Cardiovascular, Respiratory and Digestive Functions

Year 1 Semester 2

Credits: 7

Responsible Department: Department of Physiology

Module Coordinator: Prof Sudheera Kalupahana

Topic/Concept	Objectives	Time (hours)	T/L activity	Comments
1. Heart as a pump **1.1 Properties of cardiac muscle, conduction system, cardiac cycle, ECG**	1. Discuss special structural, contractile and electrical aspects of cardiac muscle in contrast to smooth and skeletal muscle. 2. Describe the conducting system of the heart. 3. Describe the origin and spread of the cardiac impulse. 4. Describe the events and explain the pressure and volume changes in the cardiac cycle. 5. Explain how normal heart sounds are produced and their timing in relation to the cardiac cycle. 6. Explain the principles of Electrocardiography.	2hrs 1hr 2hrs 2hrs	Lectures Lectures Lectures Lectures	

1.2 Changes in cardiac rate & rhythm	1. Explain the physiological basis of Arrhythmias. 2. Describe Re-entry phenomenon. 3. Identify sinus tachycardia and bradycardia on an ECG strip. 4. Calculate heart rate on an ECG strip with regular and irregular rhythm.	2hrs	Lecture	Practical on arrhythmias to be done with the practical on normal ECG
1.3 Electrocardiography	1. Draw and identify the wave forms of a typical ECG. 2. Describe variations in the ECG in health & disease. 3. Calculate heart rate in normal and abnormal ECGs. 4. Identify basic arrhythmias.	3hrs	Practical	
2.Cardiac output and venous return	1. Explain the terms cardiac output, stroke volume, end-diastolic volume and end-systolic volume. 2. Explain Starling's law of the heart. 3. Explain the term venous return, its relationship to stroke volume and discuss factors affecting it. 4. Explain the role of nervous system, hormones and body temperature in the control of cardiac function. 5. Explain how cardiac output is regulated.	2hrs	Lecture	
3.Flow dynamics **3.1 Blood flow through the vascular tree**	1. State the factors affecting blood flow. 2. Explain the term peripheral resistance. 3. Explain the nervous, mechanical, hormonal and local factors (endothelial) affecting peripheral resistance. 4. Explain the causation of arterial and venous pulsations with venous pressure waves. 5. Define pre-load and after-load. 6. Describe microcirculation with special reference to the structure of a typical	2hrs	Lecture	

	capillary bed, pre and post- capillary sphincters, metarterioles, endarteries.			
3.2 Examination of arterial and venous pulses	i. Explain the basis of examination of the arterial and venous pulses. ii. Examine arterial pulses at different sites. iii. Examine venous pulses.	3hrs	Practical	Practical to combine with Blood pressure
4.Blood pressure **4.1 Blood pressure and its regulation**	1. Explain the terms systolic, diastolic, mean arterial and pulse pressure and their relationship to each other. 2. Describe the relationship between peripheral resistance, cardiac output and blood pressure. 3. Explain the mechanisms of short-term and long-term regulation of blood pressure	2 hrs 2 hrs	Lecture SGD	SGD to cover all above topics
4.2 Measurement of blood pressure	1. Explain the basis of blood pressure measurement. 2. Measure systolic and diastolic blood pressure.	3 hrs	Practical	*Practical to combine with arterial and venous pulses

5.Tissue fluids	1. Explain the process of tissue fluid formation in terms of Starling forces. 2. Discuss the factors causing oedema giving examples, and their clinical importance.	2 hrs	Lecture	
6.Cardiovascular system examination	1. Explain the basis of examination of the cardiovascular system. 2. Perform a complete cardiovascular examination.	3 hrs	Practical	
7.Circulation through special regions	1.Explain the special features of the following regional circulations with respect to their functions: a. Skin b. Splanchnic c. Renal d. Cerebral e. Muscle f. Coronary	3hrs	Lecture	
8.Hypovolaemia and shock	1. Explain the physiological changes and compensatory mechanisms that occur in the cardiovascular system in varying degrees of blood loss. 2. Explain the changes that occur in all body systems in different types of shock. 3. Describe the neural, hormonal and metabolic responses to shock	2 hrs	Lecture	

9.Dehydration	1. Explain the regulatory mechanisms which maintain extracellular fluid (ECF) volume and osmolarity. 2. Explain the basis of different forms of dehydration	1hr	Lecture	
Roundup session	1. Discuss the physiological basis of oedema, dehydration and hypovolaemia	2 hrs	SGD	
10.1Mechanics of Breathing	1. Explain the role of atmospheric pressure, alveolar pressure and airway resistance in determining airflow in and out of the lungs. 2. Explain the role of elastic recoil of the lungs and the chest wall in breathing. 3. Describe the sequence of events which occur during normal and forced expiration. 4. Define the terms alveolar pressure, intrapleural pressure and transpulmonary pressure and state their magnitude at the end of a quiet respiration. 5. Define and explain the following terms: anatomic dead space, physiologic dead space, wasted (dead space) ventilation, total minute ventilation and alveolar minute ventilation. 6. Explain the term lung compliance and describe the factors affecting compliance. 7. Draw a normal pulmonary pressure-volume (compliance) curve. 8. Describe the role of surfactant in maintaining alveolar surface tension. 9. Define the term airway resistance.	3hrs	Lecture	

