SNS COLLEGE OF ALLIED HEALTH SCIENCES

SNS Kalvi Nagar, Coimbatore - 35

Affiliated to Dr MGR Medical University, Chennai

DEPARTMENT OF CARDIO PULMONARY PERFUSION CARE TECHNOLOGY

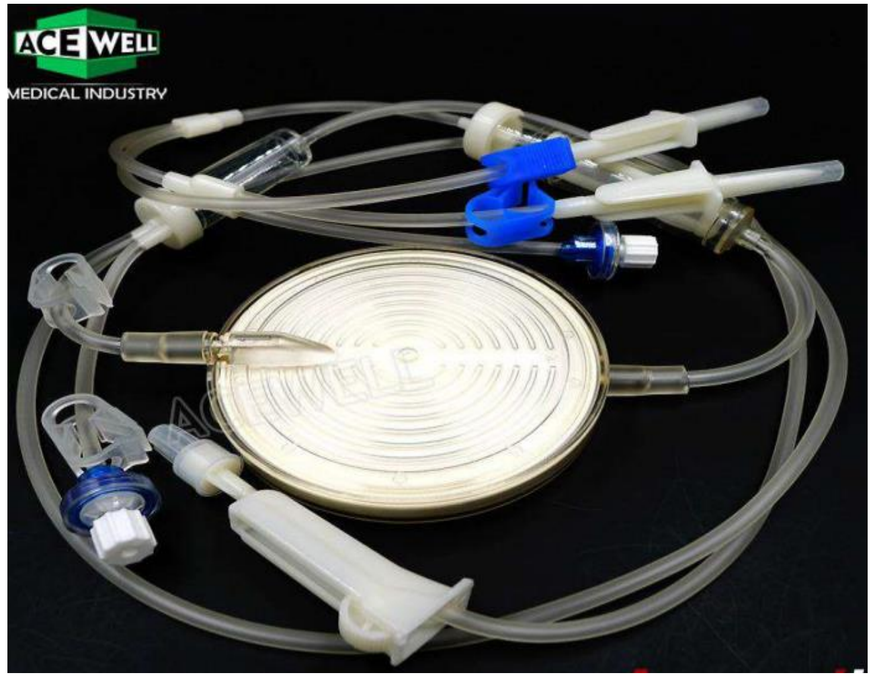
COURSE NAME : PRINCIPLES OF PERFUSION PART I

2ND YEAR

TOPIC : BLOOD FILTERS

LEUKOCYTE DEPLETION FILTER

- Leukocyte depletion filter contain non woven polyester fibers that have been surface modified to remove leukocytes.
- Neutrophil are important contributor to ischemia reperfusion injury. Neutrophils causes tissue injury by release of enzymes, reactive oxygen species and other toxic substances.
- Neutrophil filtration in CPB circuit has been proved beneficial to provide myocardial protection.
- LD filters may be placed in many different locations in the ECC, including arterial line, venous line and cardioplegia line.



Disadvantage:

- LD filters is that it adds further prime volume to the circuit.

ARTERIAL FILTER

- The arterial filters remove air and particulate matter while allowing passage of cellular elements of blood.
- In modern practice, screen arterial line filters are made of nylon or polyester are almost universally used generally with a pore size of 40µm. Surface area varies between 650 –800cm^2.

LIMITATIONS

- Relatively large priming volume (200ml) is required to prime the filters.

- Problems related to cellular components of blood – Hemolysis, platelet loss and complement activation.

- Lack of proven benefit

- A paradoxical risk of increased particulate embolism.

SPECIFIC ARTERIAL FILTER

- Pall Biomedical
- Terumo Capiox
- Dideco736

CARDIOTOMY FILTER

- Suckers return the blood from the surgical field to cardiotomy. This blood contains the usual suction debris such as fat particles and bone chips.
- Because of the turbulence of the suction, there are also large number of air bubbles in the carrying blood.
- Therefore the reservoir integrate a defoaming agent.
- When using the cardiotomy reservoir, the perfusionist use the “ unfiltered” cardiotomy, which usually has a pore size of 70 to 180 microns.
- They then filter the blood again prior infusing the patient. The use of a “filtered” cardiotomy with 30 – 40 microns filter will eliminate more particulate matter.

