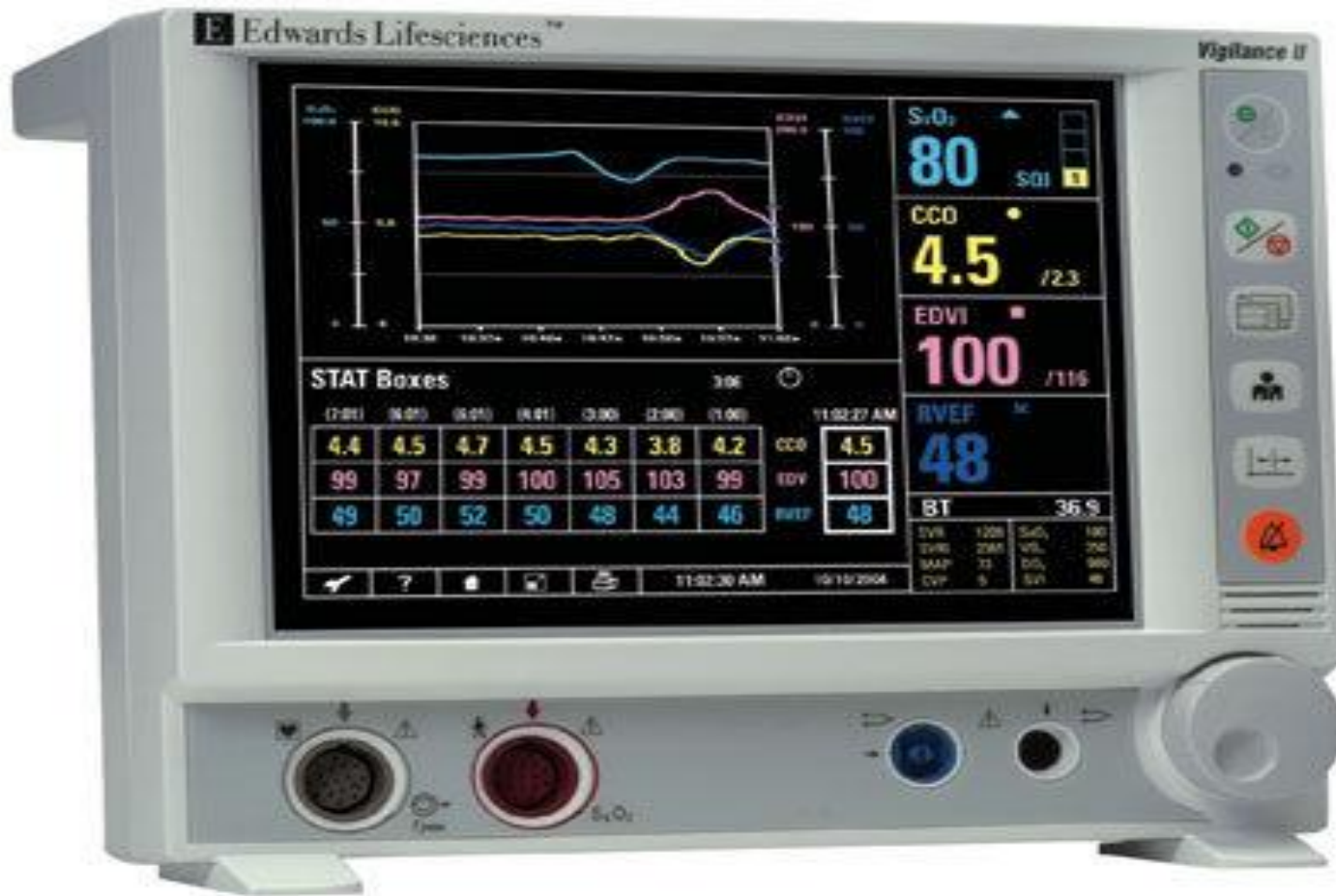




# HEMODYNAMIC MONITORING

# HEMODYNAMIC MONITOR



# Definition

## **Hemodynamic:** ○

is a term to describe intravascular pressure, oxygenation, and blood flow occurring within the cardiovascular system.

## **Hemodynamic monitoring :** ○

Using invasive technology to provide quantitative information about vascular capacity, blood volume, pump effectiveness and tissue perfusion.

It is an essential part of critical care nursing.

