

## Magnetic resonance imaging of a cerebral cavernous haemangioma in a dog

J P Schoeman<sup>a\*</sup>, M F Stidworthy<sup>a</sup>, J Penderis<sup>a,b</sup> and U Kafka<sup>c</sup>

### ABSTRACT

A 13-month-old, neutered, male Golden retriever presented with seizures and progressive depression. Clinical and neurological assessment was consistent with severe intracranial disease. The neurological condition progressively deteriorated and magnetic resonance imaging (MRI) revealed the presence of a large, contrast-enhancing, space-occupying mass in the right cerebral hemisphere. Therapy with corticosteroids, mannitol and furosemide ameliorated the signs of depression and ataxia, but the owner elected euthanasia after 1 week. *Post mortem* examination of the brain confirmed the presence of a large haemorrhagic lesion in the right olfactory lobe, the histopathological appearance of which was consistent with cerebral cavernous haemangioma. This is the 1st case describing the MRI appearance of a cavernous haemangioma of the cerebrum in the veterinary literature.

**Key words:** canine, cavernous haemangioma, magnetic resonance imaging, seizures.

Schoeman J P, Stidworthy M F, Penderis J, Kafka U **Magnetic resonance imaging of a cerebral cavernous haemangioma in a dog.** *Journal of the South African Veterinary Association* (2002) 73(4): 207–210 (En.). Department of Clinical Veterinary Medicine, Madingley Road, Cambridge, UK.

### INTRODUCTION

Brain tumours are reported to occur more frequently in dogs than in any other domestic species and occur most commonly in older animals<sup>19</sup>. The most common primary intracranial tumours in dogs are meningiomas<sup>3</sup>. Although vascular tumours are common in the dog, a retrospective study of 211 canine haemangiomas and haemangiosarcomas found the spleen, skin and subcutaneous tissues to be the most common sites, with only 1 tumour in this series affecting the central nervous system (CNS)<sup>17</sup>. Further reports have referred to vascular tumours affecting the CNS of dogs<sup>8,10,18,20</sup>, although the unequivocal distinction between neoplastic and hamartomatous vascular lesions of the CNS has not always been possible<sup>10,19</sup>. This paper describes a case of cerebral cavernous haemangioma in a Golden retriever and is the 1st in which the magnetic resonance imaging (MRI) findings are described.

### CASE HISTORY

A 13-month-old, neutered, male Golden retriever was presented to the Queen's Veterinary School Hospital, University of Cambridge, with a history of seizures and progressive depression

over the preceding 3 weeks. No abnormalities had been detected on a complete blood count and biochemistry profile performed by the referring veterinarian. He then initiated phenobarbitone therapy that resulted in prolongation of the interictal interval. This treatment was discontinued 24 hours prior to referral, as the referring veterinarian attributed the profound depression to the phenobarbitone treatment. The history did not suggest any evidence of prior exposure to trauma or toxins.

Upon clinical examination at the Queen's Veterinary School Hospital, University of Cambridge, the dog demonstrated marked depression, which had shown no improvement since the discontinuation of phenobarbitone therapy. Ophthalmoscopic examination showed no menace response in the left eye, with bilaterally intact pupillary light reflexes. Concious proprioceptive deficits were detected in the left fore- and hindlimbs. The dog showed a moderate degree of