	10. Explain the factors controlling airway resistance. 11. Define the following terms: Dynamic lung compliance, static lung compliance, closing volume and closing capacity. 12. Describe how airway resistance alters dynamic lung compliance. 13. Define the different lung volumes, capacities and flow rates. 14. Describe the mechanisms responsible for the changes in the above volumes, capacities and flow rates in obstructive and restrictive lung diseases.			
10.2 Assessment of Lung Function	1. Describe the basis of measuring lung volumes using spirometry. 2. Explain the terms tidal volume, expiratory reserve volume, inspiratory reserve volume, vital capacity, functional residual capacity, total lung capacity, residual volume, forced vital capacity, FEV1, peak expiratory flow rate, Vmax50 and Vmax25. 4. Perform peak flow rate measurements. 5. Identify nomograms and determine lung volumes and capacities using nomograms. 7. Differentiate between restrictive and obstructive lung diseases using the spirogram.	3 hrs	Practical	

11.Gas exchange, diffusion of gases, and perfusion in the lung	1. Define the terms "partial pressure" and "fractional concentration". 2. List the normal fractional concentrations and sea level partial pressures for O_2, CO_2, and N_2. 3. Explain O_2 and CO_2 composition of alveolar gases. 4. State the alveolar and blood gas pressures and discuss the factors that determine alveolar gas pressure. 5. Describe the process of gas exchange at the lungs in terms of the respiratory membrane, factors affecting gas exchange, role of diffusion and diffusing capacity. 6. Explain the oxygen cascade 7. Describe the functional anatomy, pulmonary vascular pressures and capillary dynamics of the pulmonary circulation. 8. Describe the regional differences in pulmonary blood flow in an upright person. Define zones I, II, and III in the lung, with respect to pulmonary vascular pressure and alveolar pressure. 9. Describe the consequence of hypoxic pulmonary vasoconstriction on the distribution of pulmonary blood flow. 10. Define the term "ventilation-perfusion (V/Q) ratio" and explain how it is affected by the vertical distribution of ventilation and perfusion in the healthy lung. 11. Explain the term V/Q mismatch. 12. Explain the term RQ (respiratory quotient).	3 hrs	Lecture	

12.Transport of Respiratory Gases	1. Explain the relationship between PO_2 and dissolved plasma O_2 content (Henry's Law). 2. Describe the oxygen-Haemoglobin dissociation curve and explain how the curve shifts under different conditions. 3. Explain Bohr and Haldane effects. 4. Explain oxygen carrying capacity and oxygen delivery to tissues.	2 hrs	Lecture	
13.Hypoxia	1. List the different types of hypoxia. 2. Explain the causes and basis for the clinical features and treatment of different types of hypoxia.	1hr	Lecture	
14.Regulation of Respiration	1. Describe the regions in the CNS that play important roles in the generation and control of cyclic breathing. 2.Explain the factors affecting rate and rhythm of respiration. 3. Describe the reflexes involving pulmonary receptors that influence breathing frequency and tidal volume. 4. Explain the role of peripheral and central chemoreceptors in the control of ventilation. 5. Describe how changes in arterial PO_2 and PCO_2 alter alveolar ventilation, including the synergistic effects when PO_2 and PCO_2 both change. 6. Explain the changes in respiratory drive when oxygen is given to a COPD patient.	1hr	Lecture	

15.Non-respiratory functions of the respiratory system	1. Describe the defense mechanisms in the lungs and upper airways including mucociliary clearance, cough, sneezing and alveolar macrophages. 2. Describe the role of the upper airways in warming and humidifying inspired air. 3. Describe other functions of the respiratory system (e.g. metabolic and olfactory functions, phonation).	1hr	Lecture	
16.Role of respiration in acid base balance	1. Define the terms 'acid', 'base' and explain the "Henderson Hasslebach equation". 2. Explain the different buffer systems in the body. 3. Explain the role of respiration in acid-base balance.	1hr	Lecture	
17.Respiration in special circumstances **a. Exercise**	1. Explain the changes in the following parameters during aerobic and anaerobic exercise: Cardiac output, Blood pressure, Pulmonary vascular resistance, skeletal muscle blood flow. 3. Explain the local regulation of blood flow and the role of capillary reserve in altering skeletal muscle blood flow. 4. Define VO_{2MAX} and identify factors affecting it 5. Describe the significance of the feed forward control of ventilation (central command) during exercise, and the effects of exercise on arterial and mixed	2 hrs 3hrs	Lecture Practical	Combined SGD for regulation, exercise, high altitude and diving Practical: muscular exercise + physical fitness