BANKED BLOOD FILTER

- Banked blood filters are usually incorporating as **40 microns** in size.
- This filters helps to **prevent clogging with debris.**
- This clogging would require the changing of a cardiotomy or a hardshell venous reservoir, with an integral cardiotomy.

GAS FILTER

- Gas filters are used to remove any particulate matter that come from the gas source.

- Gas filters are usually 0.2 microns in pore size.

- They usually have an arrow marking in the direction of flow, although some models are bi – directional.

CARDIOPLEGIA FILTER

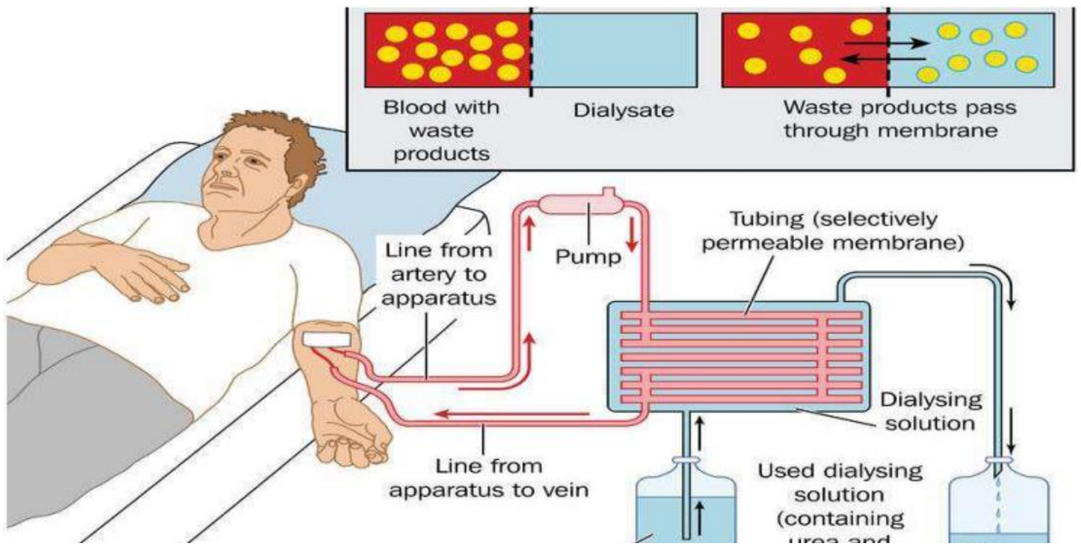
- Cardioplegia filters are available today to filter the crystalloid portion of the cardioplegia solution.

