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

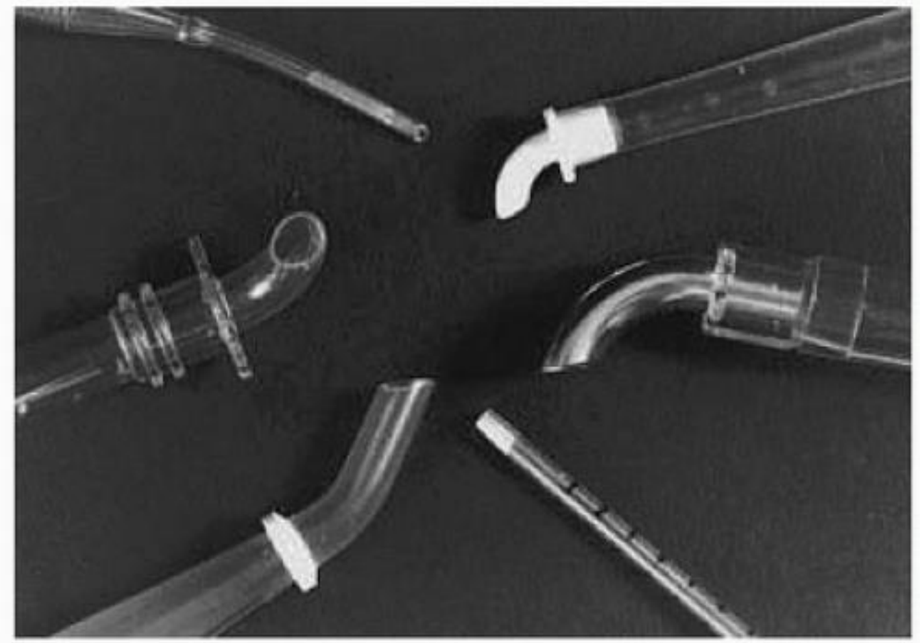
2ND YEAR

TOPIC : VENOUS CANNULATION

MS. KRIPA/LECTURER/SNSCAHS

CANNULAS

- The cannulae of the Cardiopulmonary bypass circuit include arterial cannula, venous cannula, antegrade and retrograde cardioplegia cannula, left ventricular vents, pulmonary artery vents and aortic root vents.

