

**II CPT BSC PERFUSION TECHNOLOGY  
PERFUSION TECHNOLOGY – QUESTION BANK**

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## **ESSAY (15MARKS)**

1. **Discuss the blood pumps used in cardiopulmonary bypass.**
  - Characters of an ideal pump
  - Classification of pump
  - Rotary pump
  - Displacement pump
  - Working principles of pump
  - Clinical implications of working principles
  - Fluid dynamics
  - Safety issues and accidents with pumps
  - Advantages
  - Disadvantages
  - Complications
  - Applications
  
2. **Discuss the monitoring of anticoagulation during cardiopulmonary bypass.**
  - Definition
  - Heparin
  - Pathways of coagulation
  - Heparin metabolism and elimination
  - Variables affecting ACT
  - Definition
  - ACT levels during CPB
  - Heparin resistant patient
  - Heparin dose
  - Factor consumption
  - Sub-therapeutic heparin
  
3. **What are the components of a cardiopulmonary bypass circuit. Differentiate between positive displacement and centrifugal pumps. Add a note on cavitation effect.**
  - Definition
  - Pumps
  - Cannulae
  - Tubing

- Reservoir
  - Oxygenators
  - Heat exchanger
  - Arterial line filters
  - Centrifugal pump
  - Positive displacement pumps
  - Cavitation - Definition
  - Types
  - Causes
  - Principles
  - Heparin
4. What are the drugs used for anticoagulation on CPB. What are the congeners of heparin and mention its advantages. Define protamine and list the different protamine reactions.
- Definition
  - Congeners
  - Low molecular weight heparin
  - Hirudin
  - Dermatan sulphate
  - Bivalirudin
  - Advantages of congeners of heparin
  - Protamine – Definition
  - Protamine reactions
  - Definition
  - Classification:
  - Horrow classification
  - Moorman, Zapol, Lowestein
5. Hemodynamics of cardiopulmonary bypass.
- Monitoring during CPB
  - Definition
  - Classification
  - Hemodynamic monitoring
  - Pulse oximeter

- Pressure transducer
  - Mean arterial pressure
  - Mean line pressure
  - Central venous pressure
  - Urine output
  - Transesophageal echocardiography
6. Discuss the cardioplegia in detail.
- Alternative arresting agents and additives
  - Adenocaine
  - Agents affecting calcium transport
  - Crystalloid cardioplegia
  - Advantages
  - Disadvantages
  - Blood cardioplegia
  - Advantages
  - Disadvantages
  - Types
  - Miniplegia
7. Discuss the principles of gas exchange. Compare and contrast bubble and membrane oxygenators.
- Definition of oxygenators
  - Properties of ideal oxygenator
  - Types
  - Principles of gas exchange
  - Bubble oxygenator
  - Principle
  - Design
  - Heat and gas exchange
  - Advantages
  - Disadvantages
  - Membrane oxygenator
  - Principle

- Membrane configuration
  - Blood flow path
  - Parts of Membrane oxygenator
  - Advantages
  - Disadvantages
8. What are the characteristics of an ideal blood pump. Differentiate between pulsatile and non – pulsatile blood flow. What are the different types of blood pumps available and enumerate the advantages of each.
- Definition of blood pump
  - Classification
  - Ideal characteristics
  - Pulsatile perfusion
  - Benefits
  - Hemodynamics
  - Cell metabolism
  - Brain function
  - Kidney function
  - Pancreatic and liver function
  - Pulsatile perfusion system
  - Drawbacks
9. Discuss haemostatic monitoring during cardiopulmonary bypass.
- Monitoring during CPB
  - Types
  - Haemostatic monitoring
  - Definition
  - Heparin
  - Definition
  - History
  - Source
  - Uses
  - Types
  - Mechanism of action

- Dosage
- Alternatives of heparin
- Monitoring of heparin
- ACT management
- Protamine
- Definition
- Source
- Mechanism of action
- Dosage
- Protamine reactions

### **SHORT ANSWER (7 MARKS)**

1. Differentiate between bubble and membrane oxygenators
  - Definition
  - Types of oxygenators
  - Types of filters used in oxygenators
  - Working principle
  - Principles of gas exchange
  - Types of reservoirs used in oxygenators
  - Uses of different types of oxygenators
  - Difference between bubble and membrane oxygenators
  - Advantages
  - Disadvantage
  