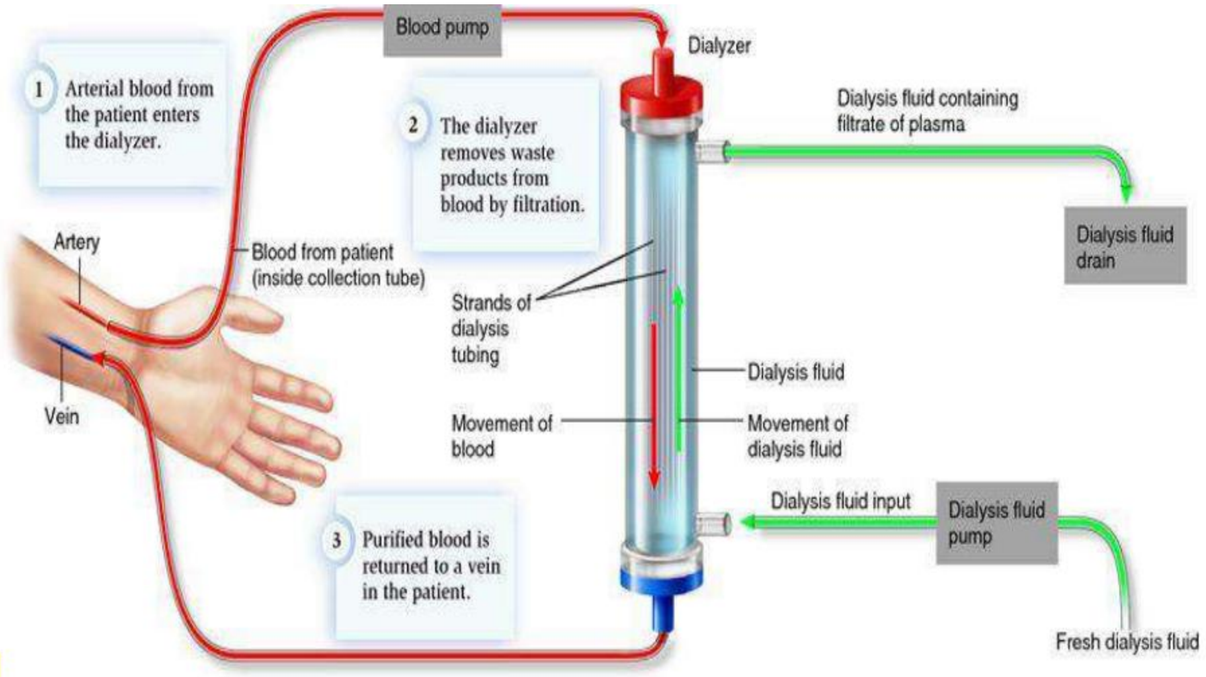
- These filters are in the 0.2 micron pore size range.

HEMOFILTER & ULTRAFILTRATION

- **DIALYSIS**

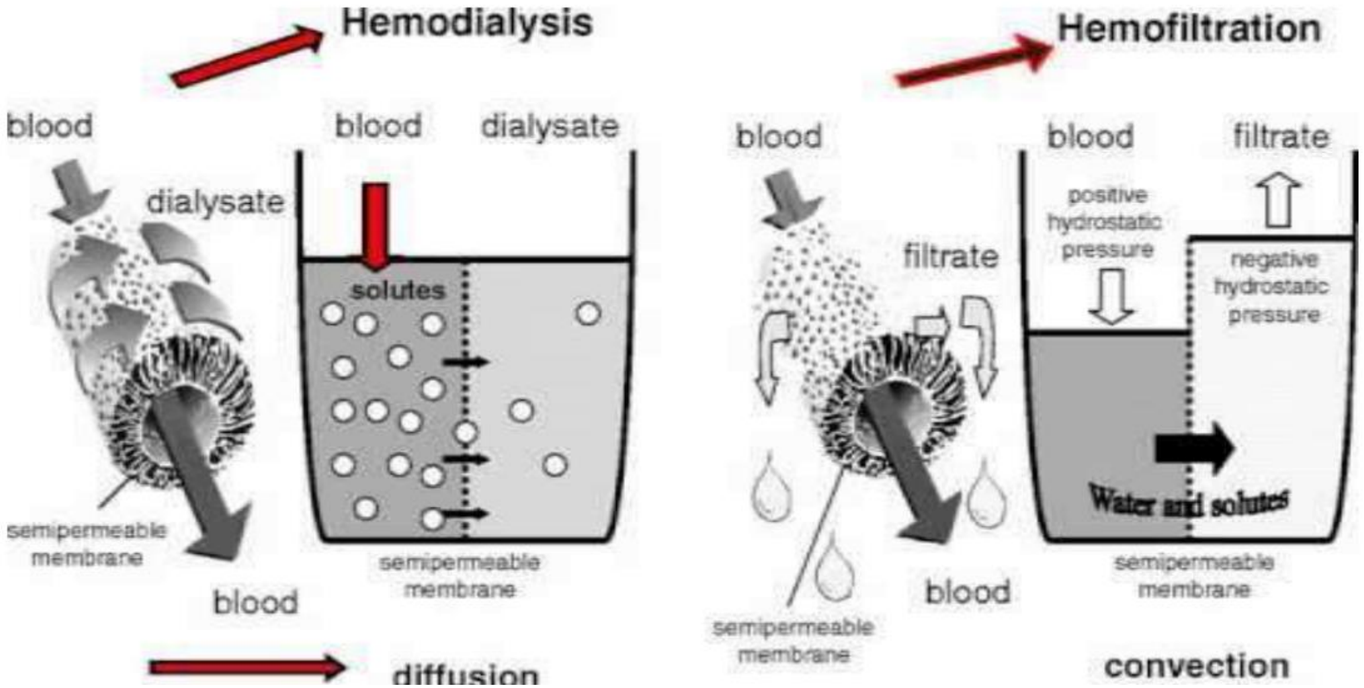
Dialysis refers to a process in which blood is separated from crystalloid solution or dialysate by a semi permeable membrane.





