Palm Beach Veterinary Society
# NEWS

**Palm Beach Veterinary Society, Inc**
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**SUMMER 2023**



## *Inside the Issue*



**NEXT MEETING DATE**

**SEPT. 7, 2023**

**Location**
Mayacoo Lakes
Country Club

**Topic:**
**Purina Cardio Care Diet**

6:30-9:30 pm
Entry Fee: Free to 2023 Paid
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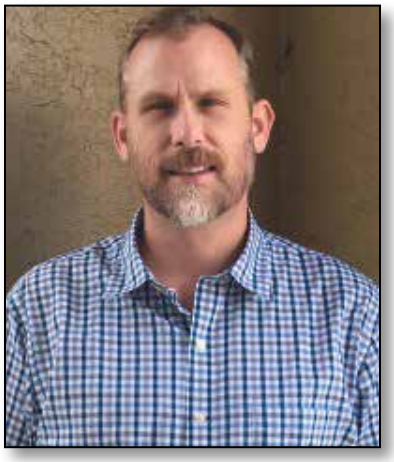
# Vet Society Members


Steve Simmons, DVM

Dear Palm Beach Vet Society Members,

How many hats do you wear? No, I am not talking about baseball caps, cowboy hats, and golf visors. I'm talking about the titles we give ourselves or that are given to us by others: Veterinarian, Parent, Spouse, Friend, Volunteer, Church member, Guitarist, Tik-Toc influencer, entrepreneur. Recently I went to a dinner party and was introduced as "Dr. Simmons. He's a veterinarian." Although I am proud to be a veterinarian and of my professional accomplishments, there is more to me than just being a veterinarian. Perhaps you feel this way sometimes too? Often, the public sees us as one-dimensional beings, namely a veterinarian only. They fail to see the person behind the scrubs and stethoscope as a whole person, who has other interests and hobbies. Personally, I like to go camping in the RV, go kayaking, and I especially love to spend time in the kitchen cooking and baking. If I was not a veterinarian, I'd probably be a chef.

I want to give a big thank you to all of you that turned out to our June meeting called F is for Fatigue. It was so great to hear about some of the hobbies and interests that you have. Margaret, I would love to see your orchid collection – It sounds beautiful! Natalie, who knew you played giant drums –so cool! Leanne, who knew you had a thing for wanting to dress chickens in tutus! Let's celebrate each other for the person we are beyond the veterinarian. I encourage each of you reading this to keep the momentum going and share a little more of yourself with your colleagues at the next meeting.

Whatever you are doing this summer – road trip to the Grand Canyon, chilling by the pool, or just enjoying a little down time – I hope you have fun and keep being you.

Sincerely,
Steve Simmons, DVM

celebrating 50 YEARS

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# FELINE HYPERTENSION: Getting Proactive - Starting Now

JUNE 2023, dvm360

**Veterinarian reluctance to recommend BP monitoring for this often-silent killer hinders early diagnosis, leaving patients at risk of severe clinical consequences.**

For most veterinarians, the thought of obtaining a feline patient's blood pressure reading is enough to raise their own blood pressure. In this busy world, it is easy to neglect preventive procedures, particularly challenging ones, to focus on what needs to be addressed urgently. And because most cats have no pathognomonic symptoms of hypertension (aka, the "silent killer") before developing target organ damage (TOD) involving the eyes, brain, heart, and kidneys,[1] blood pressure (BP) monitoring often falls off the radar. It can also feel like the stars need to align perfectly to get the proper clinic and patient conditions for an accurate BP reading. Throw in the concern for situational hypertension and a false-positive diagnosis of hypertension, and we can see why this procedure is not routine.

But it should be.

Recent online surveys of veterinarians found that although they more frequently recommend BP monitoring in cats with a comorbidity associated with hypertension, most do not recommend screening in senior feline patients presenting for wellness examinations.[2,3] Reasons for being reluctant to recommend BP monitoring in feline patients tend to include the difficulty of interpreting the results and identifying the next recommended steps in stressed feline patients, the time involved in obtaining a BP reading, and, in some cases, the cost to the owner.[2]

Results from these studies, combined with the high prevalence of feline hypertension, suggest that we may be overlooking many feline patients with hypertension. To potentially prevent the development of catastrophic and sometimes irreversible TOD and improve our patient's quality of life, we need to monitor BP proactively and routinely to identify this treatable condition early.

Implementing an effective and comprehensive BP monitoring program will not happen overnight; however, taking an incremental approach to BP monitoring will allow most general practitioners to find some of these missing hypertensive cats. To that end, this article will review the basics of feline hypertension; examine data on the prevalence of feline hypertension; offer tips, tricks, and resources on implementing routine BP monitoring and becoming more comfortable obtaining feline BP readings; and raise awareness on how you can contribute to our understanding of the disease.

