Central Venous Pressure

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Disclosures
None.

Accreditation
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Course Objectives
After completion of this lesson participants will be able to:
1. List 2 items that may cause an increase in CVP.
2. List 2 items that may cause a decrease in CVP.
3. Describe setting up a transducer.
4. Describe how to zero a transducer.
5. Describe the anatomy of a CVP waveform.

Audience
RN’s working typically in the critical care area. CVP monitoring is used to estimate a patient’s cardiac function, venous return to the heart, and gauge how well the right ventricle of the heart is functioning.
Central Venous Pressure (CVP) 
Right Atrial Pressure (RAP) 
Monitoring
Overview

• Introduction
• Equipment
• Procedure
• Maintenance
• Precautions/Key Points
Introduction

• Critical and acute care settings

• Continuous or intermittent via a CVC

• CVP ~ Right Atrial Pressure ~Right ventricular end diastolic volume (preload)

• Reflects a patient’s
  – Cardiac function ➔ venous return to the heart
  – Right ventricular function
  – Intravascular fluid volume status
Introduction

• CVP monitoring is performed in critical and acute care settings and can be done either continuously or intermittently via a central line.

• CVP is considered equivalent to right atrial pressure...which in the absence of tricuspid valve stenosis.... is equal to R ventricular end diastolic volume (preload)

• It is used to estimate a patient’s cardiac function, venous return to the heart, and gauge how well the right ventricle of the heart is functioning...if the heart cant accept blood, then it will back up into the venous system affecting the intravascular fluid volume status.

• The central venous catheter (CVC) also facilitates access to a large vessel which allows for rapid, high volume fluid administration and frequent blood draws.
How does CVP measurement work?

Because no major valves lie at the cavo-atrial junction, pressures during systole and diastole reflect back to the catheter allowing for CVP measurement.

Normal CVP values range 2-6 mmHg or 4-12 cmH2O
What do CVP values mean?

• Increase:
  – Fluid overload
  – Right heart failure
  – Cardiac tamponade
  – Pleural effusion
  – Tension pneumothorax
  – Forced exhalation
  – Mechanical ventilation
What do CVP values mean?

• Decrease:
  – Hypovolemia
  – Shock
  – Forced inhalation
Anatomy of a CVP Waveform

- **a wave**: Atrium contracting, tricuspid valve open
- **x descent**: Atrium relaxing then filling, tricuspid closed
- **v wave**: Atrium tense, full; tricuspid closed
- **y descent**: Atrium emptying, tricuspid open
• Measurement of pressure back to the catheter

• Understanding the a, c, and v waves and how they relate to cardiac function is necessary to accurately interpret the CVP waveform.
• The a wave reflects right atrial contraction.
• The c wave reflects closure of the tricuspid valve.
• The v wave reflects the right atrial filling during ventricular systole.
• The CVP measurement is the mean of the a wave.

• + a wave: This wave is due to the increased atrial pressure during right atrial contraction. It correlates with the P wave on an EKG.
• + c wave: This wave is caused by a slight elevation of the tricuspid valve into the right atrium during early ventricular contraction. It correlates with the end of the QRS segment on an EKG.
• - x descent: This wave is probably caused by the downward movement of the ventricle during systolic contraction. It occurs before the T wave on an EKG.
• + v wave: This wave arises from the pressure produced when the blood filling the right atrium comes up against a closed tricuspid valve. It occurs as the T wave is ending on an EKG.
• - y descent: This wave is produced by the tricuspid valve opening in diastole with blood flowing into the right ventricle. It occurs before the P wave on an EKG.
**Tricuspid valve closing**

- Right atrial contraction
- Right atrium emptying
- Right atrium full
- Right atrium relaxing and filling
- Tricuspid valve closing

**CVP**

- ECG
- P, R, T waves
- Systole
- Diastole
Equipment

- Pressure Bag
- Disposable Pressure Tubing
- Transducer
- Transducer Holder
- Transducer Cable
Transducer System Setup

- Pressure Bag
- Pressure Bag Gauge
- Dead End Cap
- Transducer
- Transducer Holder
- Fast Flush Device
- Calibration Button
Preparing the Monitor & Tubing System

• Improper systems can cause erroneous measurements of hemodynamic indices which can potentially invalidate a patient’s entire hemodynamic profile.