ULTRAFILTRATION

- Ultrafiltration refers to movement of water across a membrane due to transmembrane pressure gradient. No dialysate on the opposite side of membrane is required.



ULTRAFILTRATION

- It contains a semi permeable membrane that permits passage of water and electrolytes out of blood.
- The semi permeable membrane is manufactured in hollow fiber configuration.
- The hollow fibers are between 180 –200μm in diameter and the pores of microporous membrane are between 5 –10 nm.
- The rate of fluid depends on,
  - Membrane permeability
  - Blood Flow
  - Transmembrane pressure
  - Hematocrit.

ADVANTAGES OF ULTRAFILTRATION

- Ultrafiltration removes excess fluids
- Increased Hemocrit
- Decreased lung waters
- Decreased tissue edema
- Improves patient’s hemodynamics
- Improves cardiac contractility and oxygenation.
- Conserve platelets and coagulation factors that improve perioperative hemostasis.
- Conserve albumin.
- Reduces post operative ventilator support.

DISADVANTAGES

- Molecules up to a molecular mass of 20,000 Da
- At that time some heparin is removed and therefore, adequacy of heparinization should be checked

TYPES OF ULTRAFILTRATION

- Pre –Bypass ultrafiltration
- Conventional ultrafiltration
- Modified ultrafiltration
- Zero Balanced ultrafiltration

PRE BYPASS ULTRAFILTRATION

- The addition of bank blood to pump prime may elevate prime potassium, glucose, bradykinin, citrate, lactate levels. This may be deleterious especially to the neonate, whose blood volume is often less than the prime volume.
- The blood is then returned through cardiotomy reservoir.
- The advantages of the BUF is reduced cardiac impairment & pulmonary dysfunction.

Disadvantage:

- This technique has been shown to reduce the level of bradykinin, factor XIII, high molecular weight kininogen.

- BP drop is seen at the initiation of CPB.

Correction:

- Final prime electrolyte levels should be measured after pre – bypass ultrafiltration, this is to avoid removal, addition of certain priming drugs (mannitol, buffers).

CONVENTIONAL ULTRAFILTRATION

It refers to the practice of withdrawing blood from the patient through the venous reservoir during rewarming period when patient is on CPB, and passing it through the hemoconcentrator and pumping it back into the patient through venous reservoir

Technical consideration for conventional ultrafiltration

- Must have adequate volume in venous reservoir to safely remove ultrafiltrate.
- A level detector with automatic pump shut off should be used to prevent dangerously low reservoir volumes.
- The shut created by diverting arterial blood flow through the ultrafilter must be managed appropriately.