## OVERVIEW OF FELINE HYPERTENSION

The basics BP is the pressure exerted by circulating blood on the walls of blood vessels. A patient's BP is typically referring to their arterial pressure. Depending on the device used, multiple readings may be provided when measuring a patient's BP, including systolic BP (SBP), mean arterial pressure, and diastolic BP. SBP is the pressure exerted on the vessels during systole, or when the heart is contracting, and is the only reading that should be used for clinical assessment.[4] Hypertension refers to a sustained elevation in SBP.[1]

BP is a product of cardiac output (CO) and total peripheral resistance (TPR). This may give you fuzzy memories of vet school physiology (and this equation: BP = CO x TPR). TPR is determined by the radius (or diameter) of the blood vessels and the viscosity oF the blood. CO is determined by heart rate and stroke volume.

Putting it all together, BP is maintained by a system of checks and balances, using neural and hormonal homeostatic mechanisms.[5,6] The various components of this equation are controlled by multiple organs, mainly the heart, kidneys, brain, and blood vessels and associated local tissue factors affecting vasculature tone regulation **(Figure 1)**.[6] Some of these pathways work quickly and can rapidly affect changes in BP (within seconds). An example of this would be alterations in the autonomic nervous system, leading to changes in BP during times of stress, anxiety, or excitement—such as during a veterinary visit, in many cats. Other pathways, such as sodium regulation via the kidneys and the renin-angiotensin-aldosterone system (RAAS), can take hours or days to have a full effect.[7-9]

Understanding the complexity behind BP regulation can help us appreciate why a multitude of factors constantly affect BP.

## CATEGORIES OF HYPERTENSION

Once a patient has been diagnosed with hypertension, it is categorized into 1 of 3 types: idiopathic, secondary, or situational.

- **Idiopathic hypertension,** sometimes referred to as primary hypertension, is when there is an absence of any disease, pathology, or therapeutic agents associated with variations in the patient's SBP. The etiology of idiopathic hypertension is not completely understood but is thought to be due to an imbalance between CO and TPR. It is likely that increased vascular tone and activation of RAAS play a role.[6] To diagnose idiopathic hypertension, perform a full diagnostic

*Continued on page 8*

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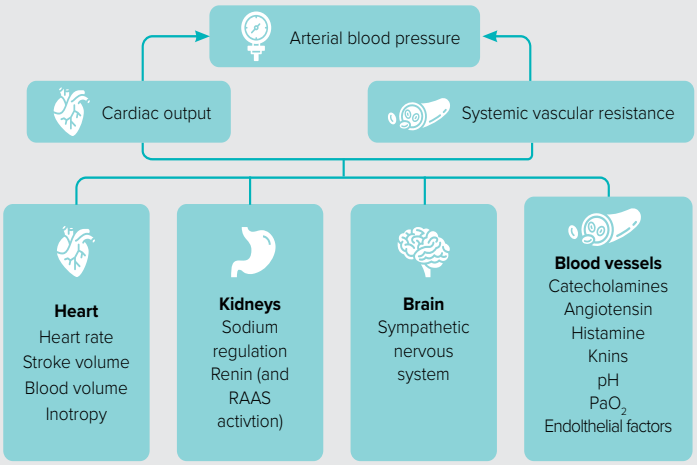
**FIGURE 1.** Important Mechanisms Involved in BP Regulation[6]




**BP, blood pressure; $PaO_2$, partial pressure of oxygen in arterial blood; RAAS, renin-angiotensin-aldosterone system.**

work-up involving a full urinalysis, blood work (complete blood count and serum biochemistry), and a thorough history to rule out secondary hypertension. Additional diagnostics such as imaging or measurement of symmetric dimethylarginine may be indicated based on patient presentation. Pay careful attention to ruling out underlying kidney disease because some patients with hypertension develop pressure diuresis, leading to polyuria and a subsequent decrease in urine specific gravity level of less than 1.030.[1,5] The exact prevalence of idiopathic hypertension is not known, but data from multiple small-scale studies have shown that approximately 13% to 20% of feline hypertension cases are idiopathic.[10-12]

- **Secondary hypertension** is associated with a disease, pathology, or therapeutic agent that influences SBP and accounts for most cases of feline hypertension.[6] The most common comorbidities associated with secondary hypertension are chronic kidney disease (CKD) and hyperthyroidism. Current estimates in the literature are that 19% to 65% of cats with CKD are hypertensive and up to 75% of cats with hypertension are azotemic.[13-15] In hyperthyroid patients, the literature suggests that approximately 10% to 23% of cats are hypertensive at the time of diagnosis, with an additional 25% becoming hypertensive with the control of hyperthyroidism.[16-18]

Other conditions also may be associated with feline hypertension, such as diabetes mellitus, primary hyperaldosteronism, pheochromocytomas, and hyperadrenocorticism.[1,5] Primary hyperaldosteronism should be considered in patients with hypokalemia, weakness, polyuria and polydipsia, and hypertension unresponsive to antihypertensive therapy. Therapeutic agents or potential toxins that can lead to secondary hypertension include erythropoiesis-stimulating agents (recombinant human erythropoietin, recombinant feline erythropoietin, or darbepoetin alfa) sometimes used to treat anemia associated with CKD, ephedrine, phenylpropanolamine, and albuterol toxicity.[1]

- **Situational hypertension** refers to a temporary elevation in SBP due to environmental or situational stressors in a patient that would otherwise be normotensive, such as a transient rise in BP associated with the neurohormonal impact of stress or anxiety.[19] Typically this hypertension resolves when the stimulus causing the stress or anxiety is reduced or eliminated. It was previously referred to as "white coat hypertension," but we have realized that other factors besides the doctor's coat can lead to this effect. Consider the feline patient's trip to and experiences in the clinic: They are placed in a cold carrier often kept out of sight (and only used for vet visits) and go on a car ride. At the clinic, they hear barking dogs and see other cats in the reception area. Then they are dumped onto the examination table by tipping the carrier upside down. All of this *before* they see a white coat.

