

# Measuring central venous pressure

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## Learning outcomes

That the clinician can:

Describe the sites of central venous catheterisation

Understand why central venous pressure monitoring is performed

Demonstrate how to perform central venous pressure monitoring using a manometer and a transducer

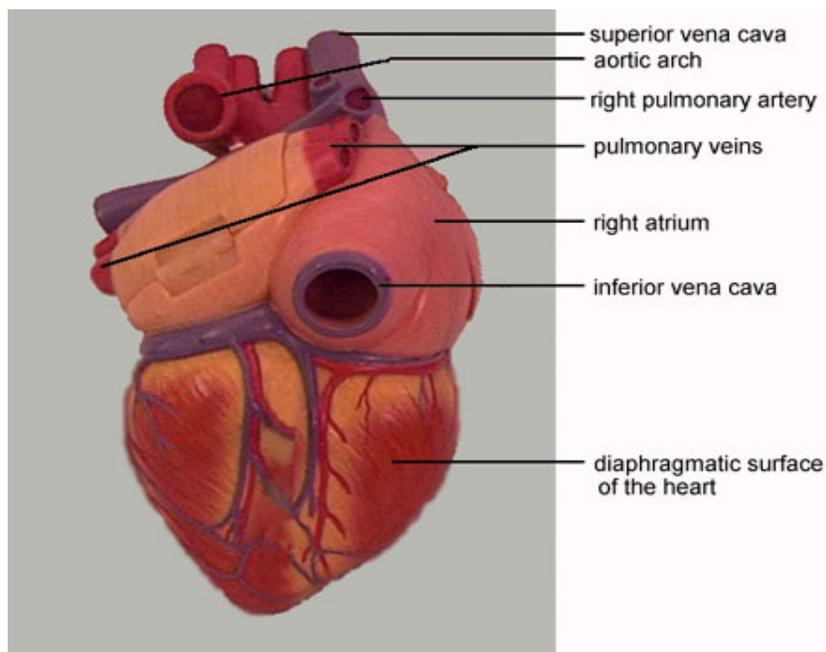
State normal parameters for CVP

## Introduction

Central venous pressure measurement is often associated with intensive and critical care settings. However, with increasing numbers of critically ill patients being cared for on medical and surgical wards, it is essential that clinicians are able to record central venous pressure measurement accurately and recognise normal and abnormal parameters.

## Reasons for measuring CVP

Circulating blood flows into the right atrium via the inferior and superior vena cava. The pressure in the right atrium is known as central venous pressure (CVP).



The condition of the patient and the treatment being administered determine how often CVP measurement should take place, for example, critically ill unstable patients may need hourly measurements.

# Measuring central venous pressure

## Equipment: manometers

CVP is measured using an indwelling central venous catheter (CVC) and a pressure manometer or transducer. Both methods are reliable when used correctly.

Wards generally use **manometers**.



## Equipment: transducers

Accident and Emergency departments, High Dependency areas and Intensive Care units use **transducers** for measuring CVPs.

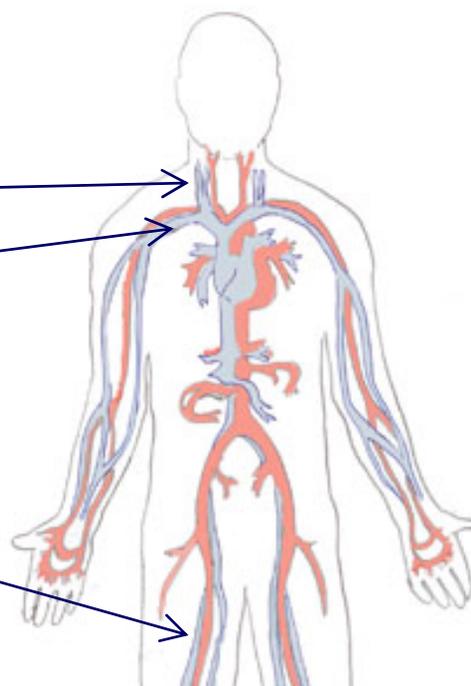


Transduced CVP waveform

## Insertion sites

CVC insertion sites include:

