension Development
 - Ventricular Distensibility and Stroke Volume
 - The Inotropic State of the Heart; Contractility
 - 1- The Role of the Autonomic Nervous System
 - a. Sympathetic Effects
 - b. Parasympathetic Effects
 - 2- Other Factors Affecting Contractility
- The work of the Heart
 - a. Cardiac Work as Determined by Volume-Pressure Loops
 - b. The Tension-Time Index
 - c. Energy and Cardiac Work
- Valve Pathology
 - a. Aortic Stenosis

- b. Mitral Stenosis
- c. Aortic Insufficiency
- d. Mitral Insufficiency

6. Cardiac output & venous return

- Output of the Heart and its Control
- Indirect Measurement of Cardiac output
- Determinants of Cardiac Output
 - a. Control of Heart Rate
 - b. Control of Stroke Volume
 - 1- Preload and Stroke Volume
 - 2- Afterload and Stroke Volume
- Compliance and Venous Function
- The Return of Blood to the Heart
 - Ventricular and Vascular Function Curves
 - The Effect of Posture on Venous Return and Venous Pressure
 - Aids to Venous Return
 - a. The Skeletal Muscle Pump
 - b. The Abdomino-thoracic Pump
 - c. The Right Ventricle

1. Circulation/Haemodynamics

- The Relationship between Volume Flow and Velocity
- Velocity and Volume of Blood Flow and Cross-Sectional Area
- The Relationship between Pressure and Flow
 - a. Energy and Pressure
 - b. Interconversion of Pressure
- Factors That Determine Flow
 - a. Pressure
 - b. Nature of the Fluid in the System
 - c. Tube Geometry
- The Effect of Resistance Changes on Blood Flow
 - a. Total Peripheral Resistance(TPR)
 - b. Resistance in Series and Parallel
 - c. Laminar Flow and Resistance
 - d. Turbulent Flow and Resistance
 - e. Resistance and Viscosity
 - 1- Hematocrit and Viscosity
 - 2- Velocity of Flow and Viscosity
 - f. Effect of Tube Distensibility on blood Flow
 - 1- Wall Tension and the Law of Laplace

2. Arterial System/Regulation of arterial blood pressure & Heart rate

- Functions of the Arterial System
 - a. Storage of Energy
- Arterial Blood Pressure
 - a. Mean Pressure
 - b. Pulse Pressure
- Determinants of Mean Arterial Pressure
- Changes in Cardiac Output and Total Peripheral Resistance
- Determinants of Arterial Pulse Pressure
 - a. Effect of Stroke Volume on Pulse Pressure
 - b. Changes in Arterial Compliance
 - c. Effect of Heart Rate on Pulse Pressure

- Measurement of Arterial Blood Pressure
- The Pressure Pulse
- Components of Nervous Control of Arterial Blood Pressure
 - a. Effectors
 - b. Sensors
 - c. Other Stretch Receptors
- Reflex Response to Changes in Blood Pressure
- Chemoreceptors and Blood Pressure
- Integration of Blood Pressure Responses
- 3. Blood flow/Tissues & its control**
 - Control of Blood Flow in the Peripheral Circulation
 - Local Control of Blood Flow
 - Circulating Hormones or Humoral Agents
- 4. Microcirculation (capillary exchange)**
 - Capillaries and Nutrient Exchange
 - Capillary Filtration (Starlings' forces)
 - Diffusion of Solute and Water; Osmosis
 - The Role of Lymphatic Vessels
- 5. Special circulation's (coronary, pulmonary & cerebral)**
- 6. Muscle blood flow & exercise**
 - Skeletal Muscle Circulation
 - a. Factors Which Alter Oxygen Extraction
 - b. Factors Which Alter Blood Supply
 - Coronary Blood Flow
 - a. Regulation of Coronary Blood Flow
 - b. Vasodilator Metabolites and Coronary Blood Flow
 - c. Myocardial Oxygen Consumption, Work and Coronary Blood Flow
 - d. Energy Sources for Cardiac Work
 - Effect of Ischemia and Direct Application of Heat and Cold on Skin Blood Flow
 - a. Reflex Control of Coetaneous Flow
 - The Cerebral Circulation
 - a. Control of Cerebral Blood Flow
 - b. The Effect of Oxygen and Carbon Dioxide on Cerebral Flow
 - c. Cerebrospinal Fluid (CSF)
 - d. The Blood-Brain Barrier
- 7. Circulatory shock & heart failure/Haemodynamics**
- Biochemistry (3 hours)
 1. Biochemical characteristic of cardiac muscle.
 2. Energy utilization including role of Ca. In contraction & relaxation
 3. Enzyme's , isoenzymes, troponin & myoglobin in myocardial infection.
- Microbiology (5 hours)

Bacterial infections:

 - Strap. Viridian's. Staph. Species. Enterococcus
 - Rickettsia
 - Post streptococcal disease

Viral infections:

 - Coxsackoie viruses. ECHO viruses

Pathology (16 contact hours)

Circulatory Disturbances

OEDEMA

Definition

Mechanisms (Hydrostatic Pressure Colloid Osmotic Pressure Lymphatics)

Na & H₂O retention

Causes (Clinico pathological settings)