The effect of situational hypertension can be severe in some patients, and the concern for a false-positive diagnosis is a reason why some veterinarians are reluctant to monitor patients for hypertension. One study looking at 13 cats with radio telemetry implants found that when they were placed in a simulated veterinary office visit, their measured SBP during the examination period exceeded the 24-hour average SBP by 17.6 ± 1.5 mm HG (range, 75.3 to –27.2 mm HG). The investigators also found that during the office visit, the magnitude of situational hypertension tended to decrease over time.[19]

## Age and hypertension

Like many other things in life, age appears to be a significant predisposing factor for the development of systemic hypertension in feline patients.[15,20] Results from a multiyear study examining 256 cats with CKD and 133 healthy cats without CKD older than 9 years showed that SBP significantly increased with age in all cats. Furthermore, healthy cats were less likely than cats with CKD to develop hypertension. A small but significant increase in SBP typically occurred as the cats aged, approximately 1 to 2 mm HG per year.[21]

This increased SBP in senior felines is the reason why they are an ideal population for screening.

## DIAGNOSING HYPERTENSION

In 2018, the American College of Veterinary Internal Medicine (ACVIM) created an updated consensus statement on the diagnosis and management of hypertension in canine and feline patients.[1] The ACVIM created 4 classifications of patients based on their risk of developing TOD if the SBP remains consistent (**Table 1**[1]). Patients with an SBP that is persistently 160 mm HG or more are considered hypertensive or severely hypertensive due to a moderate to high risk of developing TOD. Patients in the prehypertensive category (SBP, 140-159 mm HG) should be monitored closely because they may be at higher risk of developing hypertension in the future. >>

*Written by*

**Karren Prost, DVM, MPH, DACVPM**

Prost, completed her DVM at the Ontario Veterinary College while developing a passion for public health and one health concepts. She continued her studies and obtained her Master of Public Health (Epidemiology) at the University of Toronto, and obtained diplomate status with the American College of Veterinary Preventative Medicine. Prior to joining Ceva Animal Health, Prost was sharing her time between clinical practice in a busy 24-hour emergency animal hospital in central Ontario, and performing research at the Sunnybrook Research Institute on aerosolized viruses in bats, pigs and humans. Prost is currently expanding her scope of experience by being in the veterinary pharmaceutical industry while doing occasional days in clinical practice. She has a strong passion for epidemiology, preventative medicine and promoting evidence-based medicine.

**Table 1.** Classification of Hypertension in Canine, Feline Patients Based on Risk of Developing TOD as per ACVIM[1]

| Classification | Risk of developing TOD | SBP |
|---|---|---|
| Normotensive | Minimal TOD risk | < 140 mm Hg |
| Prehypertensive | Low TOD risk | 140-159 mm Hg |
| Hypertensive | Moderate TOD risk | 160-179 mm Hg |
| Severely hypertensive | High TOD risk | ≥ 180 mm Hg |

**ACVIM, American College of Veterinary Internal Medicine; SBP, systolic blood pressure; TOD, target organ damage.**

*Continued on page 9*

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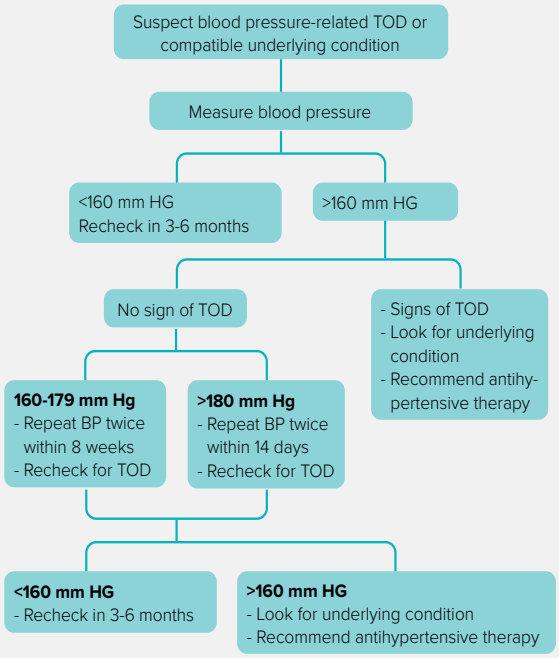
**FIGURE 2.** ACVIM Therapeutic-Decisions Flowchart for the Diagnosis of Hypertension in Canine and Feline Patients[1]




