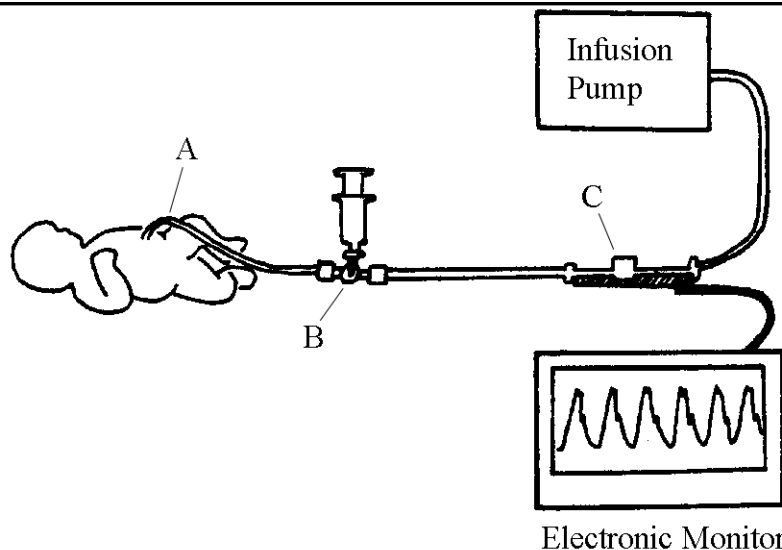


## Intensive Care Nursery House Staff Manual

### Blood Pressures

Measure intravascular pressure continuously in all infants who have:

- Arterial catheters (umbilical or peripheral)
- Umbilical venous catheters
- Central venous catheters (Unless the infant's cardiorespiratory status is stable and catheter was inserted only for intravenous alimentation.)



**Figure 1. Diagram of system used for measuring intravascular pressures.**  
A, umbilical catheter; B, stopcock; C, pressure transducer.

**TECHNIQUE:** Figure 1 shows the system for continuous direct measurement of intravascular pressures. Calibration of the system is done electronically. To apply **zero pressure** to the transducer, turn the stopcock (B in Figure 1) off to the baby and remove the syringe. This allows the transducer to read atmospheric (or zero) pressure. For this measurement, the **stopcock must be at the level of the infant's midthorax.**

**(Never turn the stopcock so that the catheter is open to the atmosphere; serious hemorrhage can occur!)**

**ARTERIAL BLOOD PRESSURE** varies directly with birth weight. Normal values for mean, systolic, diastolic and pulse pressures are shown in Figure 2. **Before treating an infant for an abnormal blood pressure (arterial or venous), be certain that the calibration is accurate and that the zero pressure measurement has been checked.**

#### A. Causes of abnormal blood pressure:

##### 1. Abnormal mean arterial blood pressure

(a) **Hypotension** may be caused by:

- Hypovolemia
- Shock (from any cause)
- Tension pneumothorax or other severe air leak
- Improper catheter position (e.g., pointing down femoral a. or through ductus arteriosus into pulmonary a.)

•Excessive ventilatory pressures that impede venous return to the heart. To test for this, briefly disconnect the ventilator from the endotracheal tube. If ventilatory pressures are excessive, arterial pressure will rise in <10 sec.

- Marked alkalosis and hypocarbia
- Myocardial failure due to:
  - Asphyxia
  - Hypocalcemia
  - Congenital heart disease (left sided obstructive lesions)
  - Cardiomyopathy
  - Cardiac arrhythmias
- Drugs (*e.g.*, PGE<sub>1</sub>, nitroprusside, isoproterenol, vancomycin [if infused rapidly])

**(b) Hypertension** may be caused by:

- Hypercarbia, moderate asphyxia
- Polycythemia
- Renovascular disease
- Drugs (*e.g.*, dopamine, epinephrine, phenylephrine)
- Hypovolemia usually **does not cause systemic hypertension, but may cause pulmonary hypertension.**
- Pain

## 2. Abnormal arterial pulse pressures

**(a) Narrow pulse pressure** may be caused by:

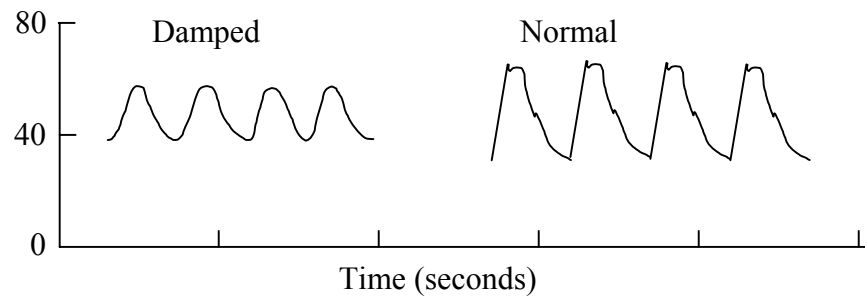
- Damping of pulse wave (See below)
- Tension pneumothorax or other severe air leak
- Improper catheter position
- Congenital heart disease (*e.g.*, coarctation of aorta, aortic stenosis)
- Myocardial failure
- Shock

**(b) Wide pulse pressure** may be caused by:

- Patent ductus arteriosus
- Arterio-venous malformation
- Truncus arteriosus
- Vasodilator drugs

**B. Damping** of the blood pressure tracing is due to decreased frequency response of the system. It abnormally narrows the pulse pressure and should be suspected when the dicrotic notch is not visible on the blood pressure tracing. An example of damping of an arterial pressure tracing is shown in Figure 3. Damping can be caused by:

- Air bubbles in the catheter system or transducer
- Blood in the catheter system
- Clot in the catheter
- Thrombosis of the artery
- Kinking of the catheter (with peripheral arterial catheters)
- Abnormal position of catheter tip (*e.g.*, UAC pointed down a femoral a.)
- Damping of venous blood pressure also can occur (*e.g.*, when UVC tip is against the atrial wall or wedged in the liver or a pulmonary vein)



**Figure 3. Damped blood pressure tracing measured through an umbilical arterial catheter in a newborn infant.** The damping was caused by an air bubble in the catheter system. When the bubble was removed, the fidelity of the tracing improved and both the anacrotic and dicrotic notches could be detected.