# Indications:

- Continuous, real-time blood pressure monitoring
- Planned pharmacologic or mechanical cardiovascular manipulation
- Repeated blood sampling
- Determination of volume responsiveness from systolic pressure or pulse -pressure variation
- Supplementary diagnostic information from the arterial waveform
- Failure of indirect arterial blood pressure measurement

# Types of Hemodynamic Monitoring

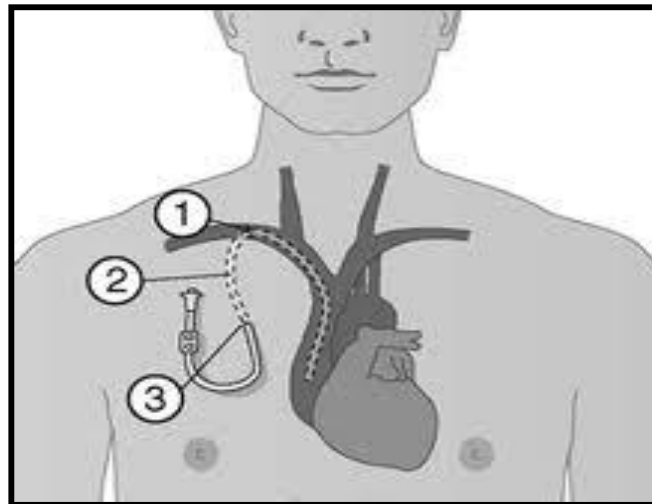
## Noninvasive Hemodynamic Monitoring

- Noninvasive BP
- Heart Rate, pulses
- Mental Status
- Skin Temperature
- Capillary Refill
- Urine Output
- Pulse Oxymetry

## Invasive Hemodynamic Monitoring

- CVP, \_ARTERIAL LINE , PAC

# Central line & Arterial line



# Outline :

## **1- Central line :**

- Definition**
- Purpose**
- COMMON CENTRAL LINE INSERTION SITES**
- TYPES OF CENTRAL LINE**

### **a- Central venous pressure:**

- What is CVP.**
- Used.**
- Site of insertion**
- Causes of increase & decrease CVP**
- Nursing management**
- METHODS OF CVP MONITORING**
- Measuring central venous pressure**
- complications**