**ACVIM, American College of Veterinary Internal Medicine; BP, blood pressure; TOD, target organ damage.**

As noted previously, a diagnosis of hypertension requires *sustained* elevations in SBP. A single period during which the SBP falls into the hypertension range is unlikely to lead to TOD. For this reason, the ACVIM also created a diagnostic flowchart to help diagnose patients with hypertension and reduce the risk of a false-positive diagnosis due to situational hypertension (**Figure 2**[1]). A diagnosis of hypertension and subsequent decision to treat a patient requires signs of TOD and an SBP greater than 160 mm HG on a single visit or multiple SBP readings greater than 160 mm HG over multiple visits. The use of multiple visits also allows veterinarians and pet owners to identify which techniques worked and which did not work to help the patient be less stressed at the next visit and reduce the risk of situational hypertension.

## CONSEQUENCES OF UNTREATED HYPERTENSION

Hypertension predisposes patients to develop pathologies, or TOD, in organs rich in arteriolar blood supply. These include the eyes, brain, heart, and kidneys.[20] Presence of clinical signs associated with the development of TOD—such as feline patients with sudden-onset blindness or ocular pathologies—are often the reason for presenting to the veterinarian.[6]

Let's take a closer look at the impact of hypertension on these 4 organs.

- **Eyes**—The eyes require a significant amount of oxygen and energy to function properly. The vascular components of the eye (retina, choroid, and optic nerve head) maintain a steady blood flow using autoregulation. Unfortunately, this mechanism can break down, such as with rapid increases in hypertension, leading to potentially irreversible damage.[22]

  Ocular lesions are found in 50% to 60% of cats with hypertension.[10,15,20,23] Ocular clinical signs of hypertension can be seen as early as an SBP reading of 160 mm HG.[24,25] Findings from one study evaluating 188 untreated cats referred for suspected hypertension-associated pathologies indicated that SBP was significantly higher in cats with retinopathies than in other hypertensive animals (262 ± 34 mm HG vs 221 ± 34 mm HG, respectively; $P < .001$).[20] This indicates that when ocular signs are noted, hypertension may be more severe.[20]

  Ocular changes seen in hypertensive retinopathy, choroidopathy, or optic neuropathy include retinal detachment, vitreous and/or retinal hemorrhage, hyphemia, secondary glaucoma, vessel tortuosity, retinal edema, and optic nerve atrophy.[22] These patients can present with mydriasis or blindness with decreased or absent menace response or pupillary light reflex. These changes are typically identified through complete ophthalmic examinations, including fundic examinations, but in some cases can be seen on visual examination.

- **Brain**—Like the eyes, the brain contains a relatively normal cerebral BP despite changes in SBP. When hypertension occurs, autoregulatory mechanisms are overcome, leading to a breakdown of the blood-brain barrier and then interstitial and cerebral edema.[26-28]

  Clinical signs consistent with hypertensive encephalopathy are found in 29% to 46% of hypertensive cats and are more common when SBP increases suddenly or is greater than 180 mm HG.[11,14,29] Clinical signs of hypertensive encephalopathy include central nervous system signs such as ataxia, lethargy, seizures, abnormal vocalization, depression, and altered mental status.[27] A presumptive diagnosis of hypertensive encephalopathy is made based on a neurological examination, response to treatment with antihypertensives, and in certain cases, advanced diagnostic imaging. Because some of these clinical signs can also be found in cases of cognitive dysfunction, any senior cat presenting with vague clinical signs should have their BP evaluated.

- **Heart**—Chronic hypertension increases afterload on the heart, eventually leading to myocardium changes to compensate and resulting in left ventricular hypertrophy.[6] If the myocardial changes are caught early enough, these are the cats that present with an arrhythmia, a murmur, or gallop sounds. These cats also can present with sudden onset of pulmonary edema or left-sided congestive heart failure during or after fluid therapy. Diagnosis is made through cardiac auscultation, thoracic radiographs, echocardiography, and electrocardiography.

- **Kidneys**—Also rich in vascular supply, the kidneys are a well-known potential organ for hypertensive TOD. Blood flow and glomerular filtration rate are maintained at an SBP range of 80 to 160 mm HG. In hypertension, the autoregulatory mechanisms become overwhelmed, leading to a direct transfer of elevated pressure to the glomerular capillaries that results in glomerular hypertension.[6]

  These cases present with proteinuria, azotemia, progression of CKD, and pressure natriuresis. Evidence shows an association between SBP and the severity of proteinuria in patients with CKD.[30] Unfortunately, this results in a vicious cycle—with hypertension comes proteinuria, which can lead to progression of renal disease, furthering the hypertension—so it is often impossible in clinical practice to determine which came first. Proteinuria has been associated with increased mortality, highlighting the severity of this consequence of renal TOD.[10] Other renal changes include the development of glomerulosclerosis and arteriosclerosis.[5,31] Diagnosis of renal TOD is performed through urinalysis and measuring the urine protein to creatinine (UPC) ratio, serum creatinine level, symmetric dimethylarginine concentration, and blood urea nitrogen level.

