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**DEPARTMENT OF CARDIO PULMONARY PERFUSION CARE**  
**TECHNOLOGY**

**COURSE NAME : PRINCIPLES OF PERFUSION TECHNOLOGY I**  
**II YEAR**

**TOPIC : VENOUS DRAINAGE AND CANNULATION**



# 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.



# VENOUS DRAINAGE

- First, the ***venous reservoir*** must be below the level of the patient and, second, the lines must be full of blood or fluid or else an air lock will occur and disrupt the siphon effect.
- 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), and ***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 height of the patient above venous reservoir.*
- *Malposition of venous cannula*
- *Obstruction or excess resistance of lines and cannula.*
- *Kink / airlock*
- *Inadequate size of cannula and venous pressure*



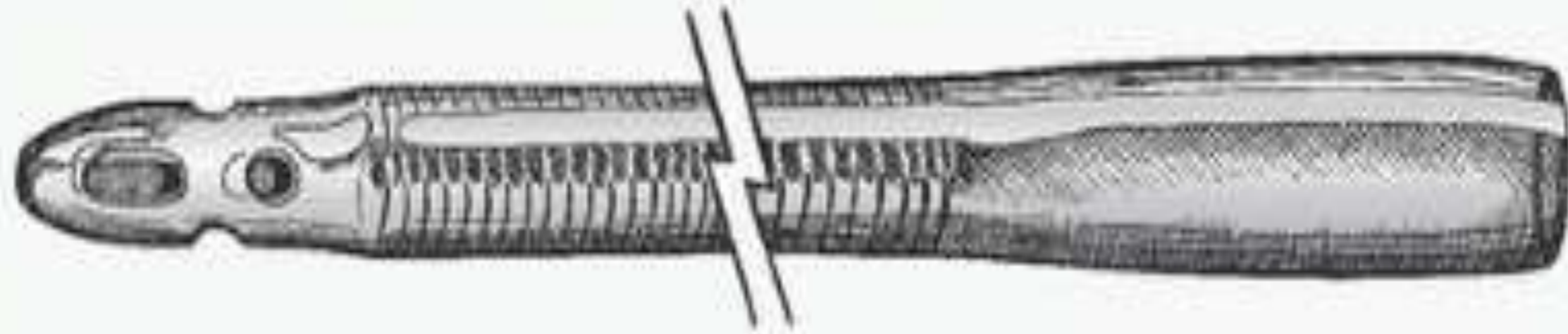
## VENOUS CANNULA

- Venous cannulas are either *single 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.

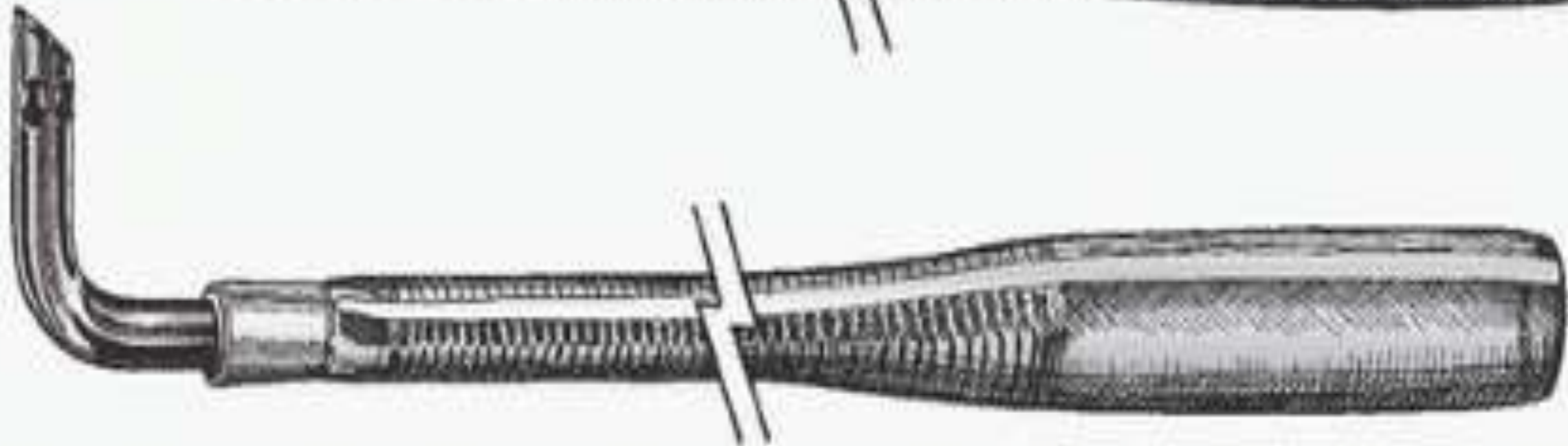




A



B



C





# VENOUS CANNULA



- Knowing the flow characteristics of the particular catheter, which should be provided by the manufacturer or established by *benchtop 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.*



