

BLOOD PRESSURE MONITORING IN CATS

Monitoring of vital signs, reflexes and anesthetic depth is critical to support patient safety and adjust anesthetic depth. Monitoring of blood pressure is reviewed below.

Cardiovascular Monitoring

Low blood pressure can lead to inadequate tissue perfusion, hypoxia and compromised organ function. As anesthetists, we are responsible for supporting homeostasis, or optimal organ function, in our anesthetized patients. Thus, blood pressure should be monitored in every anesthetized animal and steps taken to prevent and treat hypotension. Hypotension occurs when mean arterial pressure (MAP) falls below 70 mmHg or systolic arterial pressure (SAP) is less than 100 mmHg.

The goal of the cardiovascular system is delivery of oxygen to tissues. Adequate blood flow is dependent upon cardiac output – the amount of blood the heart pumps to the periphery. Cardiac output depends upon blood pressure and vascular resistance. Measuring cardiac output is not yet routine in veterinary practice, therefore we rely upon measurement of blood pressure as an estimate of blood flow. Intra-arterial monitoring remains the gold standard for determining blood pressure, yet this invasive procedure is not warranted for most veterinary patients. Non-invasive techniques are used routinely and provide valuable information about trends in blood pressure.

The Doppler blood pressure monitor uses an ultrasonic crystal that emits sound waves that bounce off moving red blood cells. An audible signal reflects the flow of red blood cells past the crystal. Manual inflation of a cuff occludes the artery proximal to the crystal. As the cuff is gradually deflated, the first audible sound correlates with SAP. Cuff size should be 30 – 40% of limb circumference. A cuff that is too large will falsely lower blood pressure; a cuff that is too small will falsely elevate blood pressure. The major advantages of Doppler blood pressure monitors include 1) detection of blood flow, 2) reliable measurements in patients of all sizes, and 3) an audible signal of heart rate. Two disadvantages of the Doppler are that it only provides information about SAP and that manual cuff inflation is required.

An oscillometric blood pressure monitor has a sensor that detects oscillations in the cuff caused by pulsatile blood flow. The monitor automatically inflates the cuff until oscillations are no longer detected (i.e., until pulsatile blood flow has been occluded). As the cuff deflates, cuff pressure and the magnitude of returning oscillations are measured and converted into SAP, MAP and diastolic arterial pressure (DAP). The PetMAP monitor is an oscillometric-type blood pressure monitoring. As with the Doppler blood pressure monitor, cuff width should be 30 – 40% of the limb circumference; inappropriate cuff sizes alter the measurements as mentioned above. The major advantages of oscillometric monitors include 1) measurements of SAP, MAP and DAP (MAP is most reliable), and 2) automatic cuff inflation. One disadvantage of oscillometric monitors is that measurements are unreliable in very small (< 5 kg) patients.

Another disadvantage is that readings are inaccurate during tachycardia, bradycardia, dysrhythmias, severe hypotension and movement.

Prevention of hypotension is the best “therapeutic” approach. Because drug-induced vasodilation may be the most common cause of hypotension in anesthetized animals, reducing the dose of vasodilating anesthetic agents, particularly isoflurane/sevoflurane, will help minimize the incidence and severity of hypotension. Other common causes of hypotension in anesthetized animals include hypothermia, bradycardia and anesthetic-induced cardiovascular depression. Administering intravenous crystalloid fluids, reducing the dose of cardiovascular depressant drugs, administering glycopyrrolate or atropine to maintain heart rate and providing temperature support are additional steps that may be taken to prevent hypotension.

The basic approach to treatment of hypotension (MAP < 70 mmHg or SAP < 100 mmHg) is to reduce the concentration of inhalant anesthetic. Then provide an intravenous crystalloid fluid bolus of 3 – 10 ml/kg; repeat the crystalloid fluid bolus once, if needed. If hypotension persists, consider slowly administering a colloid fluid bolus (eg., Hetastarch or Vetstarch) at a dose of 1 – 5 ml/kg, IV for cats. If these interventions are inadequate to support blood pressure, additional techniques such as balanced anesthesia or cardiovascular support drugs or other measures may be necessary.

Blood Pressure Monitoring Summary

- A Doppler ultrasonic blood pressure monitor is appropriate and most reliable for monitoring blood pressure in patients less than 5 kg. A Doppler can be used in patients weighing > 5 kg.
- A Doppler is strongly recommended as a back-up monitor for all patients.
- An oscillometric blood pressure monitor is appropriate and reliable for monitoring of patients larger than 5 kg, only IF the patient 1) is not tachycardic or bradycardic, 2) does not have any arrhythmias, and 3) is not hypotensive or hypothermic. If these factors exist, a Doppler blood pressure monitor is indicated.
- The appropriate cuff width is equal to 30 – 40% of the circumference of the limb.
- Cuffs may be placed on the forelimb (below or above the elbow), hind limb (above the hock) or at the base of the tail.
- If the Velcro attachment is not functioning, use a single wrap of VetWrap to secure the cuff. Do not encircle the cuff with white tape because it will prevent the cuff from inflating properly.
- For both dogs and cats, systolic blood pressure should be greater than 100 mmHg.
- Mean arterial pressure should be greater than 70 mmHg.
- Initiate treatment for hypotension if Systolic arterial pressure is less than 90 mmHg or Mean arterial pressure is less than 60 mmHg. Modify treatment if patient does not respond within 10 – 15 minutes. In medically fragile patients, consider discontinuing anesthesia and staging the procedure if hypotension does not respond to treatment.