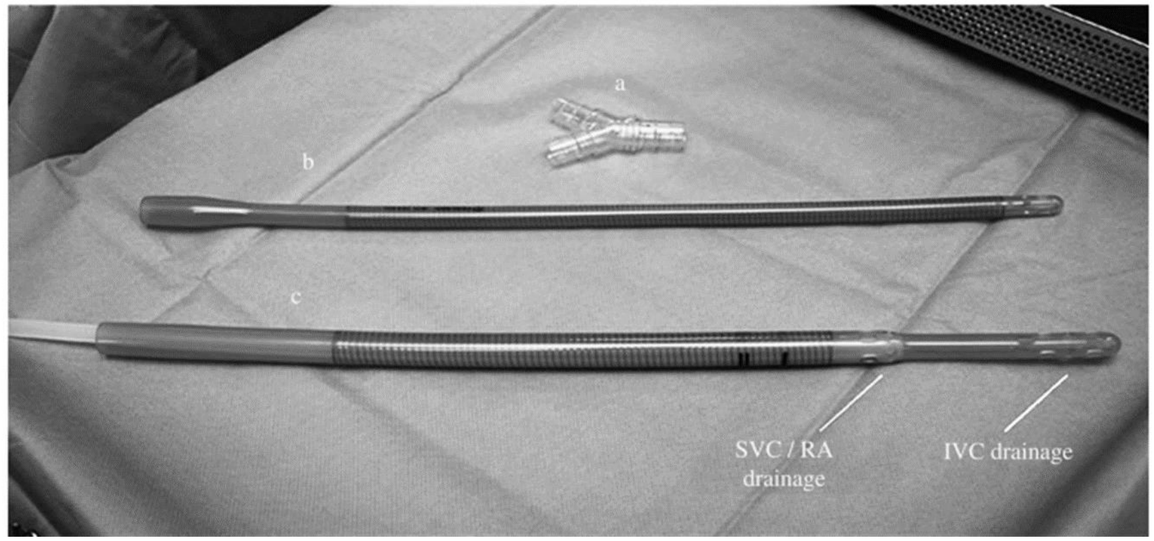


VENOUS CANNULA

- Venous cannulas are either ***single stage or two stage (cavoatrial) .***
- Cannulas are usually made of a ***flexible plastic***
- Most are wire ***reinforced*** to prevent kinking.
- They may be ***straight or right angled.***
- Some of the latter are constructed of ***hard plastic or metal*** for optimal inner diameter (ID) to outer diameter (OD) ratio.
- The venous cannulas are typically the narrowest component of the CPB venous system and thus are a limiting factor for venous drainage.

VENOUS CANNULA

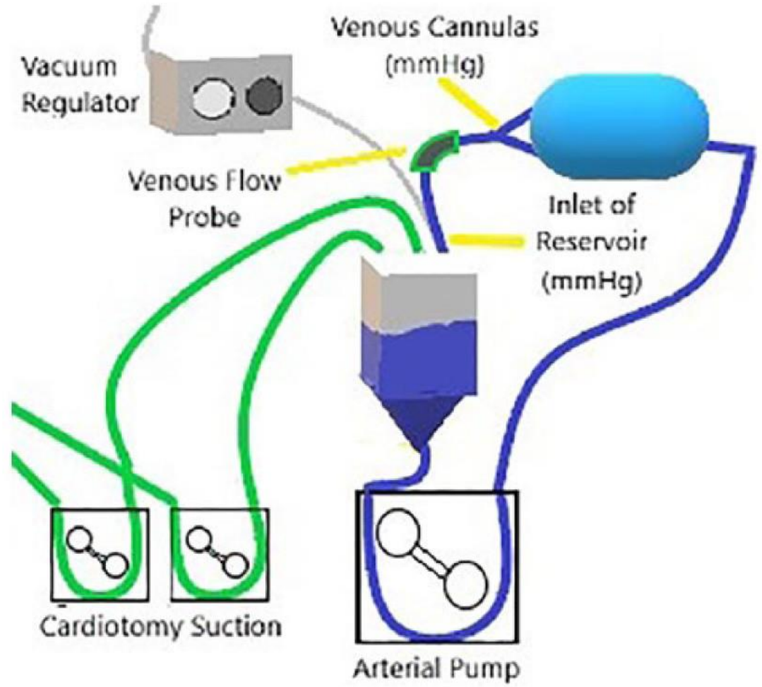
- Knowing the flow characteristics of the particular catheter, which should be provided by the manufacturer or established by ***bench-top testing***, and the required flow (about one third of total flow from SVC and two thirds of total flow from IVC), one can select the appropriate venous cannula for a patient.



VENOUS CANNULA

PRINCIPLES OF VENOUS CANNULATION:

- Venous cannulae flows are by gravity drainage.
- Higher the pressure drop greater is the resistance to flow, however lower the pressure drop, better the flow is. The pressure drop is inversely proportional to the size of the cannulae.
- Generally ***larger the venous cannulae lowers the pressure drop and better the flow is.***

