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, convention, 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:phdecrease & pCO2increase
    - respiratory alkalosis: ph increase &pCO2decrease
    - metabolic acidosis: pH decrease &HCO3 decrease
    - metabolic alkalosis:pH increase &HCO3 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 finer 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 & ivcWhen the both venacava occluded with azygous vein was not damaged the resulting 10% of cardiac outputwas 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
   - Stoping 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 (hemothec 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 trigged 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, convention, 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