	venous PCO_2, PO_2, and pH. 6. Define the effects of training on the heart, coronary circulation and skeletal muscle and how these changes contribute to an increase in VO_{2MAX}. 7. Explain how each of the following can affect exercise performance: muscle fatigue, VO_{2MAX}, anaerobic threshold, gender, and age.			
b. Acclimatization to high altitude	1. Explain the changes in PO_2 in inspired air with increasing altitude. 2. State the altitude at which acute effects of hypoxia are felt. 3. Describe the acute effects of hypoxia. 4. Explain the mechanisms of changes in the following parameters in acclimatization to high altitude: ○ pulmonary ventilation ○ RBC count and Hb ○ diffusing capacity ○ tissue vascularity ○ tissue utilization of oxygen 5. State the anthropometric and physiological changes that are seen in natural acclimatization (adaptation) of those individuals native to high altitudes.	2 hrs	Lecture	
c. Deep-sea diving	1. Describe the physiological changes that occur during deep-sea diving. 2.Describe the effects of hyperbaric N_2 narcosis.	1 hr	Lecture	

18.Heart failure	1. Explain the haemodynamics and the basis of clinical features in right and left heart failure.	2hrs	Lecture	
19.Cardiac Murmurs and shunts	1. Explain how abnormal heart sounds are produced and their timing in relation to the cardiac cycle. 2. Explain the haemodynamic changes that take place with valvular problems and septal defects of the heart.	2 hr	Lecture	
20.Respiratory insufficiencies	1. Explain the physiological derangement in restrictive and obstructive respiratory diseases. 1. Explain the basis of type 1 and type 2 respiratory failures.	1hr	Lecture	
Roundup Session	1. Discuss the physiological basis of cardio-respiratory derangements	2hrs	SGD	
21.Clinical examination of the respiratory system	1. Perform a physical examination of the respiratory system.	3hrs	Practical	
22.Tests of Cardiovascular Autonomic functions	1. Explain the basis of the tests of autonomic function. 2. Describe the Valsalva manoeuvre, the changes in physiological parameters and the basis for those changes. 3. Perform the following tests of autonomic function: Valsalva manoeuvre Deep breathing test Test for orthostatic hypotension	1hr 3hrs	lecture Practical	
23. Basic life support	1. Explain the importance of the Basic Life Support (BLS). 2. Perform BLS.	1hr 3hrs	Lecture Practical	With Dept of Anaesthesia

24. Mastication, saliva and taste	1. Describe the functional anatomy of the tongue and taste buds. 2. Describe the role of mastication in digestion. 3. State the importance of saliva in digestion, its composition, how the ionic composition is modified by passage through the ducts. 4. Explain the factors concerned in the regulation of salivary secretion. 5. Describe the conditioned reflexes involved in salivary secretion. 6. Explain the role of saliva in oral hygiene.	1 hr	Lecture	
25. Swallowing	1. Describe the three stages of swallowing in terms of mechanics and nervous control. 2. Describe the nervous control, mechanics and function of the lower oesophageal sphincter (LOS).	1 hr	Lecture	
26. General organization of the alimentary canal to perform its function	1. Describe the electrical and contractile properties of gastrointestinal smooth muscle. 2. Explain the neural control of gastrointestinal function.	1 hr	Lecture	
27. Stomach and gastric secretion	1. Describe a typical oxyntic gland and list the secretions from each type of cell in the gland. 2. Explain the role of each of the secretions in digestion and absorption. 3. Explain the mechanism of secretion of HCl from the parietal cell. 4. Explain the nervous, hormonal and chemical regulation of gastric secretion. 5. Explain the role of gastric secretion in the aetiology of peptic ulcer.	1 hr	Lecture	
28. Gastric emptying	1. Describe the motor functions of the stomach including gastric emptying. 2. Describe the factors that determine gastric emptying.	1hr	Lecture	

29. Secretory processes in the small intestine	1. Describe the secretary functions of the duodenum, jejunum, ileum, pancreas and gall bladder. 3. Describe the neuronal and hormonal control of the above secretions.	2hrs	Lecture	
30. Colonic movements and functions of the large intestine	1. Describe the movements of the colon including the rectum. 2. Describe the absorptive and synthetic functions of the colon.	1 hr	Lecture	
31.Defaecation	3. Describe the structures and neural pathways which are important in maintaining the defaecation reflex. 4. Describe the sequence of events leading to defaecation.			
32. Dysfunctions of GIT motility	1. Explain the mechanism of vomiting, including the location and connections of the vomiting center and the role of the chemoreceptor trigger zone. 2. Describe the basis of common GIT disorders (vomiting, reflux, achalasia, diarrhoea)	1+1 hrs	Lecture	1st lecture – Physiology 2nd lecture - clinician
33. Physiology of jaundice	1. List the types of jaundice. 2. Explain the basis for clinical features and investigation findings in different types of jaundice.	2 hrs	Lecture	