Use of the Doppler Blood Pressure Monitor for the Hypertensive Feline Patient

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Hypertension in Feline Patients

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Definition

Hypertension, commonly called high blood pressure, is a sustained elevation in either systolic or diastolic arterial blood pressure above normal range. Several values are found in the current veterinary literature for what constitutes hypertension in cats. Some authors feel that systolic values above 160 mmHg are abnormal. Other authors define hypertension as systolic values above 200 mmHg. It has been shown that stress and environmental factors can influence blood pressure readings; therefore, some of the variation in these values is likely due to the conditions under which the readings were made. However, there appears to be universal agreement that systolic readings above 200 mmHg are abnormal.

Causes

Primary or essential hypertension is a common disease in humans. However, it is apparently a rare disease in the cat, if it occurs at all. Most cases of feline hypertension have been closely related to two disease mechanisms: 1) Diseases that increase peripheral resistance (chronic renal failure), and 2) Diseases that increase cardiac output (hyperthyroidism).

Chronic renal disease is the most common disease that increases peripheral resistance. A very simplified explanation states that aged, shrunken kidneys, that normally receive 20% of the cardiac output, are unable to accommodate that amount of blood. Therefore, blood is regurgitated into the aorta. However, many cats that are hypertensive only have a slight degree of azotemia and may have kidneys of relatively normal size.

This observation has caused us to seek other explanations. Several rationales have been given for how hypertension is related to renal failure in human patients. These include failure to excrete a normal quantity of salt or fluid, stiffening of the venous capacitance system, alterations in adrenergic activity, activation of the renin-angiotensin-aldosterone axis with increased peripheral resistance and salt retention, stimulation of renopressor systems, and suppression of renodepressors or prostaglandins. However, none of these has been proved. One study (JAAHA 11/94) found that 65% of cats with chronic renal disease were hypertensive.

Hyperthyroidism is the most common disease that causes increased cardiac output. Thyrotoxic cardiomyopathy is a common finding in hypertensive cats. It has several effects on the feline heart, the sum of which result in tachycardia, left ventricular hypertrophy, and increased contractility. The heart is hyperkinetic, resulting in increased cardiac output. One study found that 23% of hyperthyroid cats were hypertensive.

It is important to understand these mechanisms and their likely causes. The clinical impact is that documented hypertensive cats should have a diagnostic workup that includes renal and thyroid tests.

Clinical Signs

The typical clinical presentation for hypertensive cats is sudden onset retinal blindness. Owners report that their cats have suddenly started walking into walls and furniture. Since this presentation is so dramatic, we are likely to see these cats only a few hours after the onset of blindness, a fortunate occurrence therapeutically.
Retinal blindness associated with hypertension is usually due to retinal detachment. The detached and folded retina can be seen with a direct or indirect ophthalmoscope. However, in many cats, the changes are so dramatic that they may be seen without special equipment. (Figures 1a, b)

Another clinical sign is retinal hemorrhage, which usually precedes retinal detachment. Most cats with retinal hemorrhage, but without detachment, are not blind. However, these cats may exhibit reduced pupillary light reflex or, if unilateral, anisocoria. (Figure 2)

Hypertension may cause arterial bleeding in other organs, including the brain, which may result in stroke-like signs of seizures, incoordination, circling, or excessive vocalization. (Figure 3)
Diagnosis

When retinal blindness occurs in a geriatric cat, it is important to consider hypertension as the first differential. Rapid commencement of therapy is extremely important in restoring vision, so blood pressure readings should be performed first. Blood pressure can be measured directly with intraarterial catheterization and by using several indirect methods. However, Doppler technology is the one that is non-invasive, non-stressful, and reliable in cats. The technique is described below.

Other signs of hypertension may be detected. Palpation or auscultation of the heart usually reveals a pounding beat. Filling of a syringe during blood collection from a peripheral vein, such as the cephalic, is much faster. Both of these should heighten one’s index of suspicion for hypertension. Clinical findings that may signal one of the causes of hypertension are decreased renal size, as determined by palpation, radiography, or ultrasound, and a palpable thyroid lobe.

Appropriate diagnostic tests include a CBC, chemistry profile,T4, urinalysis, and abdominal and cardiac imaging (radiographs or ultrasound). (Figure 4) These tests usually reveal the presence of renal disease, thyroid disease or both.

If your geriatric patient with retinal blindness is not hypertensive, other causes of retinal blindness should be considered. Tests for feline infectious peritonitis, FeLV antigen, toxoplasmosis, and fungal diseases are appropriate.

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Using the Doppler Blood Pressure Monitor

The doppler blood pressure monitor detects the flow of blood in arteries. The radial, cranial tibial, and median coccygeal arteries are the most practical to monitor. Our preference is the cranial tibial artery because the hair clipping that is required is least noticeable. However, the other two arteries are acceptable and preferred by some. When the median tibial artery is used, a 2-4 cm cuff is placed above the hock. The width of the cuff is critical when using oscillometric technology, but it is not as critical with Doppler technology.

Stress is a significant factor that must be minimized to get meaningful blood pressure readings. Following an automobile ride to your hospital, allow your patient a few minutes to rest in a quiet place. Be sure your patient is not exposed to dogs and other cats. If possible, place your client and patient in a quiet examination room and have the owner hold and reassure it for a few minutes. The presence of the owner is very helpful in relieving your patient’s stress. Take advantage of this, if possible.

Simple Steps for Success

1) Assemble the Doppler unit before addressing the cat. Plug in the headphones and place the ear pieces over your ears.

2) Have the owner hold the cat on your examination table. Placing a towel or blanket under the cat can help make it more comfortable and more relaxed.

