

COMMISSIONED PAPER

Blood Pressure in Small Animals - Part 3*: Hypertension - Target organ damage, eyes and the CNS - Diagnosis and treatment considerations

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*INTRODUCTION

This is the final paper in the series on hypertension in small animals which has covered assessment and target organ damage. In the previous two issues EJCAP 18(2) and 19(1) we published papers on the assessment blood pressure in small animals and target organ damage (TOD) to the heart and kidneys.

To summarise, hypertension can have various causes including renal disease, hyperadrenocorticism, and hyperthyroidism. The predominant concern with hypertension is that target organ damage (TOD) can occur. The organs most affected by hypertension include the kidney, heart, (covered in EJCAP 19(1)) and eyes and brain which are discussed in this paper.

Hypertension can be classified based on the risk of TOD (Table 1).

The Eye and Hypertension

Although various organs are affected by hypertension, the eyes are the only organs where visual inspection can often be adequate to determine that TOD is occurring. A retinal examination is certainly indicated in all animals known to be hypertensive. Ocular examination including inspection of the retina is good idea in all patients, but especially in older patients where hypertension is more common. In some cases, documenting ocular damage is the reason a more thorough work up is initiated including blood pressure measurement and a biochemical profile. Finding evidence of TOD also eliminates white coat hypertension as a cause for an elevated blood pressure reading. In one study of cats with chronic renal disease, at initial presentation approximately 20% of cats were hypertensive with 70% having retinal changes consistent with hypertension. [1] It appears that in cats systolic hypertension is more predictive of ocular TOD than diastolic or mean arterial pressure. [2]

Risk categories	Systolic Pressure	Diastolic Pressure	Risk for target organ damage
I	<150	<95	minimal
II	150-159	95-99	mild
III	160-179	100-119	moderate
IV	≥180	≥120	severe

Table 1. Classification of hypertension based on the risk of TOD.

Blood supply to the retina is via the choroidal and retinal arterioles. The retinal vessels supply nutrition to the inner retinal layer whereas the choroidal vessels supply nutrition to the outer retinal layers. [3] Retinal arteries have autoregulatory capability, as blood pressure increases, they vasoconstrict. With prolonged hypertension this will lead to pathologic changes in the arterioles resulting in ischemia and potentially rupture and haemorrhage (hypertensive retinopathy). This is not true of the choroidal vessels. Choroidal vessels have large fenestrations

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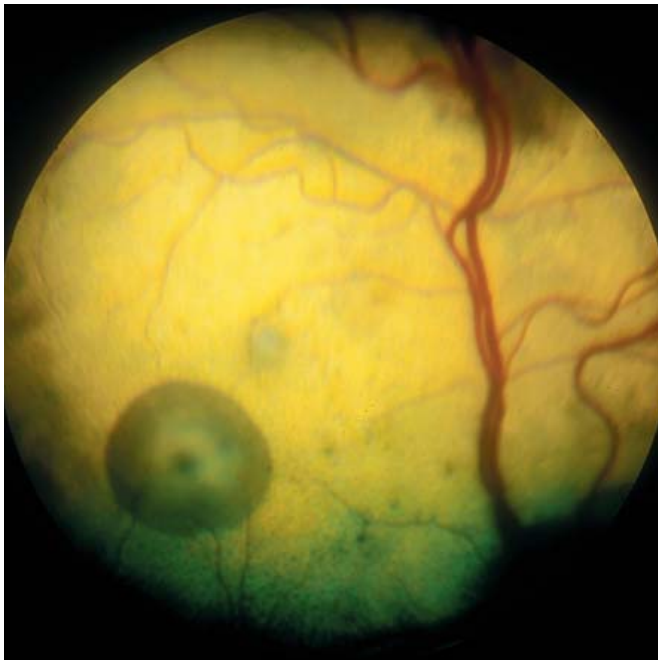


Fig 1. Focal bullous retinal detachment with tortuous retinal vessels.

which allow fluid to move freely into tissues. With hypertensive choroidopathy, severe bullous retinal detachments are more common (Figure 1). A hypertensive optic neuropathy can also be encountered.

Hypertensive retinopathy can have various manifestations. With an increase in systemic blood pressure the retinal arterioles undergo vasoconstriction. This leads to compensatory changes in the vasculature including hypertrophy and hyperplasia of the tunica muscularis. If hypertension persists, sclerosis and potentially necrosis of the smooth muscle can develop. These changes lead to leakage of fluid and potentially blood into the retina. In the choroid the process leading to hypertensive choroidopathy differs from that which occurs with retinal arterioles. In the choroid, angiotensin II and norepinephrine

Fig 2 Bilateral mydriasis and absent PLR in a cat with serous retinal detachments.



leads to vasoconstriction, ischemia and focal necrosis of the choriocapillaris. [4] This leads to infarction and degeneration of the retinal pigment epithelium (RPE). The blood-retina barrier is compromised leading to accumulation of fluid underneath the retina and serous retinal detachments.