## CANDIDATES FOR HYPERTENSION SCREENING IN GENERAL PRACTICE

Which of your patients should you screen for hypertension? The International Society for Feline Medicine (ISFM), American Association of Feline Practitioners (AAFP), and ACVIM provide great information on this (**Figure 3**[1,5,6]).

The recommendation by the ISFM and AAFP to obtain BP measurements in healthy young cats may be surprising, but there are good reasons behind it[5,6]:

- Routine BP screening at annual visits highlights to the owner the importance of BP monitoring.
- Although finding elevated SBP in a healthy young cat is unlikely to be true hypertension requiring treatment,[1] starting young is your best opportunity to figure out the process. Attempts can be made (and documented) with various methods, treats, or positions to determine what works best for this patient and reduces the risk of situational hypertension.
- Once an accurate BP reading has been obtained, you can determine the cat's baseline, which is incredibly valuable information for the future that should be documented in the patient's records.

*Continued on page 13*

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## RELIEF VETERINARIANS

We are continually updating our list of relief veterinarians. If you would like to be listed on this page, please email secretary@pbvs.info. Your membership in the society must be up to date.

Last updated: ***May 10, 2023***

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*Continued from page 9*

**Figure 3.** Recommendations Summary on Which Patients to Screen for Hypertension per Expert Groups, Consensus Guidelines[1,5,6]

| Patients to screen for hypertension | Additional notes |
|---|---|
| Patients with evidence of TOD | • New murmur, gallop, rhythm<br>• Abnormal vocalization<br>• Altered mentation<br>• Clinical signs consistent with cognitive dysfunction<br>• Neurological clinical signs (eg, seizures, acute blindness, ocular or retinal abnormalities noted on ophthalmic examination)<br>• Azotemia or elevated SDMA on blood work<br>• Proteinuria confirmed by UPC ratio on urinalysis |
| Patients diagnosed with comorbidities commonly associated with hypertension | • Hyperthyroidism or kidney disease (acute or chronic)<br>Less common but still warrant screening:<br>• Diabetes mellitus<br>• Primary hyperaldosteronism<br>• Hyperadrenocorticism<br>• Pheochromocytomas |
| Patients on medications that can influence SBP | • Antihypertensives (amlodipine, telmisartan, etc)<br>• Erythropoietin-stimulating agents<br>• Phenylpropanolamine<br>• Ephedrine |
| Patients presenting with toxin exposure to agents that can influence SBP | • Albuterol toxicity |
| Healthy cats older than 7 years | Annual/biannual screening of healthy older patients along with a full physical examination, fundic examination, cardiac auscultation, blood work, urinalysis, and thorough history |
| Healthy cats younger than 7 years | Annual screening |

**SBP, systolic blood pressure; SDMA, symmetric dimethylarginine; TOD, target organ damage; UPC, urine protein to creatinine.**

## TREATMENT OF HYPERTENSION

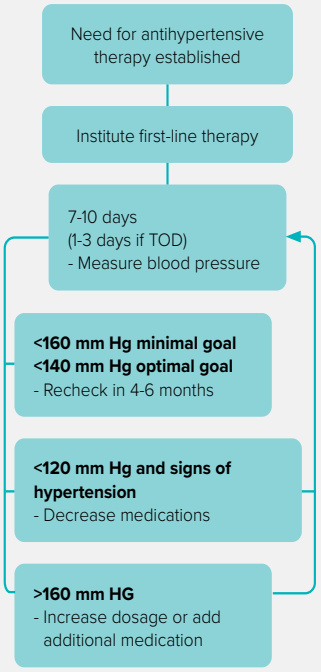
The primary goal of treating cats with hypertension is to reduce or prevent the risk of developing TOD.[1] Referring back to Table 1, this means the initial goal is to reduce SBP to less than 160 mm HG and the long-term goal is to reduce SBP to less than 140 mm HG. Early diagnosis and management are also important because lesions not associated with cranial nerve abnormalities (menace, pupillary light reflex) are more likely to respond to antihypertensives.[11]

In patients that have already developed TOD, prompt treatment of hypertension can sometimes reduce or reverse some of the damage. In a study looking at 88 feline patients with hypertensive chorioretinopathy treated with amlodipine, 58% of blind eyes regained some vision with prompt antihypertensive treatment, and 84% of cats that had complete retinal reattachment regained some vision.[32]

Following a stepwise approach to treatment, with frequent and regular reevaluation of SBP, is advised (**Figure 4**).[1] Frequent reevaluation is necessary to ensure the patient has not become hypotensive (demonstrating weakness, syncope, or tachycardia) or does not require an adjustment to their treatment plan. See **Table 2**[1,5,6] for a summary of treatment options for feline hypertension.

