You Seem Detached: A Look into Feline Systemic Hypertension

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Introduction

Systemic hypertension can be defined as a persistent increase in the systemic blood pressure (BP). The prevalence of systemic hypertension in dogs and cats is not well characterized, with reported rates between 0.5–10% of healthy dogs and 2% of healthy cats. When describing elevated blood pressure in cats, we are often considering increased systolic blood pressure over the level of 140-160 mmHg. Systemic hypertension is now commonly recognized in feline practice. Accurate identification of feline patients with systemic hypertension is necessary in order to prevent target organ damage (TOD) when levels of systolic blood pressure (sBP) are greater than 170-180 mmHg.[1] The target organs most vulnerable to hypertensive damage are the brain, heart, kidneys, and eyes. The rationale for treatment of systemic hypertension is prevention of these injuries. In animals, most cases of hypertension are secondary to underlying systemic diseases, but idiopathic/primary hypertension does exist.[1,2]

When should you check a blood pressure?[1-3]

Inappetance
Weight loss
Neurological abnormalities
Behavior changes
Azotemia
Proteinuria
Polyuria/Polydipsia
Presence of underlying disease (chronic kidney disease, heart and blood vessel disease, hyperthyroidism, hyperaldosteronism, diabetes mellitus, hyperadrenocorticism, pheochromocytoma)
Treatment with medications that cause increased BP (phenylpropanolamine, phenylephrine, steroids, mineralocorticoids)
Presence of ocular changes (retinal detachment, retinal hemorrhage, retinal edema, vitreal hemorrhage, hyphema, iris aneurysm)
Geriatric cats (>7-10 years old)

Measurement of blood pressure

The author recommends Doppler BP measurement in conscious cats, when possible, due to the numerous studies that have found good correlation with direct BP measurements.[1,3] Although not perfect (none of the non-invasive methods are perfect unfortunately!), it is generally more reliable than traditional oscillometric machines.[3] Recently, **high definition** oscillometry has been compared to direct BP assessment in conscious cats over a range of different BPs and has been shown to provide accurate results.[4] Blood pressure measurements can be somewhat unreliable depending on the situation. Most normal cats have systolic blood pressure (SBP) readings of 120–149 mm Hg. 'White coat' hypertension or stress-induced increases in the sBP

are a significant issue - on average, the 'white coat' effect increases sBP by 15–20 mm Hg. However, the effect is highly variable between cats and can be as much as 75 mm Hg. There are things that can help distinguish artifact from truly increased blood pressure, such as underlying cause (see list above: "When should you check BP?"), presence of target organ damage, or multiple elevated readings at different time points following standardized protocols to assess BP in cats.[1-3]

Blood pressure measurement should be performed in a quiet room with experienced staff. It is ideal to allow the cat 10 minutes to acclimatize to these surroundings before the measurements are taken. The cat should be in a comfortable position (ideally, lateral, or sternal recumbency). If the owner can be present, it usually makes them more comfortable. The consensus statement on systemic hypertension recommends throwing out the first measurement and then trying for 5 consistent measurements, if possible. The cuff can be on the limb or the tail. A recent study compared the radial vs. coccygeal artery for BP measurement with Doppler and found that correlation of measurements was moderate with measurement at the tail being higher. Body condition score influenced the difference with obese cats having more of a difference between radial and coccygeal values.[5] For cuff size, the cuff width should be 30-40% of the limb diameter. It is also important to keep good records including which limb, position, and cuff size was used. It may even be helpful to describe the environment in which the BP was measured.[1,3,6]

The American College of Veterinary Internal Medicine has published a classification system according to risk of TOD (Table 1).[1] If sBP is greater than 160 mm Hg on a single occasion and TOD is present, treatment is recommended. If there is no evidence of TOD, repeat measurements are recommended before instituting therapy. If sBP remains persistently above 160 mm Hg, treatment is recommended.

