

B. Sc (Perfusion Technology) Model Syllabus

Subjects

- 1 Anatomy
- 2 Physiology
- 3 Biochemistry
- 4 Pharmacology
- 5 Microbiology
- 6 Pathology
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- 9 Applied Physiology
- 10 Applied Pathology
- 10 Physics for Perfusionists
- 12 Applied Pharmacology
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- 16 Perfusion for Special Procedures
- 17 Advanced Perfusion Techniques
- 18 Pediatric Perfusion

Applied Anatomy

1. **ANATOMY OF CARDIOVASCULAR SYSTEM**
 - Gross anatomy and structural features of heart
 - GREAT VESSELS: Structure of blood vessels and its organization.
2. **ANATOMY OF RESPIRATORY SYSTEM**
 - Organization of the respiratory system
 - Gross structure and features of trachea and bronchial tree
 - Gross structure and histology of lungs

Pulmonary circulation – pulmonary arteries, pulmonary veins and bronchial arteries.
3. **ANATOMY OF NERVOUS SYSTEM**
 - Brain – location, gross features, parts, functional areas, cerebral blood circulation.
 - Spinal cord – gross features, extent, blood supply and coverings.
4. **ANATOMY OF RENAL SYSTEM**
 - Organization of renal system
 - Kidneys: location, gross features, structure, blood supply and nerve supply
 - Ureters and urinary bladder – location, gross features and structure.

APPLIED PHYSIOLOGY

1 **Physiology of cardiovascular system**

- INTRODUCTION – Functions of CVS and blood circulation. Tissue perfusion and microcirculation
- CARDIAC CYCLE – Various phases
 - Cardiac output – definition, measurements, regulation and control
 - Stroke volume, Arterial pressure and its regulationPeripheral resistance, Venous return, Heart rate
- LOCAL
 - Vasodilation, Auto regulation (myogenic theory)
 - Vasodilator metabolites, kinins and vasoconstriction
- SYSTEMIC
 - Circulatory vasoconstrictors
 - Neural and hormonal regulatory mechanism
 - Cardio inhibitory center
 - Baro and chemo receptors
 - Movement of fluids and dissolved solutes in the body
 - Basics of electro cardio gram – Definition, electrical condition, atrial activation, atrial complex, ventricular activation, ventricular complex and normal values

2 **PHYSIOLOGY OF RESPIRATORY SYSTEM**

- Upper airway – nose, pharynx, larynx
- Lower airway – trachea bronchial tree
- The mucus blanket – mucus and cilia
- Lung parenchyma – alveoli, gaseous exchange, alveolar macrophages and surfactant.
- Physics of ventilation – principles of elasticity compliance and airway resistance.
- Mechanism and regulation of respiration
- Principles of gaseous exchange
- Concept of physiological shunt and its effect Brief concept of artificial ventilation

3 **HAEMATOLOGY**

- Components of blood – their normal values and functions
- Blood groups and briefly procedures involved in blood transfusion
- Briefly coagulation factors and coagulation cascade (Hemostasis)

4 **PHYSIOLOGY OF RENAL SYSTEM**

- Organization and functions of renal system
- Renal circulation and glomerular filtration rate
- Mechanism of urine formation and excretion
- Renal function tests

APPLIED PATHOLOGY

1 **CARDIOVASCULAR SYSTEM**

a. Congenital Heart Disease and Surgical Treatment

b. Acquired Heart Disease and Surgical Treatment

- Atherosclerosis
- Ischemic heart disease
- Valvular heart disease
- Cardiac hypertrophy and hypertensive heart disease
- Cor pulmonale and pulmonary hypertension
- Myocarditis
- Cardiomyopathies
- Pericardial disease
- Endocrines and the heart
- Heart tumors
- Arrhythmias and conduction disorders
- Diseases of the aorta: Aneurysms and dissections

2 **HAEMATOLOGY**

- Anaemia – definition, morphological types and diagnosis of anemia
brief concept about haemolytic anaemia and polycythemia.
- Leukocyte disorders – briefly leukaemia, leukocytosis,
agranulocytosis etc.,
- Bleeding disorders – definition, classification, causes and effects of
important types of bleeding disorders. Briefly various laboratory tests
used to diagnose bleeding disorders.