- Internal jugular vein
- Subclavian vein
- Femoral vein



## Insertion sites

### Internal jugular veins

This site is chosen frequently as there is a high rate of successful insertion and a low incidence of complications such as pneumothorax. Internal jugular veins are short, straight and relatively large allowing easy access, however, catheter occlusion may occur as a result of head movement and may cause irritation in conscious patients.

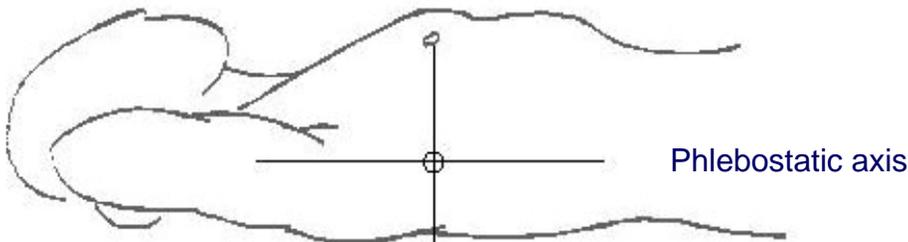
### Subclavian veins

This site is often chosen as there are more recognisable anatomical landmarks, making insertion of the device easier. Because this site is positioned beneath the clavicle there is a risk of pneumothorax during insertion. A subclavian CVC is generally recommended as it is more comfortable for the patient.

### Femoral veins

This site provides rapid central access during an emergency such as a cardiac arrest. As the CVC is placed in a vein near the groin there is an increased risk of associated infection. In addition, femoral CVCs are reported to be uncomfortable and may discourage the conscious patient from moving.

## CVP Recording



Nursing and medical staff must be familiar with the equipment being used to ensure accurate readings and provide patients with appropriate care.

CVP is usually recorded at the mid-axillary line where the manometer arm or transducer is level with the phlebostatic axis. This is where the fourth intercostal space and mid-axillary line cross each other allowing the measurement to be as close to the right atrium as possible.

## Using a manometer

1. Explain the procedure to the patient to gain informed consent.
2. If IV fluid is not running, ensure that the CVC is patent by flushing the catheter.
3. Place the patient flat in a supine position if possible. Alternatively, measurements can be taken with the patient in a semi-recumbent position. The position should remain the same for each measurement taken to ensure an accurate comparable result.

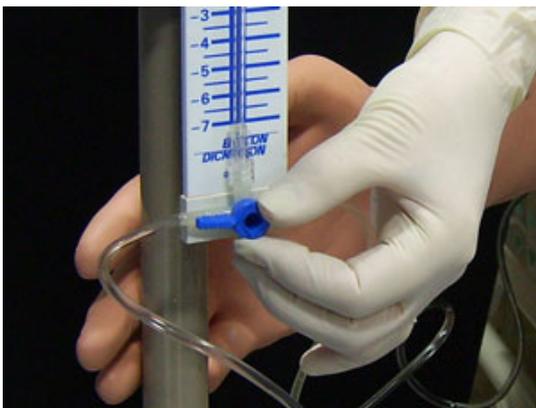
## Using a manometer



Line up the manometer arm with the phlebostatic axis ensuring that the bubble is between the two lines of the spirit level.



Move the manometer scale up and down to allow the bubble to be aligned with zero on the scale. This is referred to as 'zeroing the manometer'.