Table 1. Classification of blood pressure in cats (in mm Hg) based on the risk of future target organ damage (TOD)[1]

Risk category	Systolic BP	Diastolic BP	Risk of future TOD
I	<150	<95	Minimal
II	150–159	95–99	Mild
III	160–179	100–119	Moderate
IV	≥180	≥120	Severe

Etiologies[1,3]

- Chronic kidney disease- Chronic kidney disease (CKD) is one of the most common causes of systemic hypertension in cats, with prevalence of 20–65%.
- Acute kidney injury
- Protein-losing nephropathy
- Hyperthyroidism- the prevalence of severe hypertension in this population is relatively low (approximately 5–25%) in recent studies.
- Hyperaldosteronism- Cats are more commonly affected by aldosterone-secreting tumors of the adrenal gland, while dogs are more likely to be diagnosed with pheochromocytoma
- Hyperadrenocorticism
- Pheochromocytoma
- Diabetes Mellitus- Diabetes mellitus may cause systemic hypertension in dogs and cats, but the degree of hypertension is generally considered mild.
- Thyroid Carcinoma
- Primary/idiopathic*
- Medications/intoxicants
    - Steroids
    - Mineralocorticoids
    - Erythropoietin
    - Phenylpropanolamine
    - Methamphetamine
    - Cocaine

* Primary hypertension is synonymous with essential hypertension, a term used to describe systemic hypertension with no identifiable cause. Based on the 2018 ACVIM Consensus Statement on identification of systemic hypertension in dogs and cats, it is recommended to describe these patients as having idiopathic hypertension.[1] A diagnosis of idiopathic hypertension is made when consistent blood pressure measurements show a repeatable increase in blood pressure with no overt abnormalities on bloodwork or urinalysis. Hypertension may result in a lower-than-expected urine-specific gravity (USG<1.030) and polyuria secondary to the effects of pressure diuresis; however, the patient may have no underlying kidney disease. It is now established that about 20% of hypertensive cats have idiopathic hypertension.[6]

Diagnosis[1,3]

Diagnosis of systemic hypertension is always based on reliable BP measurements. The decision to check BP is based on suspicion due to presence of common underlying condition. In the presence of TOD, treatment is justified after a single measurement session, but in most cases, results should be confirmed by consistently high measurements on > 2 occasions.[1]

- Good history and physical exam
- Blood pressure measurement (see above: “Measurement of BP”)
- Ophthalmic exam
- Neurologic exam
- Thyroid palpation
- Complete blood count, serum chemistry panel, urinalysis
- Urine protein/creatinine ratio

- Symmetric dimethylarginine (SDMA)
- Total and free thyroxine levels
- Thoracic and abdominal radiographs
- Abdominal ultrasonography
- Echocardiogram
- +/- Aldosterone levels

Target organ damage (TOD)

The heart, kidneys, brain, and eyes are target organs for damage from systemic hypertension.[1-3] We will mostly focus on the ocular changes, but it is important to note that hypertensive cats often present with auscultatory abnormalities such as gallop sounds, and perhaps less commonly murmurs or arrhythmias. Proteinuria as a result of glomerulosclerosis and arteriosclerosis is often present as a result of kidney damage. Disorientation, seizures, ataxia, depression, and vestibular signs are often manifestations of hypertensive encephalopathy.[1,2]

Ocular

Hypertensive ocular changes have been noted in approximately 50% of hypertensive cats and typically occur at sBP values >160 mm Hg. Ophthalmic evaluation, including funduscopic examination, is recommended in all dogs and cats with hypertension.[1-3] A fundic examination is also a great screening tool for TOD in geriatric cats. A thorough ocular examination is most easily done using distant indirect ophthalmoscopy in a darkened room. Gross abnormalities including retinal edema and detachment, retinal folds, retinal/choroidal hemorrhage, intraocular hemorrhage (vitreal hemorrhage or hyphema), iris and retinal vessels changes (aneurysm, tortuosity) can be seen.[2,7-9] Many cats with severe or sustained hypertension present with blindness and bilateral mydriasis resulting from complete retinal detachments or severe intraocular hemorrhage. Direct ophthalmoscopy can be used to have a closer look at any lesions identified. If ophthalmic lesions are seen with sBP of 160 mm Hg, therapy is indicated.