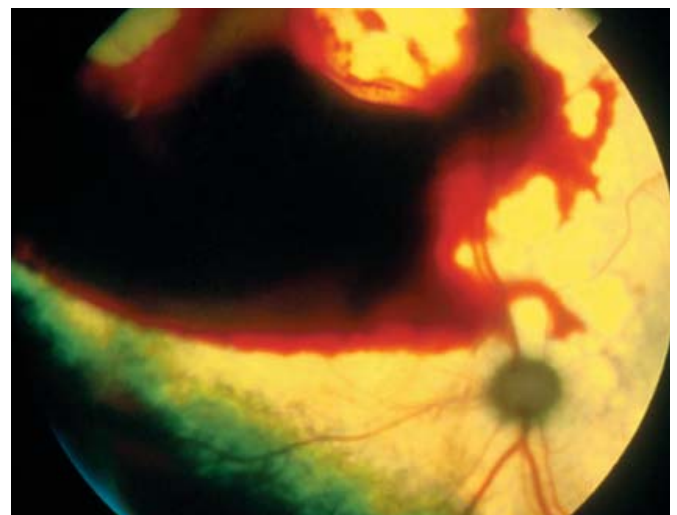
Clinical findings

A variety of clinical signs related to the eye can be seen with hypertension, however it is important to remember that other diseases (hyperviscosity, bleeding disorders, vasculitis, neoplasia) can cause similar signs. With hypertension it is not unusual to have the patient present having either sudden blindness or a change in the appearance of the eye as the primary complaint. One manifestation of hypertension is hyphaema. Variable amounts of bleeding into the anterior chamber can occur. Initially haemorrhage will cause a uveitis, with persistence secondary glaucoma can result. [3] Unilateral or bilateral mydriasis with poor to absent PLRs may be seen as well as blindness. In older cats it is important to evaluate for iris atrophy as this too can result in abnormalities of pupil size or response to light. (Figure 2).

Examination of the posterior segment is important when trying to evaluate for TOD from hypertension. A variety of lesions can be found. Initially retinal vascular tortuosity with a "box car" appearance can be seen. These lesions require experience with retinal examination to be easily identified. In fact these changes may be artefacts in acute disease, the narrowing is caused by retinal oedema. [4] In more advanced cases haemorrhages and detachments are seen. Haemorrhages can be intraretinal or vitreal (Figure 3). In some cases bullous detachments predominate and can lead to complete detachment (Figure 4). The optic nerve can also be involved with papilloedema being seen. Older lesions may be present such as retinal degeneration and retinal hyper-reflectivity (Figure 5).

Prognosis for patients with indications of ocular TOD is variable. With early and mild lesions it is often possible to arrest and reverse hypertensive injury. Once extensive retinal detachments and haemorrhage are present the prognosis worsens considerably.

Fig 3. Severe vitreal haemorrhage in a cat with hypertension.



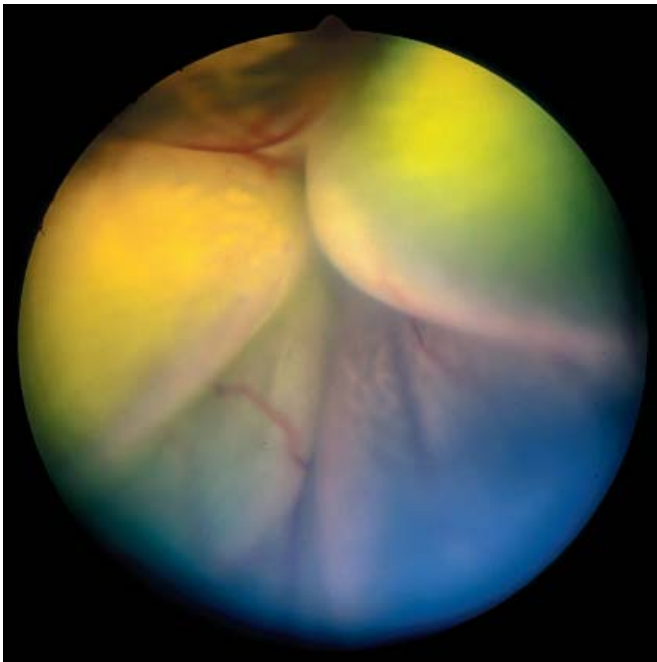


Fig 4. Complete bullous retinal detachment



Fig 5. Diffuse retinal atrophy of the temporal tapetal retina.