2. Heat-exchanger
  - Definition
  - Working principles
    - Conduction, convection, radiation
  - Counter current mechanism
  - Cross current mechanisms
  - Use of heat exchanger
  - Q-10 effect
  - Material used in heat exchanger

- Heat exchanger failure and management
3. Arterial cannulae
- Definition
  - Types of cannulation
    - Arterial
    - Venous
  - Site of cannulation
  - Type of cannulae used in arterial cannulation
  - Peripheral cannulae-femoral artery
  - Aortic cannulae-ascending aorta
  - Example: basket tipped ,angled ,straight
4. Venting
- Definition
  - Types of venting
    - right heart venting
    - left heart venting
  - Purpose of venting
  - Various sites of venting
    - ascending aorta
    - indirect LV
    - direct LV
    - Direct LA
    - pulmonary artery
  - Combination associated with left heart venting
5. Gross's well technique
- Definition
  - Collection of blood from arterial site (2ml)
  - Respiratory acidosis &metabolic acidosis /Respiratory alkalosis &metabolic alkalosis
    - acidosis:ph decrease
    - alkalosis: ph increase

- respiratory acidosis: pH decrease & pCO<sub>2</sub> increase
- respiratory alkalosis: pH increase & pCO<sub>2</sub> decrease
- metabolic acidosis: pH decrease & HCO<sub>3</sub> decrease
- metabolic alkalosis: pH increase & HCO<sub>3</sub> increase

- Normal values of ABG
- Management & correction

## 6. Membrane oxygenators

- Definition
- Parts of membrane oxygenator
  - cardiotomy reservoir
    - Types: soft shell & hard shell
  - membrane

Types :

- microporous polypropylene
  - Hollow fiber structure
  - Flat shunt membrane
  - Integrated arterial filter
- True membrane
- Advantage
- Disadvantage

## 7. Compare and contrast centrifugal and roller pumps

- Roller pump
  - Principle
  - Tubing
  - Occlusion settings : unocclusive, occlusive & over occlusive
  - Blood handling
  - Non occlusive roller pump: working principle, safety benefits
- Centrifugal pump
  - History
  - Design or components: cone, plastic housing, shaft & magnet
  - Working principle
  - Advantage



- Disadvantage
- Complications
- Application

8. Azygous flow principle

- Principle:
- Azygous vein is a vein running up the side of thoracic vertebrae column drain into svc & ivc When the both venacava occluded with azygous vein was not damaged the resulting 10% of cardiac output was sufficient to sustain the vital organ safely

9. Deep hypothermic circulatory arrest

- Definition: The technique of core cooling combined with cessation of blood flow
- Is surgical technique that induced medical hypothermia
- it involves cooling the body temperature b/w 20-25c
- Stopping blood circulation and brain function upto 1hr
- It is used to promote better vision field during surgery
- Application of DHC: cardio thoracic surgery, neuro surgery ,caval mass resection
- Neuro protection during DHCA
  - hypothermia
  - hemodilution
  - selective ante grade cerebral perfusion
  - acid base balance

10. Oxygen dissociation curve

- The oxygen-hemoglobins dissociation curve plots the proportion of haemoglobin in its saturated form on the vertical axis against the prevailing oxygen tension on the horizontal axis
- Haemoglobin
- The curve
- P50
  - measure of haemoglobin affinity for oxygen

11. Delnido cardioplegia

- An experimental technique large blood vessels of two arteries are joined together

- To avoid excess pumping of blood from organism the heart of one partner be allowed to function in joint circulation system
- Diagram
- Azygous flow principle

#### 12. Controlled cross circulation

- Three minutes after heparin is given, arterial blood sample is drawn for ACT
- Blood is introduced into chamber
- If ACT > 480sec = minimum acceptable heparin level is maintained on CPB
- If ACT < 480sec = additional heparin should be added
- When the ACT is perform
- Trouble shoot for ACT
- Limitation of ACT