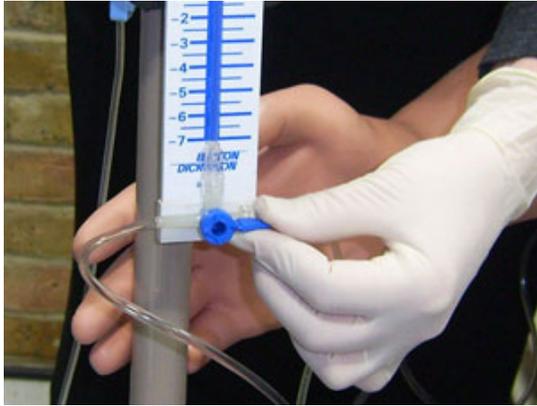


Turn the three-way tap off to the patient and open to the manometer.

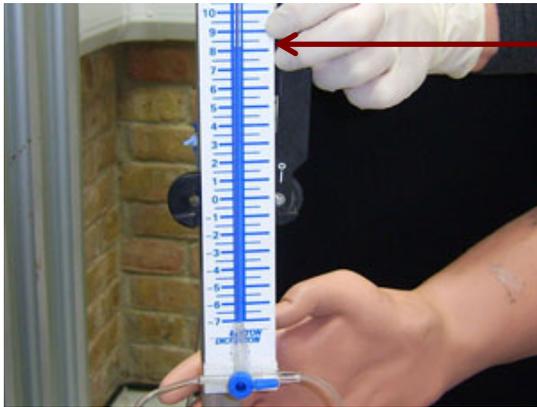


Open the IV fluid bag and slowly fill the manometer to a level higher than the expected CVP

## Using a manometer



Turn off the flow from the fluid bag and open the three-way tap from the manometer to the patient



The fluid level inside the manometer should fall until gravity equals the pressure in the central veins



When the fluid stops falling the CVP measurement can be read. If the fluid moves with the patient's breathing, read the measurement from the lower number



Turn the tap off to the manometer

## Using a manometer



Document the measurement and report any changes or abnormalities

## Using a transducer



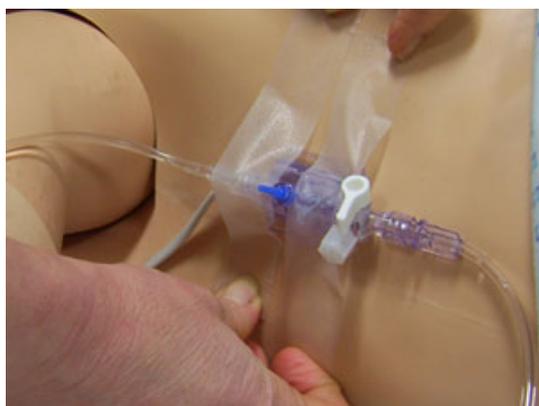
Explain the procedure to the patient to gain informed consent.

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

Place the patient flat in a supine position if possible. Alternatively, measurements can be taken with the patient in a semi-recumbent position. The position should remain the same for each measurement taken to ensure an accurate comparable result.



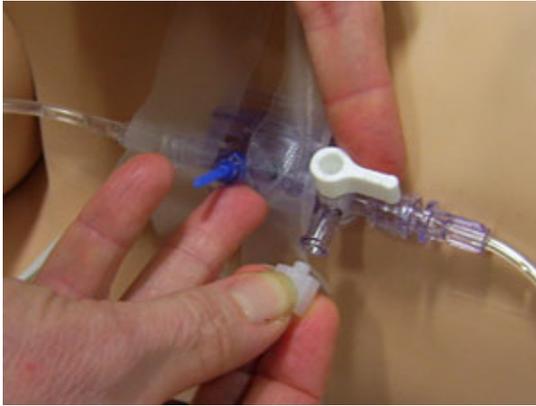
Catheters differ between manufacturers, however, the white or proximal lumen is suitable for measuring CVP.