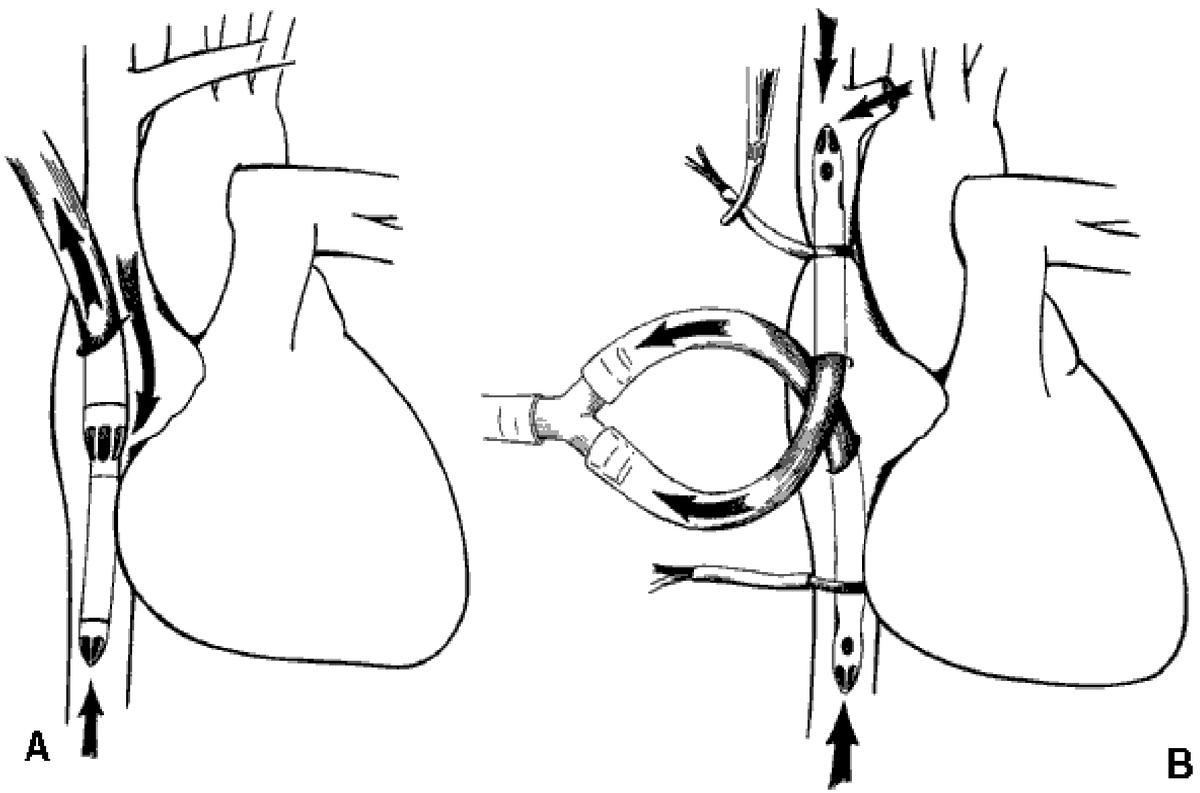


METHOD OF CANNULATION

Bicaval cannulation

Cavo atrial cannulation

Single atrial cannulation

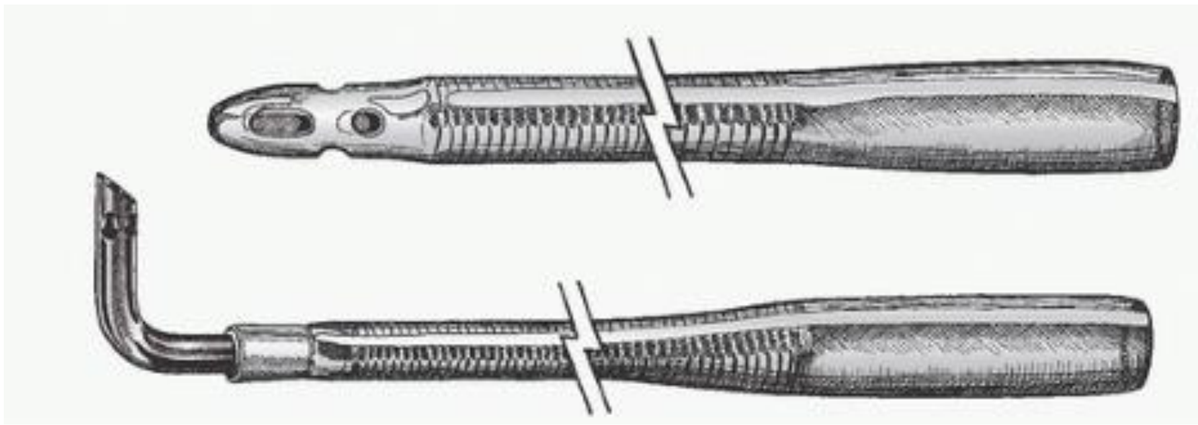


BICAVAL CANNULA

Bicaval cannula:

- This uses two single stage cannulae that sit in the inferior and superior vena cavae.
- The two stage cannula are connected using the Y-Connector to the venous line of the CPB circuit.
- Bicaval cannulation is generally used for procedures that require the ***cardiac chambers to be opened.***

Ex: ***MVR, Congenital Heart Diseases.***



TWO STAGE VENOUS CANNULA

Two Stage Venous Cannula:

- This stage involve cardiac surgery that does not involve opening the chambers of the heart.

Ex: ***coronary artery bypass grafting (CABG).***

- This is typically inserted through ***right atrial Appendage.*** The narrow tip of the cannula is in IVC where it drains the lower extremities, the wider portion with additional drainage holes, resides the RA, where the blood is received from the coronary sinus and SVC. The SVC must drain via RA when ***"cavoatrial" cannulation*** is used.

TWO STAGE VENOUS CANNULA

Cavo atrial or two stage venous cannula:

It is used routinely in,

CABG

Aortic valve procedures

AVR + CABG procedures

Bentall procedure.

The disadvantage of two stage venous cannula is, it rewarms the heart that leads to ***less myocardial protection.***

SINGLE ATRIAL CANNULA

SINGLE ATRIAL CANNULATION:

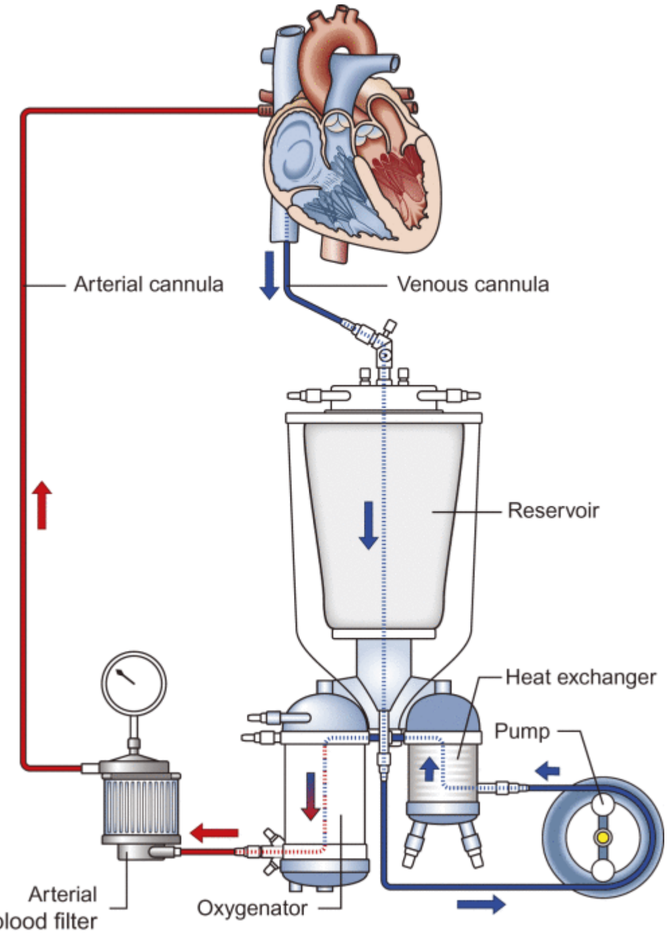
Directly into RA advantage of being simpler, faster, less traumatic with one less incision and provides fairly good drainage of both the caval and the right heart.

VENOUS CANNULATION

- Venous cannulation for CPB allows ***deoxygenated blood*** to be drained from the patient into the extracorporeal circuit.