# Cont...

## **2- Arterial line :**

- Definition**
- Purpose**
- THE ARTERIAL WAVEFORM**

### **b- Arterial Pressure ( AP ):**

- Arterial line procedure**
- Complication**
- REMOVAL OF ARTERIAL LINE**

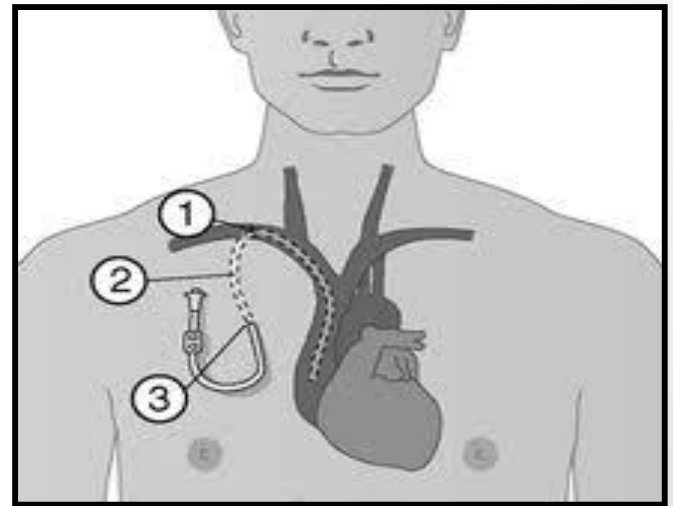


# WHAT IS A CENTRAL LINE:

**It is a catheter that provides venous access via the superior vena cava or right atrium.**

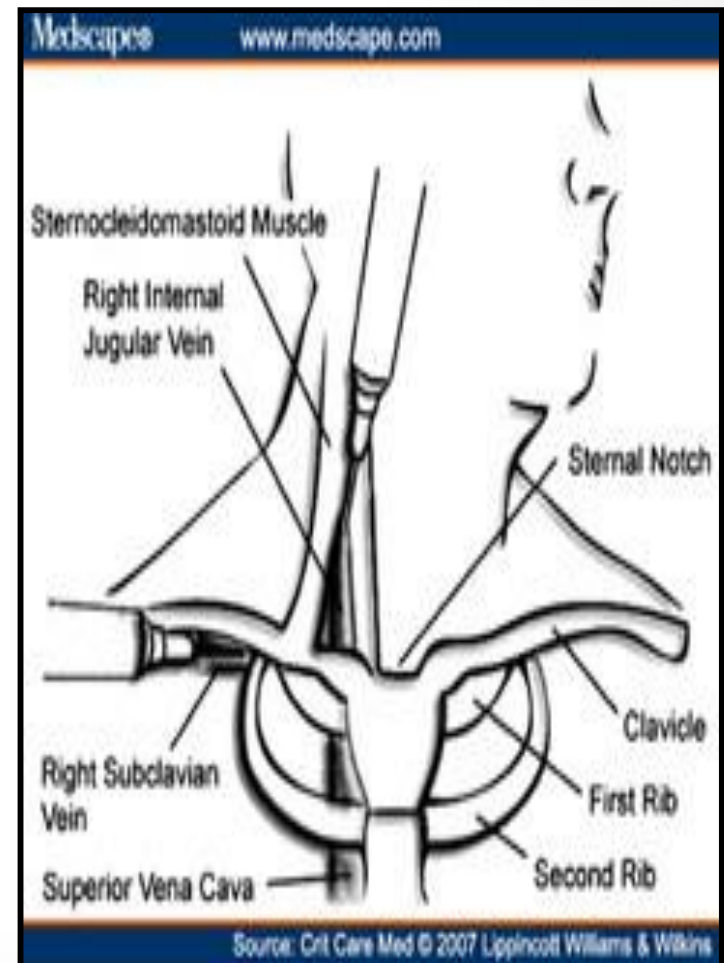
## **Purpose :**

**Permits administration of medication & nutritional support that should not be given via a peripheral route or when standard peripheral route cannot be used .**



# COMMON CENTRAL LINE INSERTION SITES:

- 1- Right internal jugular**
- 2- Left internal jugular**
- 3- Right subclavian**
- 4- Left subclavian**
- 5- Femoral**



**6- Or peripherally inserted central catheters (PICC) which are inserted via the antecubital veins in the arm and is advanced into the central veins**

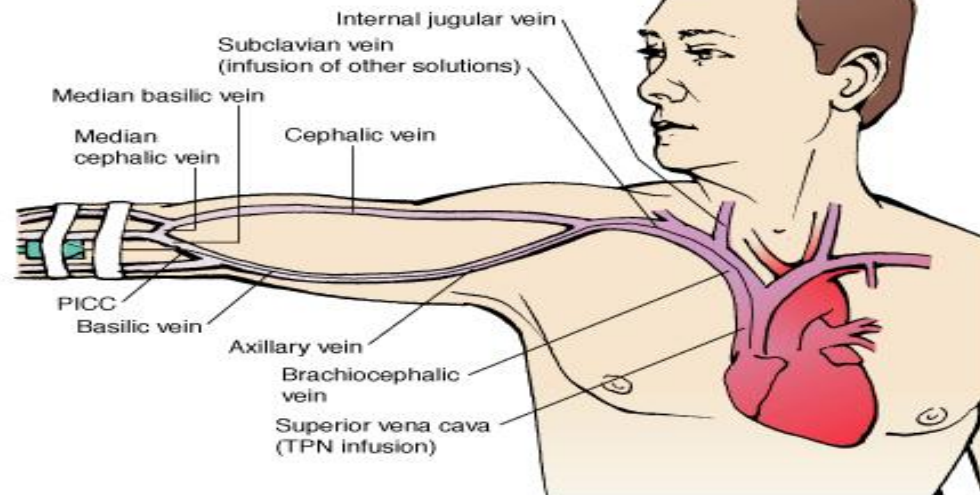


Figure 46-9 Placement of peripherally inserted central catheter (PICC).