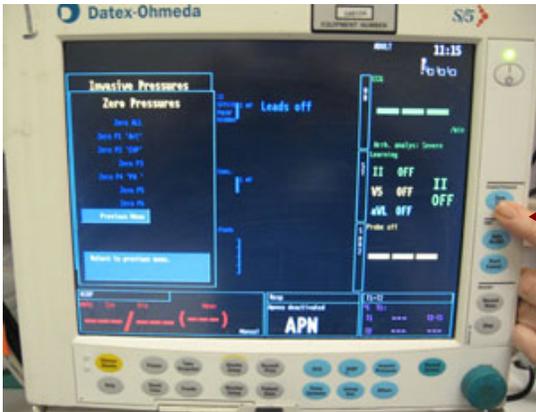
Tape the transducer to the phlebostatic axis or as near to the right atrium as possible.

# Measuring central venous pressure

## Using a transducer



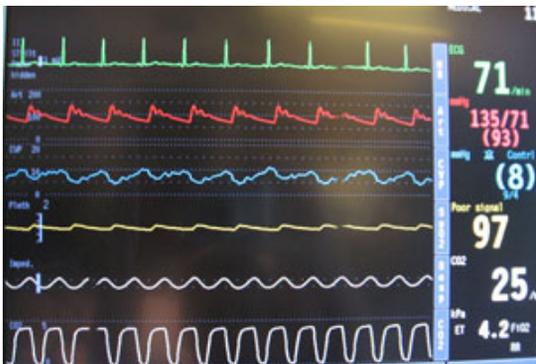
Turn the tap off to the patient and open to the air by removing the cap from the three-way port opening the system to the atmosphere.



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



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



Observe the CVP trace on the monitor. The waveform undulates as the right atrium contracts and relaxes, emptying and filling with blood. (light blue in this image)

Document the measurement and report any changes or abnormalities

## Interpreting measurements

The normal range for CVP is 5-10cm H<sub>2</sub>O (2-6mmHg) when taken from the mid-axillary line at the fourth intercostal space.

Many factors can affect CVP, including vessel tone, medications, heart disease and medical treatments. A CVP measurement should be viewed in conjunction with other observations such as pulse, blood pressure and respiratory rate and the patients response to treatment.

## Potential complications

**Haemorrhage** from the catheter site - if it becomes disconnected from the infusion. Patients who have coagulation problems such as those on warfarin or those with clotting disorders are at risk.

**Catheter occlusion**, by a blood clot or kinked tube - regular flushing of the CVC line and a well secured dressing should help to avoid this.

**Infection** - redness, pain, swelling around the catheter insertion site may all indicate infection. Careful asepsis is needed when touching a CVC site. Swabs for MC&S should be taken if infection is suspected.

**Air embolus** - if the infusion or monitoring lines become disconnected there is a risk that air can enter the venous system. All lines and connections should be checked at the start of every shift to minimise the risk of this occurring.

**Catheter displacement** - if the CVC moves into the chambers of the heart then cardiac arrhythmias may be noted, and should be reported. If the CVC is no longer in the correct position, CVP readings and medication administration will be affected.

## References

**Cole E (2007)** Measuring central venous pressure. *Nursing Standard*. 22 (7) 40-42

**Hamilton H (2006a)** Complications associated with venous access devices: part one. *Nursing Standard*. 20, 26, 43-50.

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

**Jevon P, Ewens B (Eds) (2007)** *Monitoring the Critically Ill Patient*. Second edition. Blackwell Science, Oxford.

**Morton PG, Fontaine DK, Hudak CM, Gallo BM (2005)** *Critical Care Nursing: a Holistic Approach*. Eighth edition. Lippincott Williams and Wilkins, Philadelphia PA.

**National Institute for Clinical Excellence (2002)** *Central Venous Catheters: Ultrasound Locating Devices*. Technology appraisal No. 49. NICE, London.

**Wiklund CU, Romand JA, Suter PM, Bendjelid K (2005)** Misplacement of central vein catheters in patients with hemothorax: a new approach to resolve the problem. *Journal of Trauma*. 59, 4, 1029-1031.

**Woodrow P (2002)** Central venous catheters and central venous pressure. *Nursing Standard*. 16, 26, 45-51.