The CNS and Hypertension

Damage to the CNS can be seen secondary to hypertension, though often this is the most difficult type of TOD to recognize. Clinical signs are often vague and hypertensive encephalopathy is only suspected when severe manifestations are present. These signs develop when the brain's ability to blunt the effects of high blood pressure are overwhelmed. The brain, just as the eye, has the ability to autoregulate blood flow to maintain steady blood flow to the brain as systemic blood pressure varies. In the brain, increased systemic pressure leads to vasoconstriction whereas hypotension leads to vasodilation. Sustained increases in systemic blood pressure cause the cerebral blood vessels to develop a

“sausage-string” appearance whereby the constricted portions are areas where autoregulatory constriction is still present whereas the dilated portions are areas where autoregulation is failing and the vessel is distending. [5] Eventually the over distended areas begin to leak protein and fluid (oedema formation). This will eventually lead to widespread dilation of the vessel and increased, diffuse cerebral oedema formation. Haemorrhages can also occur if the vessel ruptures. The most common area to develop oedema is the white matter, this has been documented in humans and cats. [6] Haemorrhage into the brain is irritating resulting in inflammation (meningitis, myelitis, encephalitis). Cerebral haemorrhages have been documented in cats with seizures and hypertension. [7] This same study

Table 1 A Guide to common dosages used – Please check with manufacturer or cardiology specialist

Medication	Cat Dosage	Dog Dosage
Enalapril ⁽¹⁾	0.25 to 0.5 mg/kg Orally twice daily	same
Benazapril ⁽²⁾	0.25 to 0.5 mg/kg Orally daily	same
Ramipril	0.125 mg/kg Orally daily	0.125 to 0.25 mg/kg orally daily
Amlodipine	0.625-1.25 mg/cat/day orally(0.13 to 0.3 mg/kg q24h)	0.05 to 0.4 mg/kg orally daily
Atenolol	2 mg/kg Orally once or twice daily (6.25 to 12.5 mg/cat Orally twice daily)	0.25 to 1.0 mg/kg Orally twice daily
Acepromazine	0.05-0.1 mg/kg SC, IV	same
Hydralazine	2.5 to 5 mg/cat Orally twice daily (approximately 0.5 to 0.8 mg/kg)	0.5 to 3 mg/kg Orally q 12h
Phenoxybenzamine	0.25 to 0.5 mg/kg orally twice daily	0.25 to 1.5 mg/kg PO q 8 to 12h
Prazosin	None	0.5 to 2 mg/dog orally two to three times daily

SC - Subcutaneous IV - Intravenous

1 Some suggest higher doses in dogs – up to 3.00 mg/kg twice a day, and favour the lower dose only in cats

2 some suggest a higher dose in cats of up to 1.0 mg/kg

Generally with drugs to control blood pressure it is often ideal to start at the lower end of the dosage recommendation and titrate upward to effect.

suggested that 11 of 24 cats hypertensive cats had some degree of neurologic involvement including seizures, nystagmus, decorticate posturing, and intermittent dragging of limbs. Other studies have suggested neurologic signs to be present in about 10% [8] to 25% [9] of hypertensive cats. With hypertension vascular changes in the brain are common as in the retina with the development of hypertrophy, hyperplasia and ischaemia. Although hypertension can cause damage to the brain it is important to remember that brain disease can lead to systemic hypertension as well via the Cushing reflex. If intracranial pressure increases there is a concomitant increase in systemic blood pressure to help maintain blood flow to the brain. [10]

Clinical findings

Clinical signs are relatively variable. The mildest signs noted are behaviour changes such as lethargy and depression. This can progress to include seizures, ataxia, salivation, cranial nerve abnormalities and potentially coma. It is difficult to be sure if the clinical signs noted are neurologic consequences of hypertension or not. In humans some common signs include headache, vomiting and visual disturbances, signs that might be difficult or impossible to detect in a small animal patient. [6] Other clinical signs that have been noted include polyphagia, abnormal vocalisation, photophobia, frequent blinking, head pressing, cortical blindness and extensor rigidity. [6]

Treatment

Treatment of hypertension has been described in Part 2 of this series of articles. Table 1 lists commonly used medications to control hypertension. With TOD of the brain or eye, use of medications that are known to drop blood pressure significantly is preferred. Amlodipine is the most commonly used medication for this purpose.

When treating patients with hypertensive neuropathy it is important to avoid dropping blood pressure too rapidly. If this occurs, cerebral blood flow can be compromised leading to more severe damage to the CNS. In more severely affected animals, cerebral oedema may be severe. Treating this with a diuretic such as mannitol or furosemide may be of benefit.

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