# TYPES OF CENTRAL LINE:

**1- SINGLE LUMEN**



**2- TRIPLE LUMEN**



**3- QUADRUPLE LUMEN**



# Central venous pressure ( CVP)

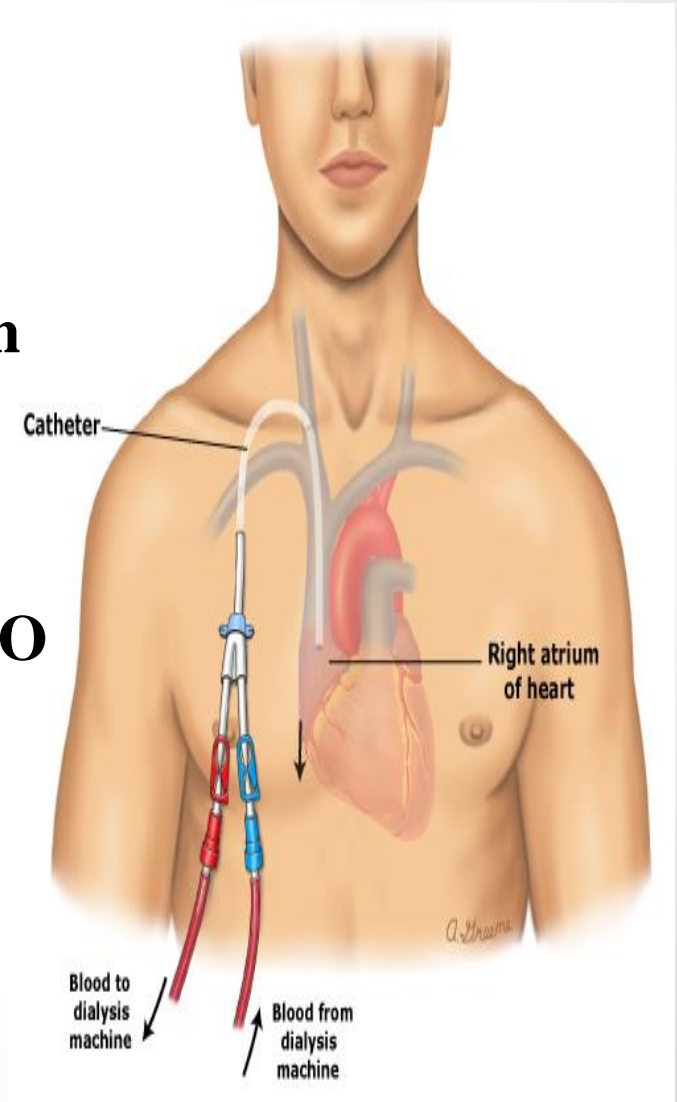
**What is CVP :**

**IS THE PRESSURE WITHIN THE SUPERIOR VENA CAVA OR THE RIGHT ATRIUM to provide information about the body volume status & right ventricular function.**

**Normal CVP= 0 - 8 mmHg or 3-8 cm H<sub>2</sub>O**

**- If less than 0 mean Hypovolemia**

**- If more than 8 mean Hypervolemia**



# **CVP READINGS ARE USED:**

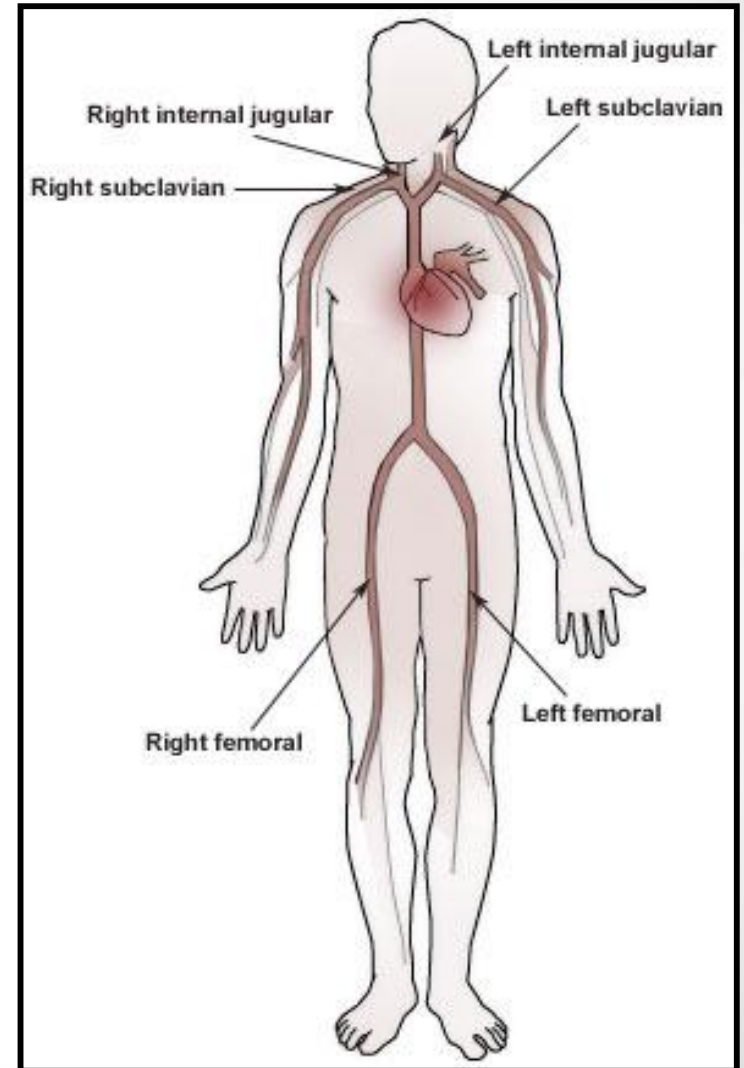
- 1- TO SERVE AS A GUIDE TO FLUID BALANCE IN CRITICALLY ILL PATIENTS**
- 2- TO ESTIMATE THE CIRCULATING BLOOD VOLUME**
- 3- TO ASSIST IN MONITORING CIRCULATORY FAILURE**

# Site of insertion ;

**1- Subclavian vein ( RT/LT)**

**2- Internal jugular vein**

**3- Femoral vein**



### Causes of increase CVP;

- Hypervolemia
- Right ventricular failure
- Pericarditis
- Cardiac tamponade

### Causes of decrease CVP;

- Hypovolemia
- Shock
- Venodilation



# Nursing management :

## Before the insertion;

- 1- Prepare for equipment

## During the insertion;

- 1- Explain procedure to the pt
- 2- Prepare the site of insertion ( cleaning & shaving)
- 3- Assist the doctor during insertion
- 4-Perform continuous assessment of the pt cardiac & respiratory status