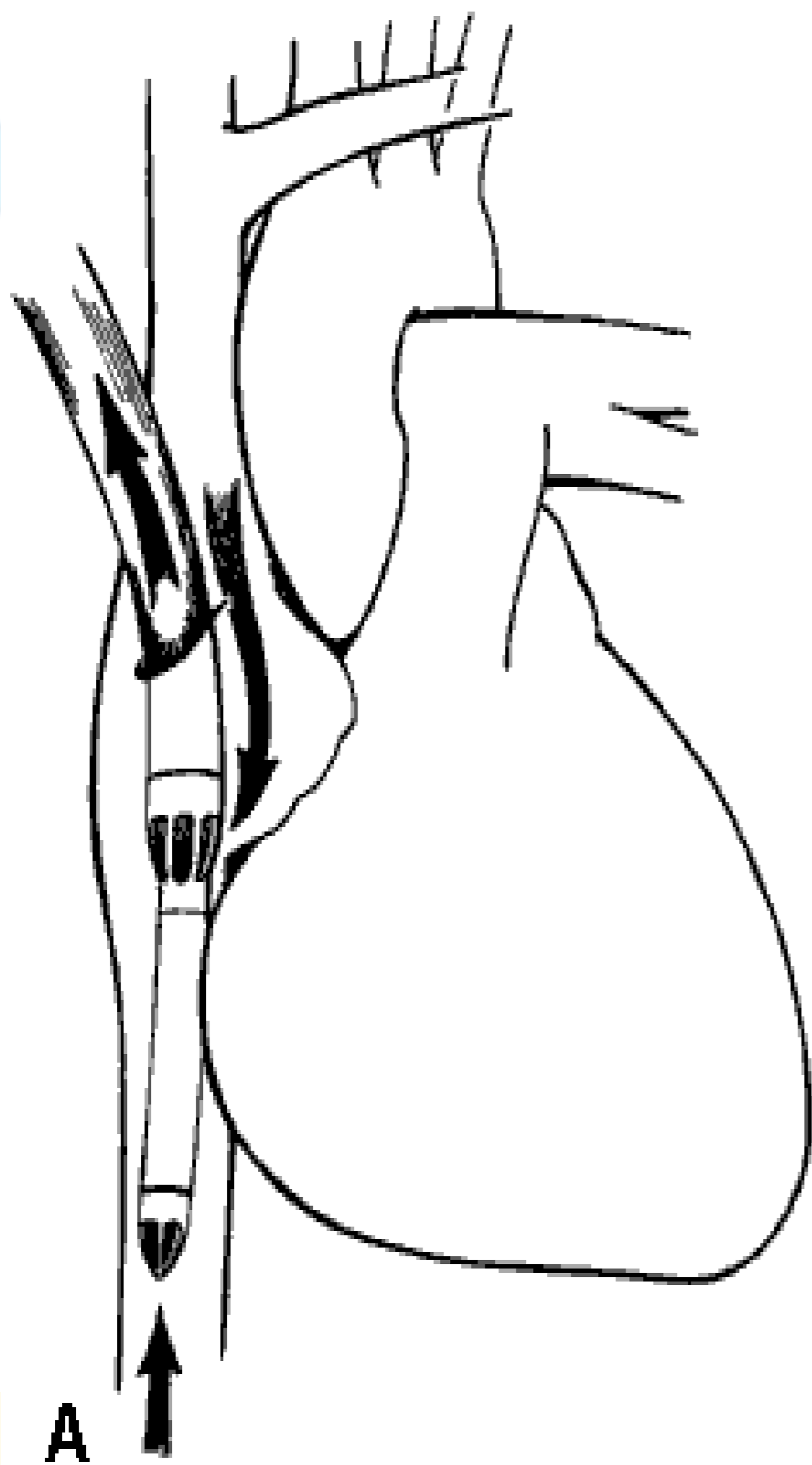
# METHOD OF CANNULATION



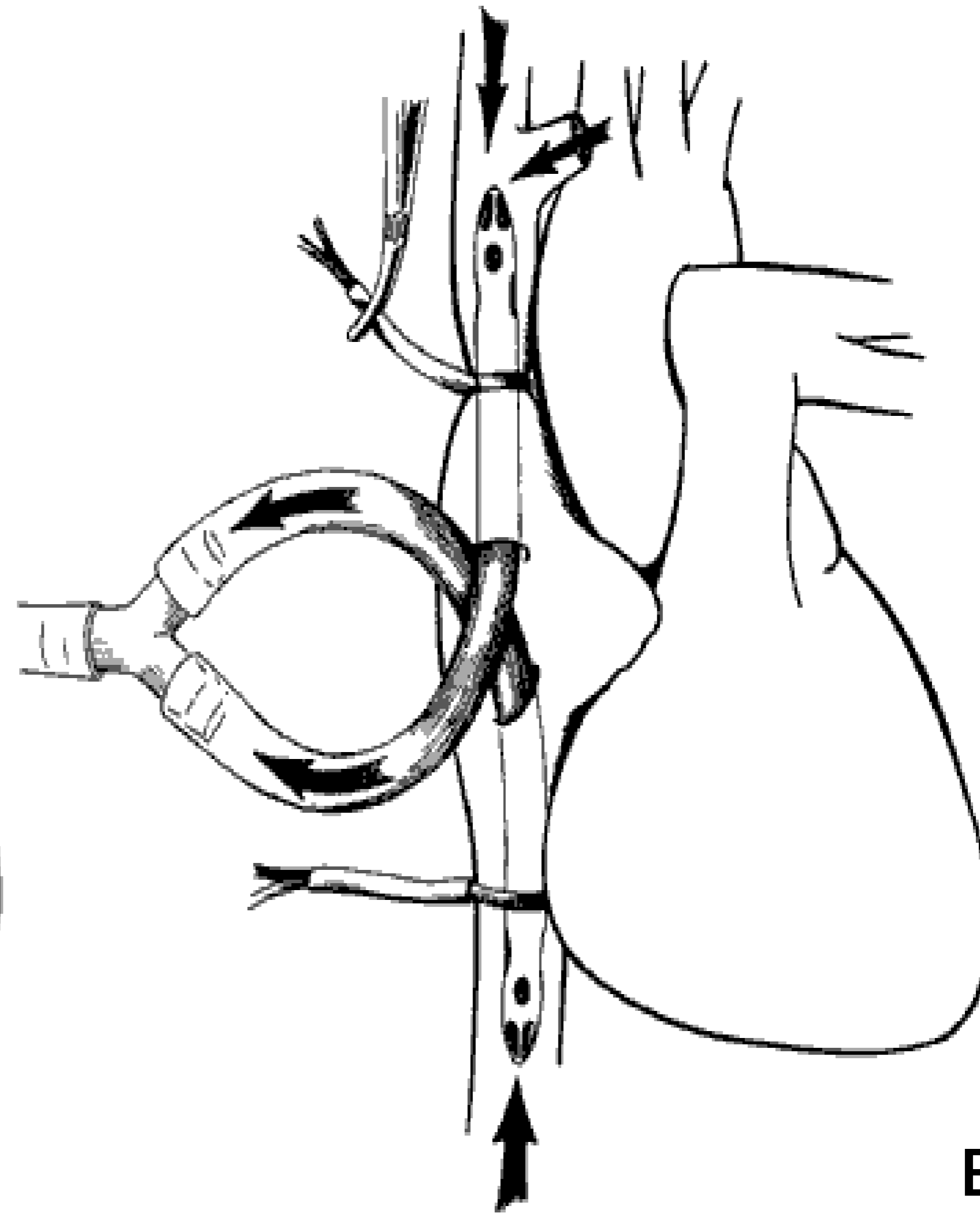
*Bicaval cannulation*

*Cavo atrial cannulation*

*Single atrial cannulation*



**A**



**B**



# 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.***



# 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.***







# 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.

## **CARDIOPLEGIA CANNULATION:**

There are three types of cannulation such as:

- RETROGRADE CANNULATION**
- ANTIGRADE CANNULATION**
- CORONARY PERFUSION CANNULATION [OSTIAL APPROACH]**



# ADEQUATE VENOUS DRAINAGE



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



# 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*
- *Microair aspiration*
- *Peripheral cannulation*



# PERIPHERAL CANNULATION



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

*femoral vein*

*iliac vein*

*innominate vein*

*axillary vein*



# INDICATIONS FOR 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*



Thank you