Therapies for comorbidities associated with hypertension must also be initiated (eg, spironolactone for feline patients with hyperaldosteronism) because lack of treatment may impact the efficacy of antihypertensive treatments. With secondary hypertension, do not delay antihypertensive treatment while addressing the comorbidity. In many cases, treatment of the underlying condition does not result in the patient becoming normotensive, and we want to reduce the risk of TOD development.[1]

**FIGURE 4.** Stepwise Approach for Instituting Antihypertensive Therapy and When to Recheck BP Readings[1]




**BP, blood pressure; TOD, target organ damage.**

**Amlodipine** has been the first-line treatment for feline hypertension for years and is considered by many to be the drug of choice for this condition.[6] It is very effective in most feline patients, and once-daily dosing is optimal for client adherence. This calcium channel blocker works to reduce SBP by relaxing arterial vascular smooth muscles, leading to vasodilation and decreased TPR with little to no effect on the heart.[33] Mean decrease in SBP of 28 to 55 mm HG is typically noted in hypertensive or severely hypertensive cats treated with amlodipine.[12,34-36] Amlodipine also may reduce the UPC ratio in proteinuric cats.[10,30] Results from one study revealed that treatment of hypertension with amlodipine significantly reduced UPC ratio in 78% of proteinuric cats with CKD, with a median decrease of 0.12.[10] Approximately 40% of feline patients treated with amlodipine may require additional therapy.[5,10,12,37] >>

**Table 2.** Most-Used Treatments for Feline Hypertension per Expert Groups and Consensus Guidelines[1,5,6]

| Drug | Dose | Comments |
|---|---|---|
| Amlodipine | 0.625-1.25 mg orally once daily | Calcium channel blocker<br>• Consider starting at 1.25-mg dose when SBP is > 200 mm Hg.<br>• Dose can be doubled if no response after 7-10 days to the maximum 2.5-mg daily dose. |
| Telmisartan | 1.5 mg/kg orally twice daily for 14 days; then 2.0 mg/kg orally once daily long term | Angiotensin II receptor blocker<br>• Safety and efficacy not evaluated in cats with SBP > 200 mm Hg.<br>• Dosage can be reduced in 0.5 mg/kg–dose increments to a minimum of 0.5 mg/kg.<br>• Label indications and dose vary by country. |
| Benazepril | 0.5-1.0 mg/kg orally 1 to 2 times/day | ACE inhibitor |
| Enalapril | 0.5 mg/kg orally 1 to 2 times/day | ACE inhibitor |
| Atenolol | 1.0-2.0 mg/kg orally twice daily<br>6.25-12.5 mg orally twice daily | β-Blocker<br>• Indicated in some cases with tachycardia or hyperthyroidism |
| Propranolol | 2.5-5.0 mg 3 times/day | β-Blocker<br>• Indicated in some cases with tachycardia or hyperthyroidism |

**ACE, angiotensin-converting enzyme; SBP, systolic blood pressure.**

*Continued on page 14*

*Continued from page 13*

**Telmisartan** is a new treatment recommended for feline hypertensive patients. This angiotensin II type I receptor blocker reduces some of the unwanted effects of the RAAS cascade, such as vasoconstriction and aldosterone release. It has modest effects on reducing SBP, but its safety and efficacy have not been evaluated in cats with an SBP greater than 200 mm HG. The pivotal clinical trial evaluating the efficacy of telmisartan as an antihypertensive also did not include cats with ocular or central nervous system TOD.[38] Telmisartan can be used alone or with amlodipine if additional therapy is required.[5]

Other potential treatments include angiotensin-converting enzyme (ACE) inhibitors such as enalapril or benazepril. They may serve as an add-on when amlodipine is not enough, but ACE inhibitors are not recommended as first-line treatment because of their minimal reduction in SBP (± 10 mm HG) or in dehydrated patients because of the risk of potentially exacerbating azotemia.[1,39]

In certain situations, tachycardic hypertensive patients may be placed on β-blockers such as atenolol or propranolol,[1] but not as a first-line treatment. Their mechanism of action for the treatment of hypertension is to reduce cardiac output, and they are likely not adequate on their own to manage hypertension.

## THE MERCURY CHALLENGE

How common is feline hypertension, really? Until recently, data for its estimated prevalence relied on findings from smaller-scale studies. It is also difficult to determine its true prevalence because BP monitoring has not been done routinely in every patient. The Mercury Challenge has been the largest study to date looking at feline BP as reported by primary veterinarians internationally.[40]

Veterinarians were encouraged to collect and enter data into an online survey on cats 7 years and older that were having their BP measured as part of their clinical assessment. Data collected included the patient's demographic information, comorbidities, and current treatments; the indirect device used to measure SBP; time taken to obtain the SBP reading; and the patient's demeanor (calm, anxious, nervous, or unknown). The survey was open from 2018 until late 2020, with the goal of collecting data from 10,000 cats to "describe the findings and assess the variables that affected the duration of assessment and the values obtained."[40]

A total of 811 clinics from 16 countries contributed 10,153 assessments; 1269 were excluded (due to age < 7 years or recorded SBP < 80 mm HG), leaving 8884 feline patients (age, 7-26 years; median age, 13 years) to analyze.