## After the insertion;

- 1- Begin the IV infusion
- 2- Assess integrity of the skin at the site of insertion
- 3- Cover site of insertion with sterile gauze
- 4- Prepare pt for x-ray
- 5- Measurement CVP

# METHODS OF CVP MONITORING:

**There are two methods of CVP monitoring**

## **1- Manometer system:**

**Enables intermittent readings and is less accurate than the transducer system**



**Enables continuous readings which are displayed on a monitor.**



# Measuring central venous pressure

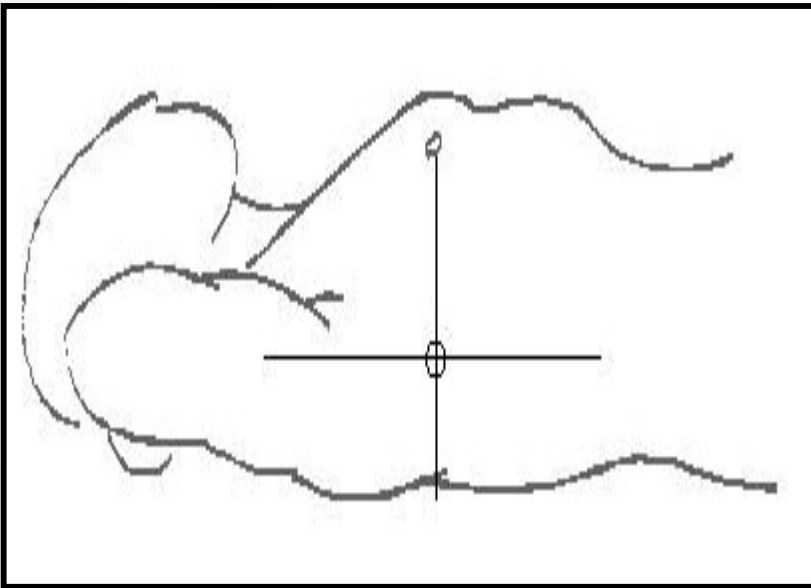
**1- The CVC will be attached to intravenous fluid within a pressure bag. Ensure that the pressure bag is inflated up to 300mmHg.**



**2- Catheters differ between manufacturers, however, the white or proximal lumen is suitable for measuring CVP.**



**3- Place the patient flat in a supine position if possible.**



**4- Tape the transducer to the phlebostatic axis or as near to the right atrium as possible.**





**5- Turn the tap off to the patient and open to the air by removing the cap from the three-way port opening the system to the atmosphere.**





**6- Press the zero button on the monitor and wait while calibration occurs .**



**7- When 'zeroed' is displayed on the monitor, replace the cap on the three-way tap and turn the tap on to the patient.**



**8- Observe the CVP trace on the monitor.**



## **9- Documentation include :**

- a- Date & time of insertion catheter.**
- b- Type & location of the catheter , including NO. of the lumens.**
- c- Care & maintain procedure performance .**
- d- Appearance of insertion site .**
- e- Problem noted such as resistance to flushing**
- f- client tolerance to procedure**



# Complications of CVP :

- 1- Hemorrhage**
- 2- Catheter occlusion**
- 3- Infection**
- 4- Air embolism**
- 5- Catheter displacement**
- 6- Cardiac arrhythmias**
- 7- Pneumothorax**
- 8- Hemothorax**
- 9- Hemo-pneumothorax**