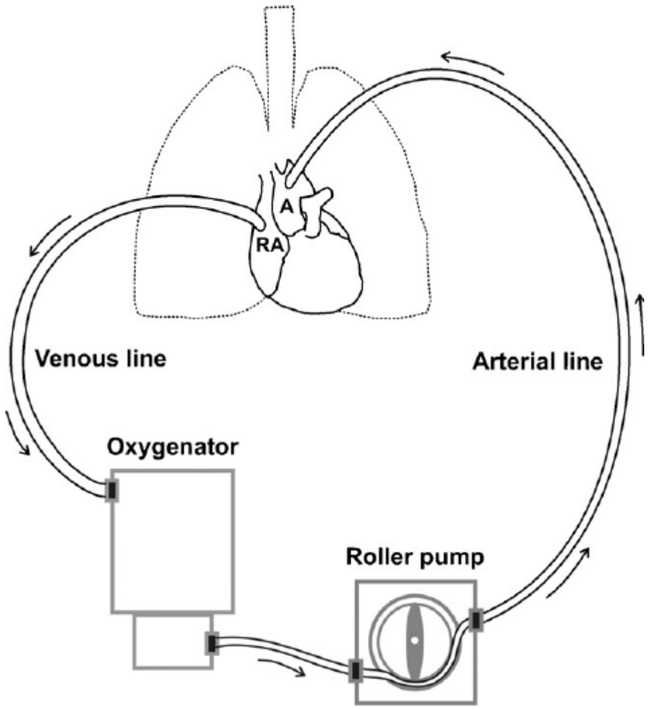
- Venous drainage is usually accomplished by ***gravity siphonage.***

- Siphonage places two constraints on successful venous drainage.
  1. The ***venous reservoir*** must be below the level of the patient
  2. The lines must be full of blood or fluid or else an air lock will occur and disrupt the siphon effect.



VENOUS DRAINAGE

- The amount of venous drainage is determined by
  - the ***pressure in the central veins*** (patient's blood volume)
  - ***the difference in height of the patient and the top of the blood level in the venous reservoir*** or entrance of venous line into a bubble oxygenator (negative pressure exerted by gravity equals this height differential in centimeters of water)
  - ***the resistance in the venous cannulas, venous line and connectors, and venous clamp,*** if one is in use.



EXCESSIVE VENOUS DRAINAGE

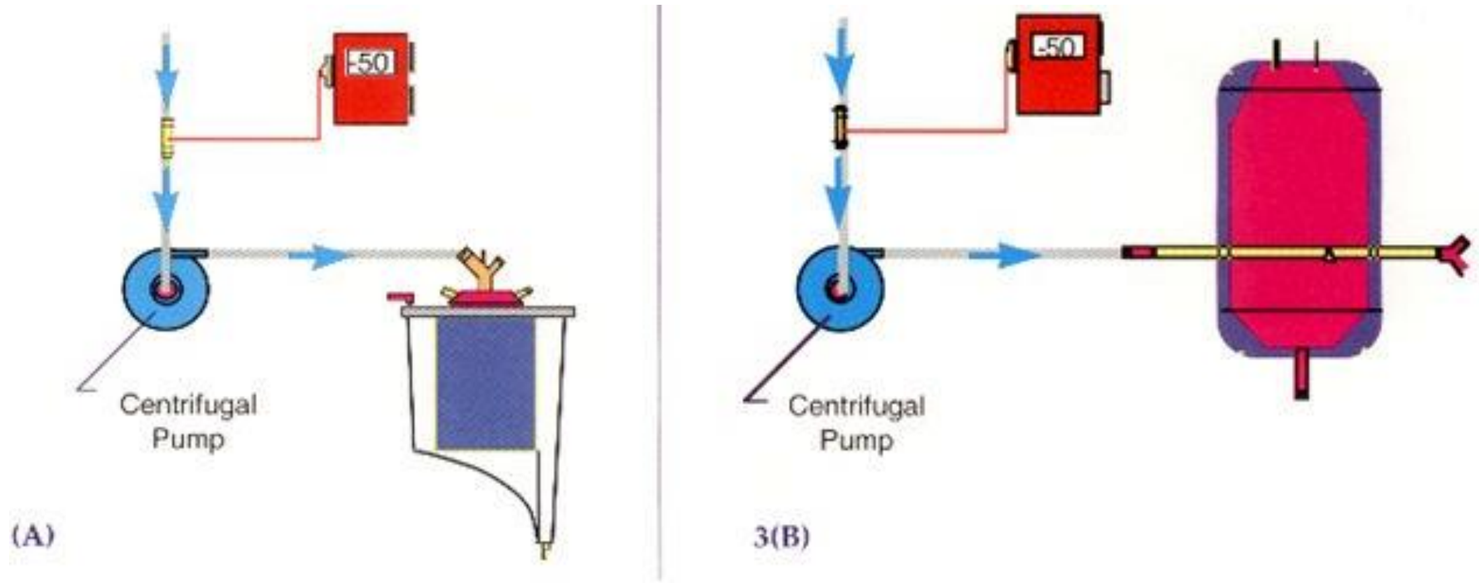
- The ***central venous pressure*** is influenced by intravascular volume and venous compliance, which is influenced by medications, sympathetic tone, and anesthesia.
- ***Excessive drainage*** (i.e., drainage faster than blood is returning to the central veins, which may be caused by an excessive negative pressure caused by gravity) may cause the compliant vein walls to ***collapse around the ends of the venous cannulas***
- This may be improved by ***partially occluding the clamp on the venous line*** or by increasing the systemic blood flow.