Pathophysiology

Systemic hypertension leads to sustained vasoconstriction of retinal arterioles via autoregulation, which can lead to ischemia and retinal degeneration. With a severe rise of BP, the autoregulation breaks down, resulting in focal or generalized dilatation of arterioles. The clinical signs of hypertensive choroidopathy are the result of the anatomic arrangement of the choriocapillaris and the lack of autoregulation in the choroid. Eventually, the blood–retinal barrier, consisting of the tight junctions between the endothelial cells of the retinal vasculature and the cell junctions between the retinal pigment epithelial (RPE) cells, breaks down with consequent leakage of serum and red blood cells into the retina and the subretinal space.[2,9] Retinal detachment is thought to be associated primarily with choroidal vascular disease, while retinal edema and hemorrhage are most likely caused by retinal vascular disease.[2,8] Iris aneurysm has been associated with feline systemic hypertension and may result in vascular rupture and acute hyphema.[9]

Treatment

Once TOD of the eye is recognized, it is vital that anti-hypertensive therapy is instituted quickly. Treatment goals include preservation or restoration of vision by decreasing BP gradually over

several week with an ultimate goal of sBP<160 mm Hg consistently. Most texts recommend a goal of 120-140 mm Hg, while avoiding hypotension.

Most common treatments of systemic hypertension include:

First line of defense
Amlodipine (calcium channel blocker) 0.625 mg/cat/day PO if sBP <200 mmHg or 1.25 mg/cat/day if sBP >200 mmHg (or for larger cats)

Additional therapy
In cats, only use ACE inhibitors as an additional treatment if blood pressure is not decreasing adequately or there is proteinuria (UPC ≥ 0.4). It is not effective as a sole therapy in cats because it only causes a small decrease in BP (even though it is usually the first line of defense in dogs). You can use enalapril (0.5 mg/kg q 24 h) or benazepril (0.5 mg/kg PO q12h) in addition to amlodipine.[1-3]
Telmisartan, an angiotensin II receptor blocker, is a newer second choice and has been shown to be effective in cats with BP >160 and < 200 mmHg. It has not been studied in cats with severe BP elevations >200 mmHg and effects may be dose dependent. Dose is 1-2 mg/kg PO q12-24h.[1,3]
These medications are often used in combination with management for underlying causes of systemic hypertension, such as treatment for CKD or hyperaldosteronism.[1,2]

Ocular therapy
Many times, the target organ damage in the eye is related to the fundus and topical therapies are not needed. If hyphema is present, the use of a topical NSAID, such as diclofenac or flurbiprofen, or a topical steroid, such as dexamethasone or prednisolone acetate, may be necessary 2-4 times daily. It is important to check intraocular pressure (IOP) when hyphema is present because hyphema can occasionally lead to secondary glaucoma. If IOP is normal or decreased, atropine or tropicamide can be used at the clinician's discretion (1-2 times daily depending on degree of anterior uveitis or miosis) in order to prevent posterior synechiae and relieve pain. If IOP is ≥25 mm Hg, use of dorzolamide, a carbonic anhydrase inhibitor, should be instituted 3 times daily and mydriatics should be avoided.[2]

Prognosis (eyes)
With treatment, the prognosis for long□term vision in cats with hypertensive chorioretinopathy, even following complete retinal detachment, is good.[7] Early diagnosis and treatment is key to restoration or maintenance of vision in these cats.[2] Factors that have been shown in studies to affect visual prognosis include status of menace response at presentation, time to complete retinal reattachment in eyes with a retinal detachment, and presence of vision at initial examination. Early diagnosis and treatment of systemic hypertension (prior to severe elevation or severe target organ damage) is best for good long term prognosis.[7]

Key Take Home Points

1. Systemic hypertension usually has a systemic underlying cause
2. It is important to perform fundic exam in older cats
3. Systolic blood pressure should be checked with doppler in awake cats
4. Early diagnosis and treatment of hypertensive chorioretinopathy has better prognosis for return and maintenance of vision
5. The first choice for treatment of feline systemic hypertension is amlodipine

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