HEMODYNAMIC MONITORING, Part 1

Critically ill patients require continuous assessment of their cardiovascular system to diagnose and manage their complex medical conditions. This is most commonly achieved by using direct pressure monitoring systems, often referred to as hemodynamic monitoring. Pulmonary artery pressure (covered in Part 1), central venous pressure (CVP), and intra-arterial blood pressure (BP) monitoring (explained here) are common forms of hemodynamic monitoring; non-invasive hemodynamic monitoring is used in some facilities. For invasive monitoring, specialized equipment is necessary, including:

- a CVP, pulmonary artery, or arterial catheter, which is introduced into the appropriate blood vessel or heart chamber
- a flush system composed of intravenous (I.V.) solution (which may include heparin), tubing, stopcocks, and a flush device, which provides for continuous and manual flushing of the system
- a pressure bag placed around the flush solution that’s maintained at 300 mm Hg of pressure; the pressurized flush system delivers 3 to 5 mL of solution per hour through the catheter to prevent clotting and backflow of blood into the pressure monitoring system
- a transducer to convert the pressure coming from the artery or heart chamber into an electrical signal
- an amplifier or monitor, which increases the size of the electrical signal for display on an oscilloscope.

collateral circulation exists and the cannulated artery became occluded, ischemia and infarction of the area distal to that artery could occur. You can check collateral circulation to the hand by the Allen test to evaluate the radial and ulnar arteries or by an ultrasonic Doppler test for any of the arteries. With the Allen test, compress the radial and ulnar arteries simultaneously and ask the patient to make a fist, making his hand blanch. After the patient opens his fist, release the pressure on the ulnar artery while maintaining pressure on the radial artery. The patient’s hand will turn pink if the ulnar artery is patent.

Nursing Interventions: Site preparation and care are the same as for CVP catheters. The catheter flush solution is the same as for pulmonary artery catheters. A transducer is attached, and pressures are measured in millimeters of mercury (mm Hg). Complications include local obstruction with distal ischemia, external hemorrhage, massive ecchymosis, dissection, air embolism, blood loss, pain, arteriospasm, and infection.


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Central venous pressure monitoring

You’ll use the CVP—the pressure in the vena cava or right atrium—to assess right ventricular function and venous blood return to the right side of the heart. The CVP can be continuously measured by connecting either a catheter positioned in the vena cava or the proximal port of a pulmonary artery catheter to a pressure monitoring system. The pulmonary artery catheter is used for critically ill patients. Patients in general medical-surgical units who require CVP monitoring may have a single-lumen or multilumen catheter placed into the superior vena cava. You can obtain intermittent measurement of the CVP using a water manometer.

Because the pressures in the right atrium and right ventricle are equal at the end of diastole (0 to 8 mm Hg), the CVP is also an indirect method of determining right ventricular filling pressure (preload). This makes the CVP a useful hemodynamic parameter to observe when managing an unstable patient’s fluid volume status. CVP monitoring is most valuable when pressures are monitored over time and are correlated with the patient’s clinical status. A rising pressure may be caused by hypervolemia or by a condition, such as heart failure (HF), that results in decreased myocardial contractility. Pulmonary artery monitoring is preferred for patients with HF. Decreased CVP indicates reduced right ventricular preload, most often caused by hypovolemia. This diagnosis can be substantiated when a rapid I.V. infusion causes the CVP to rise. (CVP monitoring isn’t clinically useful in a patient with HF in whom left ventricular failure precedes right ventricular failure, because in these patients an elevated CVP is a very late sign of HF.)

Before CVP catheter insertion, clip (don’t shave) the site and cleanse it with an antiseptic solution. A local anesthetic may be used. The physician threads a single-lumen or multilumen catheter through the external jugular, antecubital, or femoral vein into the vena cava just above or within the right atrium.

Nursing Interventions: After the CVP catheter is inserted and secured, you’ll apply a dry, sterile dressing. Catheter placement is confirmed by a chest X-ray. Inspect the site daily for signs of infection. Change the dressing and pressure monitoring system or water manometer according to hospital policy. Keep the dressing dry and air occlusive, and use sterile technique when changing dressings. You can use a CVP catheter to infuse I.V. fluids, administer I.V. medications, and draw blood specimens in addition to monitoring pressure. To measure the CVP, place the transducer of the pressure monitoring system (or the zero mark on a water manometer) at a standard reference point, called the phlebostatic axis. After locating this position, mark the location on the patient’s body. If you use the phlebostatic axis, you can correctly measure CVP with the patient supine at any backrest position up to 45 degrees. The range for a normal CVP is 0 to 8 mm Hg with a pressure monitoring system or 3 to 8 cm H₂O with a water manometer system.

Watch for common complications of CVP monitoring, such as infection and air embolism.

Intra-arterial blood pressure monitoring

Intra-arterial BP monitoring is used to obtain direct and continuous BP measurements in critically ill patients who have severe hypertension or hypotension. Arterial catheters are