# WHAT IS AN ARTERIAL LINE?

**AN ARTERIAL LINE IS A CANNULA USUALLY POSITIONED IN A PERIPHERAL ARTERY SUCH AS**

- Radial artery
- Brachial artery
- Dorsalis pedis artery
- Femoral artery

**Purpose :**

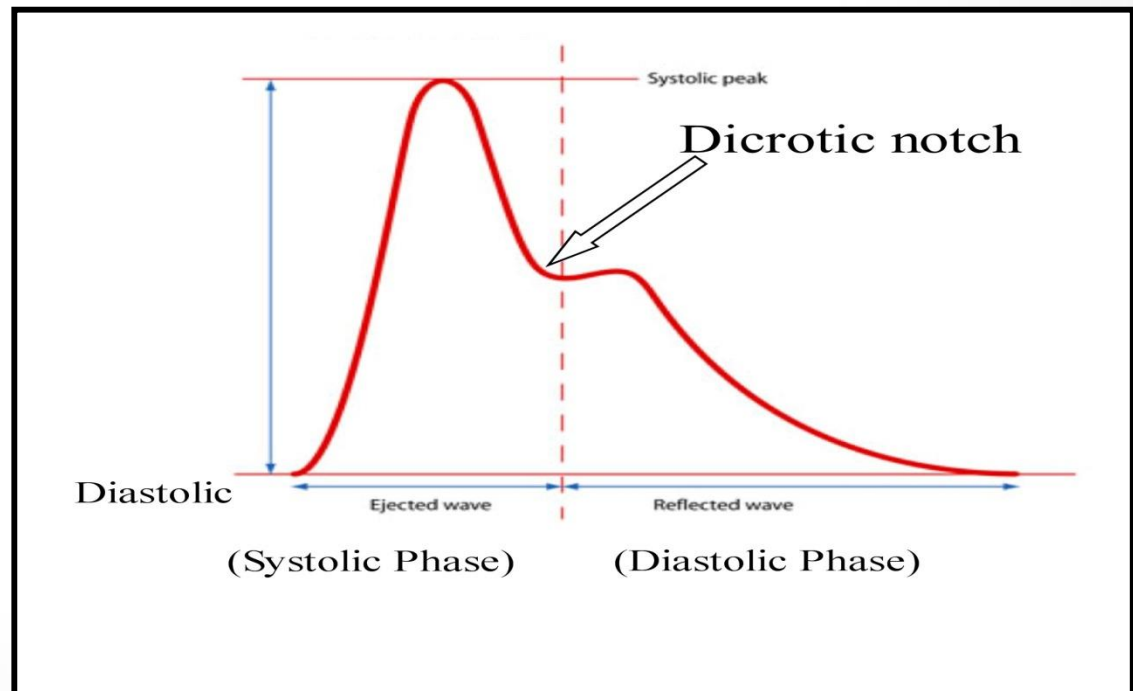
- 1- Facilitate monitoring of hemodynamic status by providing information about ABP readings.**
- 2- Obtain hemodynamic data necessary for regulating vasoactive medication & fluid administration.**



# THE ARTERIAL WAVEFORM

The arterial waveform reflects the pressure generated in the arteries following ventricular contraction and can be described as having:-

- Anacrotic notch
- Peak systolic pressure
- Dicrotic notch
- Diastolic pressure



# Arterial Pressure ( AP ):

**The pressure of the circulating blood on the arteries**

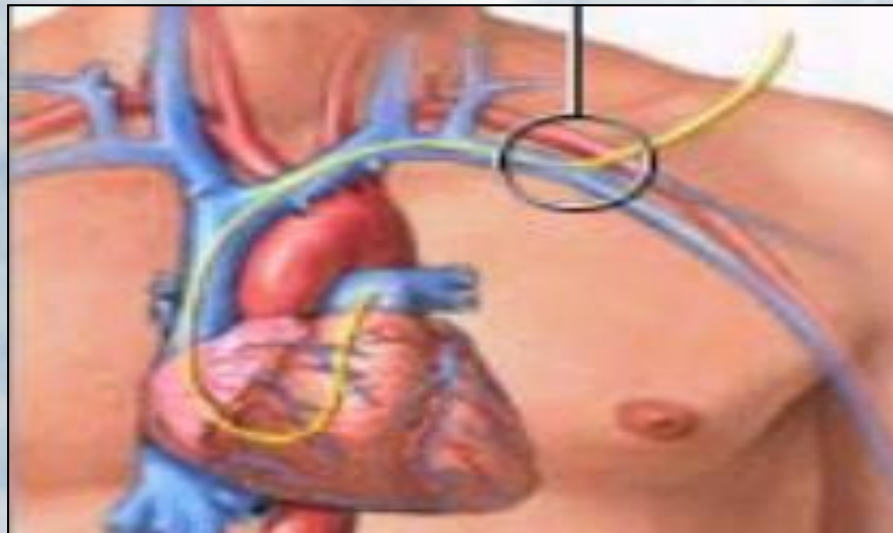
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# COMPLICATIONS:

