

Measuring Blood Pressure

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Blood pressure is a vital sign which should be measured in all critical neonates. Except in cases with severe hypotension and vasoplegia, indirect measurements using the oscillometric technique is generally adequate. With this technique, as the pressure in the cuff falls below the systolic pressure, the artery begins to pulsate. These pulsations are transmitted to the cuff and oscillations are sensed by a transducer. The pressure transmitting maximum oscillations closely correlates to the mean blood pressure. The pressure at which the cuff oscillations begin is recorded as the systolic pressure and the pressure at which the oscillations stop decreasing is recorded as the diastolic pressure. The instrument eliminates internal artifacts by maintaining the level of cuff pressure deflation until 2 consecutive oscillations of equal amplitude are detected. Although the technology differs somewhat between monitors from different manufactures, once the mean pressure is identified, algorithms are used to fine tune systolic and diastolic values and eliminate artifacts. Still, it cannot differentiate external stimuli so it is best to use when the patient is in a resting state. When used correctly, blood pressure measurements obtained by this method correlate well with direct, intraarterial recordings unless the neonate is suffering from severe hypotension and vasoplegia, when it may be impossible to obtain a reading.

To minimize errors of noninvasive blood pressure measurements careful attention to technique is important. First the cuff should encircle at least 80% of the part's circumference (100% or more is best) and the width should be at least 40% (up to 70%) of the part's circumference. The same size cuff should be consistently used to minimize artifactual variation. The cuff should be placed on the same body part each time and should have the same vertical relationship to the heart. In the foal, the tail is the most convenient site. The blood pressure should be measured during a quiet or sleep state. Blood pressure values obtained during activity, full arousal and especially when standing or heavily restrained have little relationship to the physiologic state of perfusion. It may take some perseverance to obtain readings while minimally disturbing the patient. Because of the likelihood of artifacts, at least 3 measurements should be taken, to insure consistent results. If the results are not consistent more should be obtained until consistent results are found. The mean value is less likely to be erroneous compared to systolic and diastolic pressures. Blood pressure values will tend to decrease with repeated measurements but the differences will be small in magnitude. In addition, a heart rate should be measured while the blood pressures are measured to compare to the heart rate derived by the machine. If the 2 values don't correlate, the blood pressure results won't be accurate.

Steps for Measuring Blood Pressure in the Neonate

1. The blood pressure monitor should be charged between uses so should be found plugged into an outlet (don't forget to plug it in when your done so that it is ready for the next measurement!). With a charged battery it is not necessary to have the monitor plugged in during the measurement. Take the monitor to the stall.
2. Locate the cuff used on the foal. It should be on the foal's cart. It is very important not to share cuffs between foals and to use the same cuff for repeat blood pressure measurements. Be sure to return the cuff to the cart and not leave it on the monitor at the end of the procedure.
3. Place the cuff snugly on the foal's tail at the base using the Velcro. The bladder should encircle the tail, but if it doesn't, be sure the cuff completely covers the artery being used (on the ventral aspect of the tail). Be sure the cuff stays in place during inflation.
4. Push the "NIBP Start" button and let the monitor measure the pressure.
5. While the monitor is working, take a heart rate. If your heart rate and the monitor's heart rate are not similar, the blood pressure result should be considered erroneous and discarded.
6. A series of at least 3 reading should be taken. The results should be similar (especially the mean value). If they are not, more readings should be taken until consistency is found.
7. The results should be recorded on the BP flow sheet. There is room for a series of 3 readings, but you should record each one you do (even if there are 6 or 8) unless it is clearly erroneous (e.g. heart rates don't match). If you are helping in an emergency and a flow sheet is not available, you should record your results in the record on a progressive sheet using the convention: systolic value/diastolic value (mean) heart rate such as 64/38(44) 95.

Measuring PCV, TP, dextrose

Although you may feel that measuring PCV, TP and dextrose are very simple procedures that you have performed before, for various reasons, at least a third of the measurements performed by 2nd year students are erroneous. Please take note of the following hints that may help you obtain accurate results.

1. *Be sure you are using the correct materials for the situation.* There are 2 types of microhematocrit tubes. The red ringed tubes contain heparin and should be used if the blood sample has not been placed in a tube with an anticoagulant. Thus if the sample is drawn right from a needle in the vein or if the sample is drawn in a syringe and then placed directly into the microhematocrit tube, a red ringed tube must be used. The blue ringed microhematocrit tube does not contain an anticoagulant and should be used for samples from blood tubes that already contain an anticoagulant. (Hint: if when breaking the tube to remove the plasma to run a TP value the plasma comes out in a gel like liquid, the sample has clotted and neither the PCV nor TP will be accurate).
2. *When a blood sample is taken, it must be immediately placed in the microhematocrit tube or constantly agitated in order to obtain an accurate PCV.* Horse RBCs settle out of blood rapidly resulting in a heterogeneous sample. This will occur in a TB syringe as well as in blood tubes. It is more difficult to resuspend the sample in a TB syringe, so samples drawn in TB syringes should be drawn into microhematocrit tubes within 1-2 minutes of obtaining the sample. Samples taken in larger syringes or placed in blood tubes should be constantly agitated by gently turning or rolling them to keep them well mixed. If they are not for even a short time, they should be gently agitated for at least 3 to 4 minutes before a sample is taken.
3. *To insure the sample is well mixed, 2 samples should be run.* Two microhematocrit tubes should be filled from the sample, but the sample should be mixed between. In that way, if the results from the 2 tubes are different, you will know that the sample was not well mixed.
4. *Be sure to line up the microhematocrit tube properly on the measuring chart.* The bottom of the blood (not the clay) should be aligned with the zero line and the middle of the plasma meniscus must be aligned with the 100% line and the tube aligned perpendicularly using the perpendicular guide lines.

5. *When using the TS meter focus it by turning the objective to get a clear reading.* Also remember that although it is called a TS (total solids) meter, the result you get is TP (total protein). TS is a measurement of all of the refractive solids in plasma which includes creatinine, glucose and other blood solids as well as proteins, but proteins make up almost all of the total solids. The scale in all of the TS meters you will use converts the refractive index into TP (when reading the result, note “TP g/dl” next to the scale you are reading).
6. *Check to see if your result is consistent with past results.* How do you know if your results are correct? Check the earlier results. You should be entering your result into the Dextrose/PCV/TP flow sheet. Check earlier results as recorded on that sheet. If your results are different ask a clinician/nurse/4th year student if this is expected and find an explanation why or trouble shoot your technique to find where you have gone wrong so you can get consistent results the next time.
7. *When running a dextrose level using the Accu-Chek[®] Advantage[®] dextrometer remember the following:*
 - a. *Check to make sure the test strip code is correct.* When you turn on the dextrometer, a 3 digit code will flash on the view panel. It should be the same as the code on the bottle of test strips.
 - b. *Do not expose the test strips to air for any period of time.* Don’t “preload” the dextrometer with a test strip before the blood sample is obtained and don’t leave to top off the test strip container. Exposing the test strips to air for a long period will make them inaccurate.
 - c. *Make sure the golden grid on the test strip is completely covered with blood.* If you can see the golden grid through your sample, you have too little blood for an accurate reading.