Morphology – skin... Lung, Brain

HYPEREMIA & CONGESTION

Definition

Acute, Chronic passive

Organs: liver, lung...etc

HEMORRHAGE

Definition, types & names

THROMBOSIS

Definition

- Pathogenesis: Endothelial injury

Abnormalities in Blood flow

Hypercoagulability

- Morphology: Arterial, Venous ...etc.
- Disseminated intravascular coagulation (DIC)

EMBOLISM

Definition

Types

Morphology

INFARCTION

Definition

Types & Morphology

SHOCK

Pathogenesis & Types

Morphology

DISEASES OF BLOOD VESSELS

- ATHEROSCLEROSIS

Risk factors

Pathogenesis, morphology

Clinical importance & features

- HYPERTENSION, SYSTEMIC

Definition

Types

Morphology

- VASCULITIS

Giant cell arteritis

Takayasu's Disease

Polyarteritis Nodosa

Kawasaki's syndrome

Hypersensitivity...etc

Wegener's Granulomatosis

Thromboangitis Obliterans

Other disorders

Infectious Arteritis

Raynaud's Phenomenon

ANEURYSMS & DISSECTION

- **VEINS & LYMPHATICS**

Varicose Veins

Vena Cava syndromes

Lymphangitis & Lymphedema

- **TUMOURS**

Benign

Intermediate

Malignant

- **INTERVENTION-THERAPY**

Coronary bypass

Balloon Angioplasty...etc.

THE HEART

- **NORMAL & ABNORMAL**

- **HEART FAILURE**

- **ISCHEMIC HEART DISEASE**

Angina pectoris

Myocardial infarction

Chronic ischemic HD

Sudden Cardiac Death

- **HYPERTENSIVE HEART DISEASE**

Systemic

Pulmonary

- **VALVULAR DISEASE**

Degeneration & calcification

Mitral Prolapse

Rheumatic

Infective Endocarditis

Non-Infected: SLE... etc

Complication of Artificial valves

- **MYOCARDIAL DISEASES**

Myocarditis

Cardiomyopathy (Names & hints)

- **PERICARDIAL DISEASES**

Pericarditis

Effusion

- **CONGENITAL: CYANOTIC (Early, late)**

OBSTRUCTIVE

Cardiovascular Pharmacology (8 hours)

- **Inotropic agents:**

Cardiac glycosides

Catecholamines

Phosphodiesterase inhibitors

-**Antianginal Drugs**

Organic nitrates

Calcium channel blockers

Beta adrenergic blockers

- **Antihypertensive agents:**

Vasodilators

Sympatholytic agents

Angiotensin inhibitors

Antiarrhythmic agents:

- Class I: Sodium channel-blocking drugs
- Class II: Beta adrenoceptor-blocking drugs
- Class III: Drugs prolonging refractory period
- Class IV: Calcium channel-blocking drug

EXAMINATION OF THE CARDIOVASCULAR SYSTEM:

1. General inspection:

- Appearance
- Attitude
- Effort of breathing
- Cyanosis:
 - Central
 - Peripheral

2. Hands:

- Cyanosis
- Clubbing of fingers
- Clod or warm
- Splinter hemnorrhages
- Osler's nodules
- Janeway spots

3. Arterial Pulsations:

a. Palpate the radial artery

- Compare both sides
- Pulse Rate
- Rhythm

b. Carotid artery

- If unable to visualize pulsation's in the internal jugular, look for them in the ext. jugulars.
- Record the vertical distance & the angle at which the patient is lying

c. If C.H.F is suspected, do the hepatojagular reflux

- Press by your hand in the right upper quadrant region of abdomen for 30-50 sec.
- Observe for a rise in the JVP

d. Observe the amplitude & timing of the jugular venous pulsation's in order to time these pulsation, listen to the heart

SI.....a

SI.....S2x dessent

S2..... V

4. Blood Pressure:

- Choice of sphygmomanometer:
- Position of the patient
 - Supine
 - Sitting:
 - Standing:
- Which arm : vs two arms.

Technique:

- Sit of the bag
- Secure the cuff. (Not loose)
- Position of the patient's arm & its support

- Feel brachial artery
- Inflate the bag 30 mmHg above the pressure when pulsations disappear & then deflate = Palpable syst. BP then deflate & listen to changes in sound

5. **The Heart:**

Stand on the right side of the patients

Explain to the patient

Put the patient in a supine position with the upper body some what elevated

Expose the patient down to the waist

Inspection:

Pulsation:

- Apical
- Left parasternal
- Epigastrec, area
- Aortic area
- Pulmonary area
- (Common on S1 in the apical area & S2 in the base)
- (Listen in both phases of respiration)
- Extra sounds in systolic:
 - Ejection sound
 - Systolic clicke
- Extra sounds in diastole:
 - S₃, S₄, O.S
- Listen for systolic murmurs
- Listen of diastolic murmurs
- Ascultate the base of the heart with the diaphragm while the patient is sitting up, leaning forward, breath in complete exhalation.
- Ascultate the apical area using the bell of the stechescope rolling the patient on to his left side
- Ascultate the base of the heart while the patient standing up
- If you hear a murmur: comment:
 - Systolic or diastolic
 - Timing
- Location of maximal intensity
- Radiation
- Intensity- Grades
- Pitch
- Quality: blowing, rumbling, harsh, musical
- Variatin with respiration
- Search for oedema, ascites and hepatomegaly

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