CAUSES OF LOW VENOUS DRAINAGE

- Inadequate size of cannula.
- Inadequate venous pressure.
- Kinks in circuit with obstruction of line.
- Air lock in venous line or cannula.
- Oxygenator or venous reservoir is not positioned low enough.
- Inadequate height of patient above CPB venous reservoir.
- Venous cannula placed too far dawn or up, and vena cava not draining.
- Reduced venous volume related (drugs, anesthetic agents).
- Non cardiac suction being used instead of pump suckers
- Reduced venous volume due to bleeding .
- Fluid rapidly moving to interstitial area ,due to decreased intravascular colloid osmotic pressure .
- Vent or Cardioplegia line inadvertently open and draining blood on field

KINETIC ASSISTED VENOUS DRAINAGE

It is achieved by the speed of 1000 to 2000 rpm of kinetic pump or application of 20mmHg vacuum to venous reservoir.



KINETIC-ASSISTED VENOUS RETURN SYSTEMS. (A) OPEN CIRCUIT CONFIGURATION WITH HSVR,[16,17] (B) CLOSED CIRCUIT CONFIGURATION WITH VENOUS RESERVOIR BAG (VRB).[7]

PROBLEMS OF AUGMENTED VENOUS RETURN

Potential problems of augmented venous return:

- ***Hemolysis***
- ***Collapse of right atrium resulting in impaired venous drainage***
- ***Chattering of venous line***
- ***Micro air aspiration***
- ***Peripheral cannulation***

Complications Associated with Achieving Venous Drainage

- Atrial dysrhythmias
- Laceration
- Bleeding of the atrium
- Air embolization

PERIPHERAL CANNULATION

In some circumstances, venous cannulation is done peripherally through the,

femoral vein

iliac vein

innominate vein

axillary vein

INDICATIONS FOR PERIPHERAL VENOUS CANNULATION

- *Emergency closed cardiopulmonary assist*
- *Support of ill patients before induction of anaesthesia*
- *Before sternotomy for reoperations*
- *Minimal access surgery*
- *Certain aortic and thoracic surgery*

ASSESSMENT 1

1. What are the different types of cannulas used in CPB?
2. What are the different types of venous cannula?
3. Methods of approaching of venous canulation
4. Principle of venous drainage
5. Causes of low venous return
6. Indications of peripheral cannulation

Reference

- Cardio Pulmonary Bypass Sunit Ghosh Florian Falter Albert C. Perrino
- Cardiopulmonary Bypass Principles and practice Glenn P. Gravlee

THANK YOU