3 **RESPIRATORY SYSTEM**

- Chronic obstructive airway diseases – definition and types
- Briefly concept about obstructive versus restrictive pulmonary diseases
- Pulmonary congestion and edema
- Pleural effusion – causes, effects and diagnosis
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4. **RENAL SYSTEM**

- Clinical manifestation of renal diseases
- Briefly causes, mechanism, effects of acute renal failure and
chronic renal failure. Briefly glomerulonephritis and pyelonephritis
Brief concept about obstructive uropathy

APPLIED PHARMACOLOGY

1. **Cardiovascular drugs**
 - Antihypertensives
 - Beta Adrenergic antagonists
 - Alpha Adrenergic antagonists
 - Peripheral Vasodilators
 - Calcium channel blockers
 - Antiarrhythmic drugs
 - Cardiac glycosides
 - Sympathetic and non sympathetic inotropic agents.
 - Coronary vasodilators.
 - Antianginal and anti failure agents
 - Lipid lowering & anti atherosclerotic drugs.
 - Drugs used in Homeostasis – anticoagulants Thrombolytics and antithrombolytics, Fibrinolysis inhibitor
 - Cardioplegic drugs- History, Principles and types of Cardioplegia.
 - Priming solutions – History, principles & types.
 - Drugs used in the treatment of shock.

2. **Pharmacological protection of organs during CPB**

3. **Inhalational gases and emergency drugs.**

4. **Corticosteroids** – Classification, mechanism of action, adverse effects and complications. Preparation, dose and routes of administration.

5. **Diuretics**

6. Detailed review of drugs and fluids commonly added to the pump by the perfusionist and/or anaesthetist
 - Mannitol
 - Sodium bicarbonate
 - Cardioplegic solutions
 - Potassium, magnesium, and calcium ions
 - * Heparin
 - * Blood and blood products
 - * Crystalloid and colloid solutions
 - * Vasoactive drugs
 - Anaesthetic vapour agents

PHYSICS FOR PERFUSIONISTS

An introduction to the properties of liquids and gases and the medical application of pressures in fluids and the cardiovascular system, mass and heat transfer as they apply to equipment used in extra- corporeal perfusion.

1. Introduction to thermal sciences, review of calculus
2. Pressure, hydrostatics, and intro concepts in thermodynamics
3. Conservation of mass
4. The first law of thermodynamics and mechanical energy balance
5. Applications of conservation of energy
6. Integral conservation of linear momentum
7. Concepts in cardiovascular fluid mechanics
Flow through tubes
8. Intro to differential analysis and the continuity equation
9. The Navier-Stokes equations
10. Transport applications in cardiopulmonary bypass: oxygenation and ultrafiltration
11. Mass transfer and the differential component mass balance
12. Gas laws, solubility of gases
13. Volume, pressure, flow
14. Mass, density, viscosity
15. Heat units, temperature scales, heat transfer
16. Diffusion/osmosis
Molarity, concentrations
S.I. units

PERFUSION TECHNOLOGY

1. Basics of diagnostic techniques-

1. Chest of X-ray, ECG, Angiography, Echo
2. Laboratory investigations in relation to perfusion technology

2. Monitoring and instrumentation-

1. Instrumentation technology of ECG machine, pressure transducers, syringe and peristaltic pumps, monitors, ventilators, pulse oximeters, temperature probes and thermo regulatory monitoring, defibrillators.
2. Hemodynamic monitoring, Haemostatic monitoring.
3. Maintenance of oxygen, carbon dioxide and acid base status and their monitoring

3. Physiology of extra-corporeal circulation

1. Assessment of patients before bypass; going on & coming off bypass.
2. Hemodilution and priming solutions
4. Principles of extracorporeal gas exchange
5. Analyzing & correction of ABG, VBG and other blood investigations

4. Perfusion Equipment - Hardware:

1. Heart-lung machines/centrifugal pumps
2. Pressure and low level alarm devices
3. Heart-lung heater/coolers
4. Mechanical/electronic flow meters, blenders
5. Perfusion data's recording, store keeping
6. In-line oxygen saturation devices
7. In-line blood gas devices
8. Oxygen analyzers
9. Cell savers
10. Intra-aortic balloon pump

5. Support of Cardiac Operation Theatre Techniques

- Monitoring
 - Setup for ECG and intravascular pressure monitoring
 - Coronary artery and graft flow measurement
- Resuscitation and support
 - Catheterisation
 - Angiography
 - Angioplasty
 - EPS Studies
 - Valvuloplasty
 - Intra-aortic balloon