- 1- HYPOVOLAEMIA**
- 2- ACCIDENTAL INTR-ARTERIAL INJECTION OF DRUGS**
- 3- LOCAL DAMAGE TO ARTERY**

# Pulmonary artery catheter

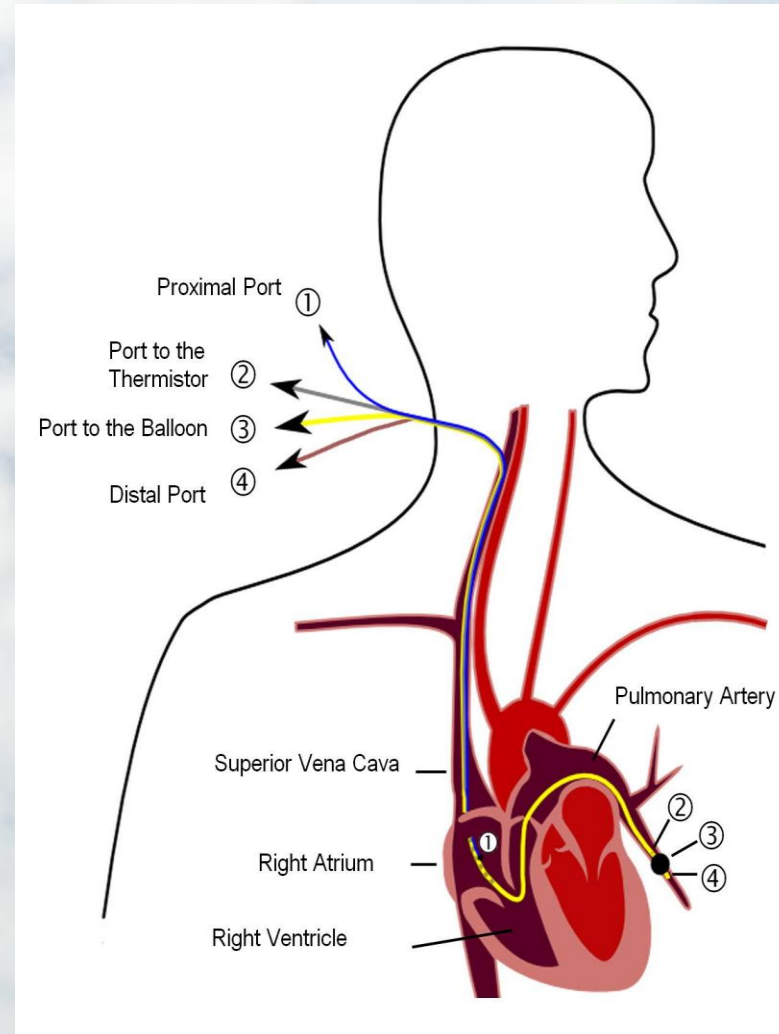


# **Outline :**

- 1- Definition.**
- 2- Purpose .**
- 3- Indication.**
- 4- Contraindication .**
- 5- Insertion site .**
- 6- Lumen type .**
- 7- Assessment.**
- 8- Equipment**
- 9- procedure**
- 10- Normal values of commonly measured parameters.**
- 11- Complication.**

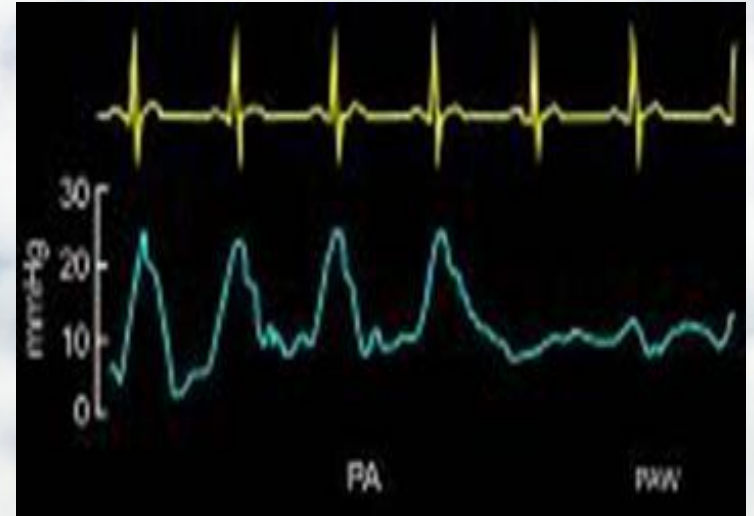
# Pulmonary artery catheter

- Pulmonary artery catheter (PAC) is also known as Swan Ganz catheterization .
- A light flexible balloon-tipped tube that is introduced into the pulmonary artery (the artery from the right ventricle of the heart to the lungs.)



## Purpose :

- 1- Facilitate monitoring of hemodynamic status , providing information about right & left side intracardiac pressure , cardiac output , mixed oxygen saturation.
- 2- Obtain hemodynamic data necessary for regulating vasoactive medication and fluid administration .





# Indication :

- 1- Assessment and management of shock states.
- 2- Assessment of pulmonary edema (cardiogenic vs ARDS) .
- 3- Optimization of cardiac index in cardiogenic shock.
- 4- Evaluation and drug titration for severe pulmonary hypertension .
- 5- Diagnostic evaluation of left-to-right cardiac shunts.
- 6- May aid to optimize peri-operative clinical status in high-risk surgical candidates