MODIFIED ULTRAFILTRATION

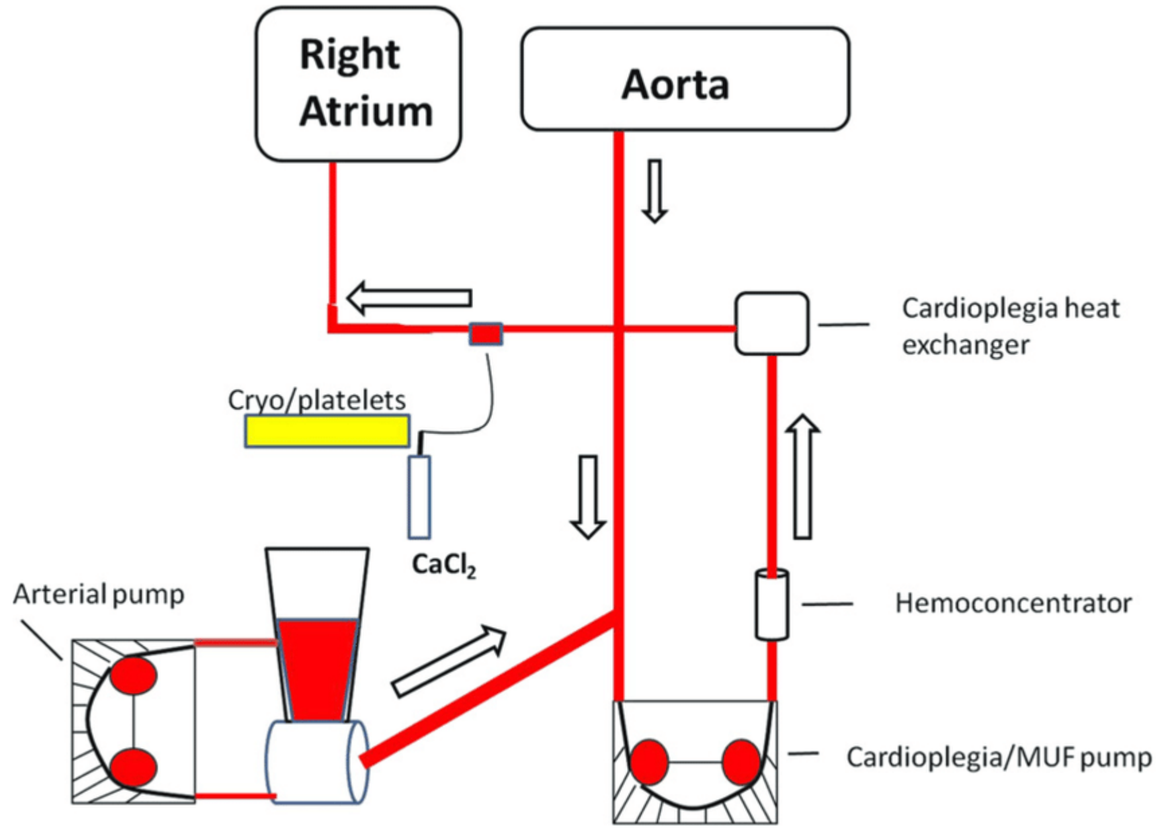
It refers to the practice of withdrawing blood from the patient through aortic cannula, after weaning from CPB and passing it through a hemoconcentrator and pumping it back into the patient through venous cannula.

Technical consideration for modified ultrafiltration:

- Delays protamine administration
- Air entrapment in AV –MUF mode caused by negative pressure generated in the arterial line.
- Patient temperature loss may occur during VV –MUF or when a heat exchanger is not used.
- Aggressive AV – MUF may result in carotid steal.
- Rate of MUF pump should be indexed to patient size (15 –30ml /kg /min).
- Concentration of heparin into the patient will occur.

ADVANTAGES OF MUF

- Decreased blood loss
- Fewer blood transfusion
- Increase in arterial blood pressure.
- MUF seems to be most effective in pediatric patients. This is due to the disparity in ratio of the circuit and patient volume.



DISADVANTAGES OF MUF

- Patient needs to remain cannulated for 10 –20 minutes after CPB termination and to maintain integrity of ECC, protamine should not be added to MUF.
- Air aspiration is the major concern. Because of the risk of air entering into arterial circuit. Antegrade flow should not be permitted once MUF is begun.
- Technically complex require prior planning

THANK YOU