3) Clip a 1 x 2 cm patch of hair immediately proximal to the tarsal pad or carpal pad or on the ventral surface of the tail about 4-5 cm from the body, depending upon which artery is to be used. (Figure 5)

4) Position the cuff proximal to the hock, proximal to the elbow, or at the base of the tail, depending upon which artery is to be used.

5) Turn on the unit and set the volume in the high range. If the volume is too low, arterial sound may not be detected.

6) Apply a thin coat of coupling gel to the skin.
7) Apply coupling gel to the ventral surface of the transducer.

8) Position the transducer over the artery. The median tibial artery is usually slightly medial to midline. It will be necessary to move the transducer until the swishing of the blood is heard in the artery. Hold it in place with your thumb. (Figure 6) It may be necessary to apply firm pressure to assure proper contact between the transducer and the skin.

9) Squeeze the bulb on the manometer until the pressure in the cuff exceeds that of the artery. At that point the swishing of blood in the artery will no longer be heard. (Figure 7) Note that filling the cuff too rapidly may frighten your patient.

10) Slowly bleed off the pressure in the cuff by squeezing the manometer’s trigger. When the pressure in the cuff falls below the arterial pressure, the arterial swishing sound can be heard again. This should be noted and recorded as the systolic pressure.

11) The conventional approach is for seven measurements to be taken. Discard the high
and low readings and average the remaining five. This is considered the systolic blood pressure and is measured in mmHg. However, some stressed cats may relax during the course of the examination. These cats will have several readings at a higher level followed by several at a lower level. The former should be ignored, and the latter considered as the accurate ones.

The diastolic pressure can be detected in some cats by closely watching the dial of the manometer. It oscillates at the diastolic pressure level. However, a reproducible reading is not always possible, especially in cats that are stressed due to catecholamine influence (that makes the vessels more stiff than normal), cats that are cold, and very small patients. However, the important measurement is systolic blood pressure in the cat.

**Technique Tips**

Do not tape the transducer in place, as is recommended by some. The slightest movement of the cat's foot or leg will often move the transducer enough that the arterial sounds are lost. Instead, hold the transducer in place with your thumb. If the artery is lost, slight movement of your thumb can relocate it. This is much faster than having to untape and retape.

Firm pressure is required to make adequate contact between the transducer and the skin. However, do not place too much pressure on the transducer with your thumb or you will mechanically shut off the artery with the transducer.

Use the maximal volume that is comfortable to your ears. Too little volume may cause you to miss the sounds.

Use the headphones. Although they are somewhat cumbersome, they minimize the stress of the procedure. The sounds of the external speaker frightens many cats, elevating their blood pressure. The headphones bypass the external speaker so the cat no longer hears the harsh sounds. (Figure 8)

Comfortably extend the cat's leg. If it is flexed, the blood flow through the artery may be abnormally restricted giving no readings or falsely low readings. (Figures 9a, b)

You may notice that the blood pressure readings decline as you are making the seven measurements. This means that the cat is more comfortable and less stressed. These are actually more accurate readings, so discard the ones that were initially made.

The transducer is fragile (and expensive to replace). It may be damaged by dropping it or by striking it against something solid. Treat it with utmost care.

The use of ultrasound gel is essential for making good contact between the transducer and the skin. However, do not use ECG paste or baby oil. These products may cause deterioration of the resin surface of the transducer.

Ultrasound gel is water soluble. Remove it from the transducer after each use.

Figure 8: Headphones are used to bypass the external speaker to prevent frightening the cat.
**Treat the Underlying Disease**

Cats with hyperthyroidism should be started on methimazole (Tapazole). The average initial dose is 5 mg q12h PO. Definitive treatment options for this disease are long-term methimazole, thyroidectomy, and radioactive iodine therapy. Most cats that are treated successfully for hyperthyroidism maintain a normotensive state without further specific blood pressure therapy.

Cats with renal failure should be considered for further diagnostics, including an ultrasound examination, renal biopsy, and excretory urogram, to further delineate the etiology of the renal disease. However, geriatric cats with very small kidneys are typically diagnosed with end-stage renal disease or idiopathic tubulointerstitial nephritis. Aggressive treatment for renal failure should commence. As the BUN and creatinine improve, blood pressure should be monitored. A few cats become normotensive and no longer need therapy for hypertension on a long-term basis.

**Summary**

Hypertension is a serious threat to geriatric cats because it is associated with two common diseases of elderly cats; hypertension and chronic renal failure. Blood pressure determinations should be performed on all aged cats for the purpose of early detection of hypertension and on all cats with retinal disease. Hypertension causes retinal blindness and can easily complicate the signs of cardiac disease and systemic metabolic disorders.

**Other Uses for Blood Pressure Monitoring**

A Doppler blood pressure monitor can also be used in the following situations:

1. As a surgical monitor: The transducer can be taped in place during surgery so the pulse can be audibly monitored in a hands-free fashion.

2. For suspected thromboembolic disease: Thromboembolic disease most often occurs secondary to hypertrophic cardiomyopathy. If blood flow impairment is suspected to any limb, the Doppler can be used to determine the blood flow in the distal artery of the limb. If a thrombus is present, the blood pressure will be very low or zero.

3. For suspected vascular compromise to a traumatized limb or tail: The Doppler can be used in a similar manner as above when vascular impairment is suspected due to trauma.

4. For monitoring renal failure patients: Hypertension may be an ongoing disease in cats that are undergoing treatment for chronic renal disease. The only way to know if hypotensive therapy is indicated and to properly adjust the dose is to perform serial blood pressure determinations.

**Suggested Readings**