• To ensure accuracy:
  – Priming of the pressure tubing
  – Leveling and zeroing
  – Dynamic response testing

If we don’t set up our system correctly, we won’t get correct readings which can invalidate a pt’s hemodynamic profile.

In order to ensure accuracy and minimize incorrect measurements, three procedural steps should be followed to prepare the monitoring tubing system: priming of the pressure tubing, leveling and zeroing, and dynamic response testing.
Priming the Pressure Tubing

• Use 500 mL Normal Saline
• Check all connectors on tubing
• Use aseptic technique to spike bag and prime entire tubing (stopcocks, luer-locks, transducer)
• Insert IV fluid bag into pressure bag and inflate the pressure bag to 300 mmHg
• Insert transducer into the transducer holder
Priming the Pressure Tubing

- Label IV bag with date and time solution is hung + initials
- How often does solution need to be changed: 24 hours

- Check all connectors on tubing as they may be loose. Make sure that the connectors are secure but don’t over tighten them b/c they can become stripped
- Using aseptic technique, spike bag and prime entire tubing (stopcocks, luer-loks, transducer)
- Be sure to eliminate all air bubbles as they can be a main factor in waveform blunting or overdamping.

- Insert IV fluid bag into pressure bag and inflate the pressure bag to 300 mmHg
  Why?
- Prevents air from going into the solution and catheter from clotting allows 3ml/hr flush solution to be delivered through the catheter

- Insert transducer into the transducer holder that mounts onto the IV pole
Primed the Pressure Tubing

• Check all connectors on tubing
  – Avoid over tightening and stripping of connectors
• Prime entire tubing system including stopcock, luer-loks, and transducer
• Be sure to eliminate all air bubbles as they can be a main factor in waveform blunting or overdamping
• Insert IV bag into pressure tubing and inflate pressure bag to 300mmHg
Priming the Pressure Tubing

• Label IV bag, indicating date and time solution is hung and your initials.

• Check all connectors on tubing as they may be loose.
• Ensure all connections are secure, but avoid over tightening and stripping of the connectors.

• Using aseptic technique, spike the outlet port of the IV solution with pressure tubing and prime entire tubing system including stopcock, luer-locks, and transducer. Be sure to eliminate all air bubbles as they can be a main factor in waveform blunting or overdamping.

• Insert the IV bag into the pressure bag on the IV pole and inflate the pressure bag.

• External pressure cuff surrounding the flush solution bag should be maintained at a pressure of 300mmHg (prevents air from going into solution and catheter from clotting by allowing 3mL/hr of flush solution to be delivered through the catheter).
Priming the Pressure Tubing

- Insert transducer into pole mount holder
- Clamp CVC lumen to be used
- Remove needleless connector
- Scrub CVC port with alcohol swab (15 sec)
- Connect transducer directly to CVC port

With the use of a pole mount, insert the transducer into the pole mount holder. Clamp the central venous catheter (CVC) lumen to be used. With aseptic technique remove the needleless connector, scrub the CVC port with alcohol wipe for 15 seconds, and connect the end of the transducer tubing directly to the CVC port.
CVC port : IV tubing Connections

• PA catheter → Proximal lumen

• CVC with multiple lumens → distal port

• PICC → any port

If using a pulmonary artery (PA) catheter, use the proximal lumen for continuous CVP monitoring. If using a central venous catheter (CVC) with multiple lumens, use the distal port for continuous CVP monitoring. Trace tubing and ensure that it is connected to the proper port.
Zeroing the Transducer

When does leveling and zeroing of the transducer need to be completed?