Now for the staggering results—35.1% had no reported disease. Additionally, 45.9% of patients with CKD and 50.4% of patients with hyperthyroidism were hypertensive or severely hypertensive based on ACVIM criteria, necessitating additional evaluation to determine whether treatment was indicated.[40]

Not surprisingly, nervous or anxious cats typically had a higher SBP than those that were calm, and the longer it took to obtain the BP readings, the higher the median BP. The authors also found a statistically significant weak correlation between SBP and age and body weight, with a mild increase in SBP as age or body weight increased. Finally, the demeanor of the patient affected the time it took to obtain the reading, and of cats classified as "nervous" there was a higher proportion in whom it took more than 10 minutes to obtain readings. Overall, 92% of BP measurements took less than 10 minutes, with no significant time difference in the duration of SBP measurement based on the type of device used.[40]

With so much information, it can be difficult to spot key takeaways. Here are 4:

- This study's data demonstrate the importance of measuring SBP routinely in all cats older than 7 years and in those with CKD and hyperthyroidism.
- SBP can be measured in most cats in 10 minutes or less.[40]
- A cat-friendly approach is needed to reduce stress, fear, and anxiety in the clinical setting.
- Consider all information (eg, cat's demeanor, time taken to get the SBP measurement) when interpreting the results, and develop a process to determine whether the numbers are accurate or whether external factors were at play.

## TIPS AND TRICKS FOR IMPLEMENTING ROUTINE BP MONITORING

### Equipment needed

Two methods are used to measure a patient's BP: direct methods and indirect devices. Because direct methods are "not practical for hypertension screening and treatment in general practice,"[1] we use indirect devices, which work by detecting the return of the pulsating blood flow after the artery is occluded using an inflatable cuff. As of this writing, no device has met all ACVIM standards for accurate measurements of BP in cats or dogs.[1] However, with proper training and practice, these devices can still provide clinically relevant information.

Indirect BP devices fall into 2 main categories: Doppler sphygmomanometry and oscillometric. Surveys of general practitioners show that both types of devices are used almost evenly.[2,3]

- **Doppler devices** provide SBP only and work by detecting the flow of blood in the arteries. The transducer is typically held over the artery to occlude with a thumb after shaving the area or applying alcohol. Use plenty of ultrasound gel to ensure good contact between the probe and the skin. Because the cuff is inflated and deflated manually, it can be tricky to obtain a constant deflation rate. Placing too much or not enough pressure on the transducer can affect results. The forelimb seems well tolerated with the transducer placed between the carpal and metacarpal pads. Inflate the cuff slowly to 20 to 40 mm HG above the point at which blood flow is no longer heard.

  The most reliable readings for the Doppler occur in the SBP range of 70 to 160 mm HG. Although the readings are well correlated with direct BP, the Doppler can underestimate SBP, particularly at higher values.[41,42] Using a headset is critical because the sound emitted from the Doppler (the pulsatile blood flow) can sound like a cat hissing and could cause additional stress.

- **Oscillometric devices** work by detecting arterial wall oscillations produced by pulse waves as the cuff is deflated. They typically include the use of a cuff and an electronic pressure sensor (or transducer) with a numerical readout. The cuff is inflated and deflated automatically. Benefits of oscillometric devices include ease of use and the fact that they provide additional data (SBP, diastolic BP, heart rate, and mean arterial pressure) and a graph of the detected oscillations to determine the accuracy of the measurements.

  Unfortunately, patient movement may alter the results. Using the tail for the location of the cuff helps reduce potential movement at the site. Various devices are available. Similar to the Doppler, oscillometric measurements tend to underestimate SBP in severely hypertensive patients.[42] Newer generations of oscillometric devices, or high-definition oscillometric devices, may produce more accurate results compared with direct BP measurement in cats.[5]

### Cuff selection

Proper cuff selection is critical. Selecting a cuff that is too small will result in overestimated SBP values, and a cuff that is too large will result in underestimated SBP values.[43]

The width of the selected cuff should be 30% to 40% of the circumference of the area on the limb or tail where the cuff will be placed. This width can be identified by using a measuring tape and a readily available chart (**Table 3**). The most-used cuff sizes in feline patients are 2.5 to 3 cm. In certain cases, as shown in **Figure 5**, the cuffs may have an "optimum zone" within dotted lines. To be appropriate for the patient, the dotted line at the end of the cuff should line up within the optimum zone.

The cuffs should be free of fur and stay closed on their own. (If you need tape to keep the cuff closed when inflated, you need new cuffs.) The cuff balloon should have no discoloration or overstretched

**Table 3.** Reference Chart for Cuff Selection Based on Measured Limb Circumference

| Circumference (cm) | Cuff size |
|---|---|
| < 6.0 cm | 1 |
| 6.1-8.0 cm | 2 |
| 8.1-11 cm | 3 |
| 11.1-13 cm | 4 |
| >13 cm | 5 |

*Continued on page 15*

*Continued from page 14*

**FIGURE 5.** Cuff With Optimum Zone Demarcations


areas. Most cuffs half a shelf life of 6 months with regular use.[5]

Where to place the cuff on the patient depends on multiple factors, such as the patient's most relaxed position (eg, in owner's lap, standing), the limb at heart level, and the presence of arthritis or discomfort. The most-used locations for cuff placement are the radial artery (forelimb), caudal saphenous artery (metatarsal region of the hind limb), and coccygeal artery (tail).