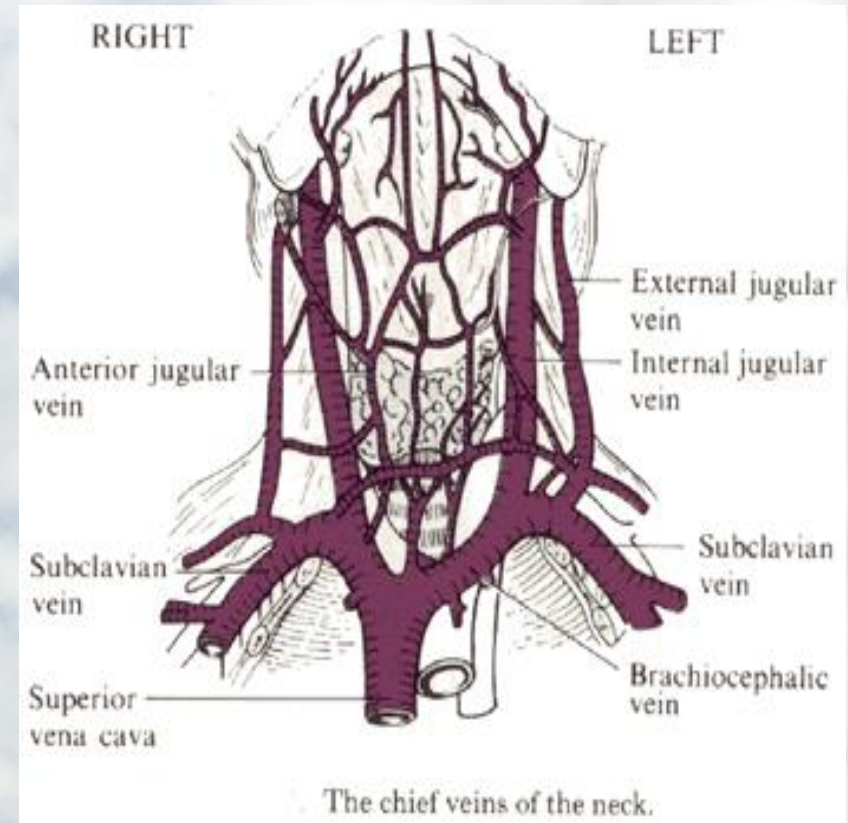
## Contraindication :

- 1- Uncontrolled ventricular or atrial dysrhythmias.
- 2- Right ventricular mural thrombus.
- 3- Cardiac arrest .
- 4- Respiratory arrest.
- 5- Cyanotic congenital heart disease.
- 6- Ventricular masses or other structural abnormalities

## Insertion site :

Catheterization of the right side of the heart and pulmonary artery via;

- 1- Right internal jugular vein
- 2- Subclavian vein

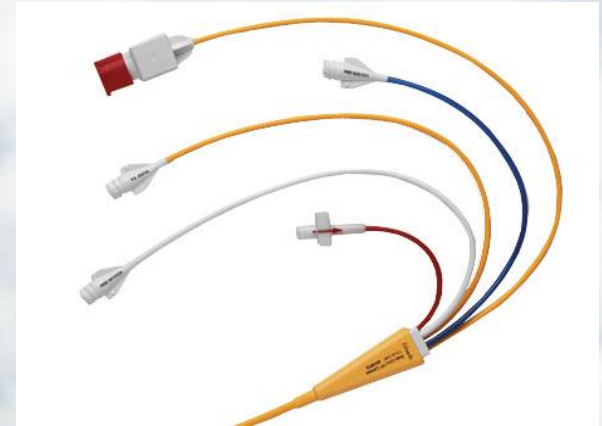




# Type of lumen :

PAC has 4-5 lumens:

- 1- Temperature thermistor located proximal to balloon to measure pulmonary artery blood temperature
- 2- Proximal port located 30 cm from tip for CVP monitoring, fluid and drug administration
- 3- Distal port at catheter tip for PAP monitoring
- 4- +/- Variable infusion port (VIP) for fluid and drug administration
- 5- Balloon at catheter tip



## Normal values of commonly measured parameters are as follows:

- Pulmonary artery systolic pressure: 20-30mmHg
- Pulmonary artery mean pressure: 9-17mmHg
- Pulmonary artery diastolic pressure: 5-15mmHg
- Pulmonary capillary wedge pressure: 8-12mmHg
- Right atrial pressure: 2-6mmHg
- Cardiac index: 2.5-4 L/min/m<sup>2</sup>
- Cardiac output (CO) L/min

# Complication :

- 1- Accidental puncture of adjacent arteries
- 2- Bleeding
- 3- Neuropathy
- 4- Air embolism
- 5- Pneumothorax
- 6- Dysrhythmias
  - a- Premature ventricular and atrial contractions
  - b- Ventricular tachycardia or fibrillation

# CONT....

- 7- Thromboembolism
- 8- Mechanical, catheter knots
- 9- Pulmonary Infarction
- 10- Infection, Endocarditis
- 11- Endocardial damage, cardiac valve injury
- 12- Pulmonary Artery Rupture





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- Hamilton H(2006b) Complications associated with venous access devices: part two. *Nursing Standard*. 20, 27, 59-65.
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