Damping will affect systolic, diastolic and pulse pressures. However, in most cases, the **mean pressure will be accurate.**

1. If there is damping of an umbilical arterial or venous pressure wave form and the damping cannot be corrected by removing blood and/or bubbles from the system, remove the catheter. **Do not flush a damped catheter.** This may cause embolism with disastrous consequences.
2. Damping of the pressure wave from a peripheral arterial catheter is less serious and can be tolerated if the catheter samples well. Do not vigorously flush a damped peripheral arterial catheter because of the risk of retrograde emboli.

**INDIRECT MEASUREMENT OF ARTERIAL BLOOD PRESSURE** can be done with a cuff and an electronic monitor. In stable infants, indirect blood pressure is usually accurate. However, in some cases, indirect blood pressure is inaccurate and may be misleading (*e.g.*, shock, marked vasoconstriction, extremely LBW infants).

When indirect blood pressure does not agree with directly measured arterial blood pressure, **the direct measurement is more accurate** if the calibration is correct and the zero pressure has been adjusted accurately.

**CENTRAL VENOUS PRESSURE (CVP):** In most cases, the trend in CVP (over several minutes to hours) is more helpful than the absolute value of the CVP. CVP may be difficult to interpret because it is affected by several factors.

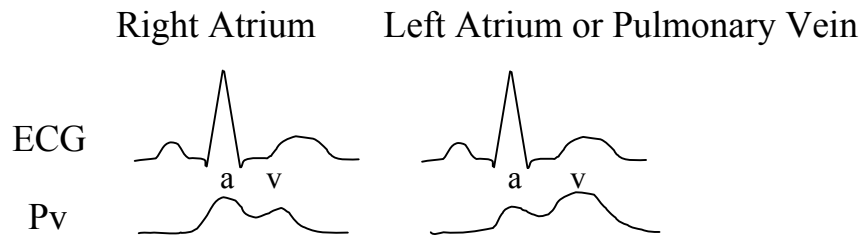
**A. Increased CVP** may be caused by:

- Hypervolemia
- Excessive ventilatory pressures
- Tension pneumothorax
- UVC tip in portal system (*i.e.*, not central venous)
- Myocardial failure (from any cause)
- Grunting respirations
- Pleural effusion

**B. Decreased CVP** may be caused by:

- Hypovolemia
- Deep inspiratory retractions

**C. Location of UVC Tip.** It may be difficult to know if the UVC tip is in right or left atrium even with radiographs and measurements of  $PO_2$ . Comparison of the CVP tracing with the ECG tracing can be helpful. In right atrium, the “a” wave is dominant; in left atrium and pulmonary veins, the “v” wave is dominant (Figure 4).



**Figure 4. Relationships of right and left atrial pressures to ECG in newborn infants.**  
a, atrial “a” wave; v, atrial “v” wave; ECG, electrocardiogram; Pv, venous pressure

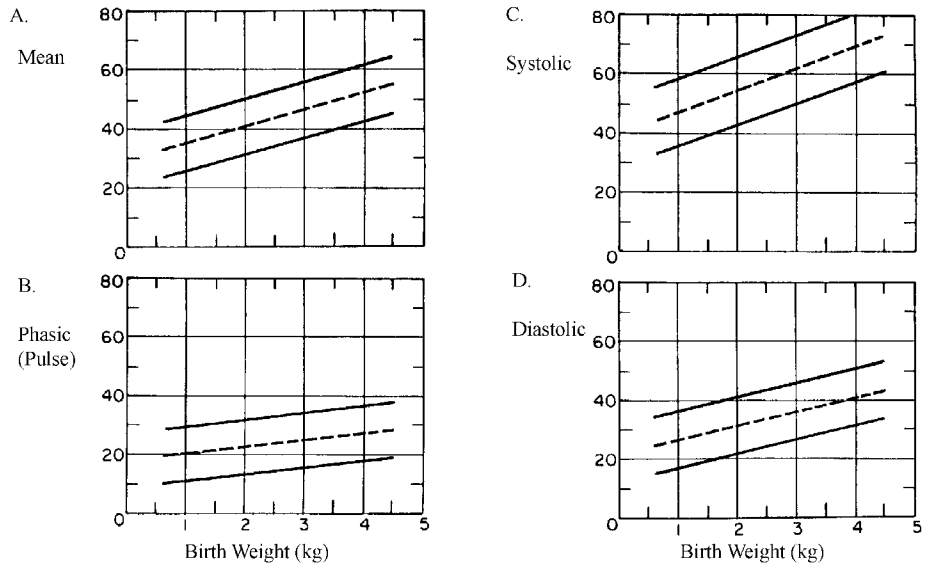


Figure 2. Average values (dashed lines) and normal ranges (solid lines) for arterial blood pressures according to birth weight in newborn infants. A. Mean, B. Phasic (pulse), C. Systolic, and D. Diastolic Pressures. All values are in mmHg. Adapted from Vermold, et al.: Aortic blood pressure during the first 12 hours of life in infants with birth weight 610 to 4,220 grams. *Pediatrics* 67:607-613, 1981.