The coccygeal artery is a fantastic site for feline patients with sensitive paws or with pain or discomfort in their limbs due to arthritis, and it may be optimal for those using a high-definition oscillometric device. If in lateral recumbency, place the cuff on the nondependent leg; do not place a cuff on a leg with an intravenous catheter. Cuff placement too far above or below the heart level can falsely decrease or increase the readings, respectively. Finally, place the tubing of the cuff directly over the artery to be occluded, with the rest of the tubing pointing away from the patient.

## Setting up the proper environment

Consistent with Fear Free and Cat Healthy practices, allow your feline patient to explore the examination room on its own (with the owner, of course) for 5 to 10 minutes before any handling. And perform BP readings before any other procedure or handling to reduce the risk of situational hypertension.

The room should be quiet with minimal disruptions. Consider placing a "do not disturb" sign on the outside doorknob. Involve minimal people, ideally 2 (one to take the BP and another/owner interacting with the cat). Use calm personnel who handle the patient gently. If you are hearing barking dogs from the treatment area, find a new room or another time to perform the readings.

Place the patient wherever it will be most comfortable (eg, on a bed, in the bottom of the carrier, on the owner's lap) to keep restraint to a minimum and reduce the risk of situational hypertension. Because too much patient movement can lead to inaccurate results, it is important to find what works for the patient. We can obtain BP measurements with cats in lateral or ventral recumbency and even while they are standing. If the cat becomes agitated, take a break and try again later.

## Taking the measurements

General guidelines for obtaining SBP measurements include the following:

- Obtain 5 to 7 measurements.
- Discard the first measurement. It is often falsely elevated due to stress and the patient not being used to the cuff inflating.
- Aim for less than 20% variation between SBP readings. If you are seeing significant variation, obtain additional readings or reschedule the procedure.
- Take the average of the remainder of the readings.
- If SBP readings are trending down, obtain additional readings until they level off.
- Document everything using the premade templates from the resources provided in this article:
  - Unplanned disturbances
  - Patient's demeanor and behavior during the experience
  - Patient's position and activity
  - Cuff location and site used

## What about gabapentin?

Over the past few years, veterinarians have discovered the benefit of previsit pharmaceuticals, particularly gabapentin, for their nervous or anxious feline patients. Most sedatives and analgesics will influence BP, but findings from a few recently published studies indicate that a low dose of gabapentin in cats prior to BP monitoring may have limited effects on SBP results.

One study compared BP readings and signs of stress during veterinary visits in patients with and without gabapentin who were classified as "fractious" or "stressed." Cats were randomly assigned to receive 100 mg of gabapentin (dose range, 13-29.4 mg/kg) or placebo 90 minutes prior to transportation to the vet clinic. Using oscillometric devices, the authors found no significant difference between the gabapentin group and placebo group in SBP and mean BP, with only a mild difference in heart rate noted.[44]

A more recent study evaluated whether a single 100-mg oral dose of gabapentin (median dose, 20 mg/kg) given 60 minutes before a cardiac evaluation would affect heart rate, SBP, electrocardiogram, and echocardiographic indexes. The authors found that most variables did not change, including SBP and heart rate, and that gabapentin increased patient adherence with the procedure.[45]

Ideally, attempt to measure SBP without gabapentin. However, if the patient appears very anxious, a single standard dose (100 mg per cat) 60 to 90 minutes before the examination is unlikely to significantly affect SBP readings.

## Get creative

Consider the following if obtaining a BP measurement in a patient is a struggle:

1. Consider training the owner to measure BP at home themselves. Some veterinary clinics are teaching pet owners to use a BP device and obtain a deposit for the machine until its return. Although not an option for every patient, it is one to consider. Findings from smaller-scale studies using dogs and cats show significant differences in SBP results obtained in clinic vs at home by an owner and support training owners to obtain results at home as a possible alternative.[46-49]
2. Have house-call veterinarians or registered veterinary technicians use their own device in the patient's home.
3. Set up BP clinics when loud noises and traffic are at a minimum, allowing extra time to ensure appropriate conditions.

## CONCLUSION

Feline hypertension, although prevalent, remains underdiagnosed and undertreated, leaving these patients at risk of developing serious and potentially irreversible TOD. Many cats with the condition are missed because some veterinarians are reluctant to recommend SBP monitoring due to fear of a false-positive diagnosis, the time involved in the procedure, or not being comfortable performing it.

The thought of implementing a comprehensive BP monitoring program can be overwhelming. Take an incremental approach instead by developing a SMART goal (ie, one that is specific, measurable, attainable, realistic, and timely). For example, start by aiming to advise BP monitoring in 100% of the cats you diagnose with hyperthyroidism for the second half of 2023, eventually expand out to all comorbidities, and then to senior wellness appointments.

Now, let's get started monitoring these cats and working on better understanding feline hypertension.

*References available online at www.dvm360.com/Journal/CE/June2023*

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