#### 13. Temperature probes.

- Device used to measure body temperature
- Types:
  - Thermistor : resistance changes with temperature & can be indicated on a meter
    - characteristics
  - Thermocouple : measure slight changes in temp
    - consisting 2 wires of diff wires
    - automatic difference b/w 2 metal causes development of temp & voltage when they are twisted together
- Uses of temperature probe

## **ANSWER BRIEFLY (5 MARKS)**

1. Boyles Law
  - Law stated that the pressure exerted by a gas is inversely proportional to the volume occupied by it at a constant mass and temperature.
  - Principle of gas exchange
  - Equation
  - Uses
  
2. Enumerate and briefly explain three types of venous drainage
  - Types of venous drainage
  - Principle and purpose
  - Explain each of them
  - Advantages and disadvantage
  - Uses
  
3. Pulse oximeter
  - Principle of pluse oximeter
  - Uses
  - Advantages and disadvantage
  - Working
  
4. Defibrillator
  - Defibrillator: definition
  - Principle
  - Indication
  - Advantages
  - Disadvantage
  
5. Flow meters
  - Definition
  - Principle of two basic pumps
  - Ultrasonic principle
  - Electromagnetic principle
  
6. Heparin

- Heparin
  - Describe it
  - Function
  - Source
  - Difference between porcine and bovine
  - Mechanism of action
  - Dosage of heparin
  - Antidote of heparin
  - Mechanism of action protamine
  - Alternative of heparin
  - Protamine reactions
7. Activated clotting time
- ACT
  - Definition
  - Activator used in ACT tubes
  - Uses
  - Two types (hemotec and hemochron)
  - Limitation of ACT
8. Controlled cross circulation
- Controlled cross circulation
  - Definition
  - Working
  - Diagram
9. Left heart venting
- Left heart venting
  - Sites of left heart venting
  - Explain each sites
  - Advantages and disadvantage
  - complications associated with left heart venting
10. Haemodilution
- Definition

- Benefits
  - Advantages and disadvantage
  - Priming fluids used in CPB
11. Mixed venous saturation monitoring
- Definition and effect in body
12. Pulsatile CPB
- Definition
  - Theories:
    - Energy equivalent pressure
    - Capillary critical closing pressure
    - Neuroendocrine reflex mechanism triggered by baroreceptor
    - Hematologic effect
    - Hemodynamic effects
    - Metabolic effects
13. Advantages of blood priming
- Definition of priming fluids
  - Types of priming fluid(crystalloid eg: RL, plasmolyte and colloid eg: albumin)
  - Uses
    - Adv: Reduced hemolysis
    - Increased blood volume
    - Dearing the circuit
    - Leak or damage can be identified
    - Hemodilution acceptable limit is useful and it's effect can be harmful
14. Thromboelastogram
- TEG is a non-invasive test that quantitatively measures the ability of whole blood to form a clot.
  - To access the strength of clot
  - Diagram and explanation
15. Advantages of leucofiltered blood
- Reduce the systemic inflammatory response in blood and reduce the inflammatory markers(cytokines, TNF , compliment activator etc...)

- Pore size
  - Application
16. Fetal circulation
- The fetal circulation is the circulatory system of a Human foetus, often encompassing the entire Fetoplacental circulation which includes the umbilical Cord and the blood vessels within the placenta that Carry foetal blood.
  - Diagram and explanation
  - Pathway
17. Complications of venting
- Complications of venting
  - Air embolism
  - Excessive suction another source of air embolism
  - Bleeding due to injury
  - Cause LV aneurysm or rupture
18. Syringe pump
- Syringe pump: It is particularly helpful under such circumstances as they are programmed to deliver drug through vein at a determined rate.
  - Working of syringe pump
  - Maintenances of pump
  - Ideal properties
19. Heat exchanger
- Definition
  - Working principles
  - Conduction, convection, radiation
  - Counter current mechanism
  - Cross current mechanisms
  - Use of heat exchanger
  - Q-10 effect
  - Material used in heat exchanger
  - Heat exchanger failure and management

## 20. Protamine

- Protamine: it is an antidote of heparin. mechanism of action: it binds to heparin to produce a stable precipitate which has no anticoagulant property
- Has mild anticoagulant effect independent of heparin
- Actions
- Source
- Dosage
- Protamine reaction