Whenever the air-fluid interface and whenever the reference point changes.

Position change, Q shift, when accuracy of waveform reading is questionable.
Zeroing the Transducer

1. Place HOB from zero to 45 degrees
   Supine is recommended

2. Position the patient and the transducer at the same level

3. Make sure the transducer is located at the phlebostatic axis
Zeroing the Transducer

With a carpenter’s level or yard stick move the transducer up or down along the IV pole so that the transducer is located at the phlebostatic axis (right atrium of the heart – 4th intercostal space, midaxillary line).

This ensures the accuracy of the readings by eliminating hydrostatic forces on the transducer.
- If transducer is too high will have falsely low BP readings.
- If the transducer is too low will have falsely elevated BP readings.
Zeroing the Transducer

• Turn the stopcock just above the transducer off to the patient’s arterial catheter ... “off to the patient”
Zeroing the Transducer

• Zero Balance & Calibrate the Transducer by:
  – Open stopcock on transducer to port or “air”
  – Remove dead-end cap
  – Activate flush device
  – Press zero button on bedside monitor (will read 0)
  – Hold down 100mmHg calibration button to eliminate drift (will read 100)
  – Return stopcock back to port/monitoring position
  – Replace dead-end cap
Once Transduced...

A distinct “a” wave in the CVP trace due to atrial contraction

http://www.dynapulse.com/educator/webcurriculum/chapter%203/abnormal%20ekg%20and%20waveform.htm
Maintaining a CVP Line

• Assess flush system every 4 hours to ensure pressure bag is inflated to 300mmHg and that fluid is present in flush solution

• Evaluate the patient regularly for signs or symptoms of catheter-related infection

• Evaluate pressure monitoring system regularly for air bubble formation and remove if present
Maintaining a CVP Line

- Assess the CVP line flush system every 4 hours to ensure that the pressure bag device is inflated to 300mmHg and that fluid is present in the flush solution.

- Continuously observe the CVP waveform quality on the monitor and record variances to ensure the accuracy of the waveform and to detect changes in the patient's hemodynamic status. A normal CVP waveform has a, c, and v waves.

- Evaluate the patient regularly for signs or symptoms of catheter-related infection, which can include (but are not limited to) fever, chills, tachycardia, increased white blood cell count, redness or swelling at catheter insertion site, and positive blood cultures.

- Evaluate the intra-arterial pressure monitoring system regularly for air bubble formation, which can lead to potentially lethal air emboli. Remove air emboli by flushing through a system stopcock.
Precautions & Key Points

• Monitor alarms set at appropriate limits

• Obtain baseline data including vital signs, level of consciousness, and hemodynamic stability to help identify acute changes in the patient.

• Ensure that pt is still while CVP reading is being taken – measure at end expiration

• If CVP fluctuates by more than 2mmHg suspect change in clinical status and report
Precautions & Key Points

• If using a pulmonary artery (PA) catheter, use the proximal lumen for continuous CVP monitoring. If using a central venous catheter (CVC) with multiple lumens, use the distal port for continuous CVP monitoring. Trace tubing and ensure that it is connected to the proper port.

• Ensure that the patient is still while the CVP reading is being taken to prevent artifact.
Precautions & Key Points

• Read the CVP value by measuring the mean of the a wave at end expiration.

• Understanding the a, c, and v waves and how they relate to cardiac function is necessary to accurately interpret the CVP waveform. The a wave reflects right atrial contraction. The c wave reflects closure of the tricuspid valve. The v wave reflects the right atrial filling during ventricular systole. The CVP measurement is the mean of the a wave.
Precautions & Key Points

- Transparent dressings should be changed every 7 days and PRN
- Assess catheter necessity daily
- Complications of CVP monitoring include sepsis, thrombus, vessel puncture, and air embolism.
Documentation

• Position for zeroing the transducer
• CVP readings, interventions, outcomes, and if MD was notified
• Dressing, tubing, flush solution changes, and discontinuation of line
References