6. Blood Transfusion Techniques

- Blood grouping
- Minor and Major cross matching
- Venous Sample Collection
- Storing Techniques of Blood Products
- Blood collection from Donor
- Separation of the Blood products

PATHOPHYSIOLOGY OF CPB

1. **Blood cells trauma & Anticoagulation in bypass: its monitoring and complications Blood conservation & Auto transfusion**
 - Risks of blood transfusion
 - Blood conservation techniques
2. **Myocardial Protection & Cardioplegia**
 - History
 - Various methods of myocardial protection
 - Reperfusion injury, oxygen free radicals ,myocardial edema
 - myocardial protection for specific clinical problems
 - problems during Cardioplegia delivery
 - Hot shot
- 3 **Effects of CPB**
 - Immune and inflammatory response
 - Fluid balance and interstitial fluid accumulation
 - Nervous system
 - Renal function
 - The lungs
 - The liver
- 4 **Hypothermia**
 - Physiology
 - Deep Hypothermic Circulatory Arrest
 - Alterations with temperature change
 - Acid-base
 - Organ function

CLINICAL APPLICATION OF CPB TECHNIQUES

1. **Conduct, Monitoring & Termination of CPB**
 - Check lists
 - * Flow/pressure
 - * Hemodilution
 - * Acid/base balance
 - * Oxygen and carbon dioxide exchange
 - * Patient core temperature
 - * Anticoagulation
 - * Hypothermia
 - * Pressure, flow, resistance
 - * Adequacy of perfusion
 - * Myocardial preservation
 - General bypass
 - Coronary
 - Valvular
 - Re-Operations
 - Congenital
 - Fem-Fem bypass Emergency
2. **Accidents and safeguards**

PERFUSION FOR SPECIAL PROCEDURES

1. **Aortic Surgery**
2. **Management of Unusual Problems & Special Consideration in Perfusion**
 - I. **Sickle cell**
 - A. Pathophysiology
 - B. Considerations for CPB
 - C. Other blood disorders
 - II. **Methemoglobinemia**
 - A. Pathophysiology
 - B. Considerations for CPB
 - III. **Thalassemia**
 - IV. **Spherocytosis & elliptocytosis**
 - V. **Hemosiderosis & hemochromatosis**
 - VI. **Erythroblastosis fetalis**
 - VII. **Hereditary coagulation disorders**
 - A. Von Willebrand's disease
 - a) Type I
 - b) Type II
 - c) Type III
 - B. Hemophilia A
 - C. Hemophilia B
 - VIII. **Acquired coagulation disorders**
 - A. Disseminated intravascular coagulation (DIC)
 - B. Primary fibrinolysis
 - C. Vitamin K dependent deficiency
 - IX. **Platelet disorders**
 1. Thrombocytopenia
 2. Cold Agglutinin
 - X. **Perfusion techniques for Pregnant Patients.**
 - XI. **Malignant Hyperthermia.**

ADVANCED PERFUSION TECHNIQUES

1. ECMO
2. Counter pulsation and VENTRICULAR ASSIST DEVICES(VAD)
3. Minimally Invasive Cardiac Surgery(MICS)
4. Perfusion for Non cardiac Procedures
 - Liver transplant
 - Isolated Limb Perfusion
5. Recent advances in Perfusion Techniques

PEDIATRIC PERFUSION

1. Preparation for CPB: Equipment
Preparation of the Patient for CPB
 2. Blood Flow, ECC component and circuit selection
Cannulation
 3. Priming
Conduct of Bypass
CO2 management & Choice of Acid Base management
Fluid Management and Drug management during CPB
Myocardial Protection
 4. ECMO for Neonates, Infants and Children – Components
Circulatory assist devices for Infants and children
Blood Conservation Techniques
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1. Preparation for CPB:
Equipment Preparation of the Patient for CPB
 2. Blood Flow, ECC component and circuit selection Cannulation
 3. Priming
Conduct of Bypass
CO2 management & Choice of Acid Base management Fluid
Management and Drug management during CPB Myocardial
Protection
 4. ECMO for Neonates, Infants and Children –
Components Circulatory assist devices for Infants and children
Blood Conservation Technique