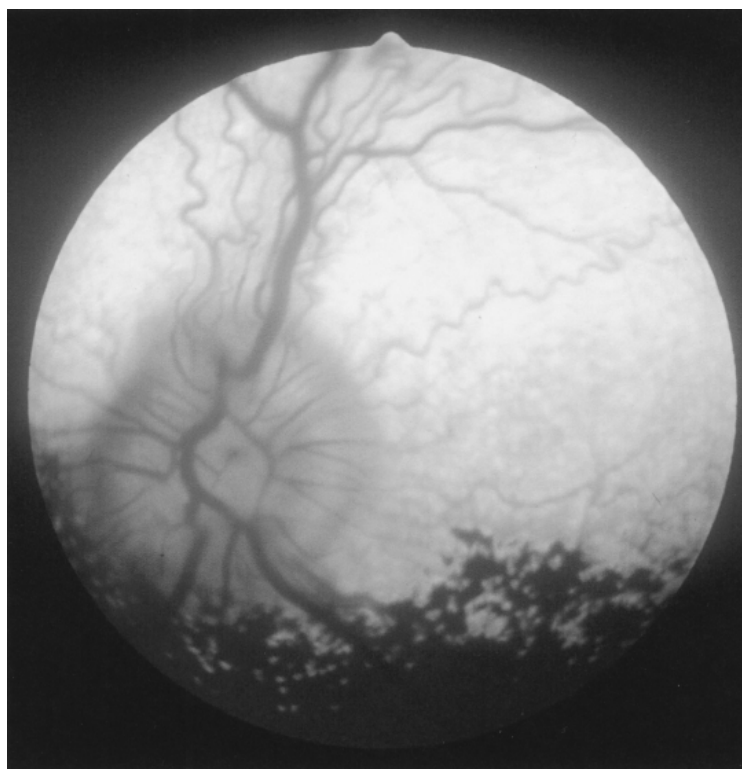


Fig. 1: Fundic photograph of the optic disc showing the irregular and swollen optic disc margin, the appearance of which is consistent with papilloedema.

<sup>a</sup>Department of Clinical Veterinary Medicine, University of Cambridge, Madingley Road, Cambridge, UK.

<sup>b</sup>Animal Health Trust, Centre for Small Animal Studies, Newmarket, UK.

<sup>c</sup>Department of Companion Animal Clinical Studies, Faculty of Veterinary Science, University of Pretoria, Onderstepoort, South Africa.

\*Author for correspondence. Present address: Department of Companion Animal Clinical Studies, Faculty of Veterinary Science, University of Pretoria, Private Bag X04, Onderstepoort, 0110 South Africa.  
E-mail: jschoema@op.up.ac.za

Received: April 2002. Accepted: October 2002.

ataxia in all 4 limbs.

Haematological parameters were within normal limits. Significant findings on serum biochemistry included markedly elevated gamma glutamine transferase (GGT) activity, markedly elevated cholesterol and triglyceride levels, moderately elevated fasting bile acid concentrations and mildly elevated serum glucose concentrations. A bile acid stimulation test revealed no abnormal stimulation. Total serum thyroxine and endogenous thyroid stimulating hormone (TSH) concentrations were within normal range. No serological evidence of *Toxoplasma* infection was found. Immunofluorescent antibody test was positive to a dilution of 1/50 to *Neospora caninum*. This was not considered significant, given the signalment and clinical signs of the dog. The serum phenobarbitone concentration was below the therapeutic range and was considered unlikely to have contributed to the depression.

Over the next 24 hours the patient showed a deterioration in neurological status and started to circle continuously to the right. The patient became progressively more stuporous and appeared unresponsive to his environment. Ophthalmoscopic examination revealed bilateral papilloedema (Fig. 1). The neurological examination further demonstrated decreased nasal sensory awareness on the left. The neurological findings were consistent with a right cerebral hemisphere lesion, with concomitant elevation of intracranial pressure and a magnetic resonance examination was performed.

### Magnetic resonance imaging findings

Magnetic resonance imaging (0.5 Tesla, SMIS, Guilford, Surrey) was performed. Contrast enhancement was demonstrated by the administration of gadolinamide (Omniscan, Nycomed, UK) 287 mg/ml, at a dose of 0.1 mmol/kg intravenously.

On T<sub>1</sub>-weighted images an ill-defined soft tissue mass of 22 mm in diameter was seen in the cortex of the rostral frontal lobe. The mass was isointense with surrounding brain matter and extended caudally to the thalamic adhesion. An associated moderate mass effect, as evidenced by a midline shift to the left, moderate reduction of the right ventricular volume and occlusion of the rostral aspects of both lateral ventricles, was seen. A thin, 1 mm hypointense rim surrounded most of the mass. Another poorly defined, up to 5 mm, hypointense zone surrounded the mass laterally and extended dorsally into the parietal and temporal white matter. The latter was

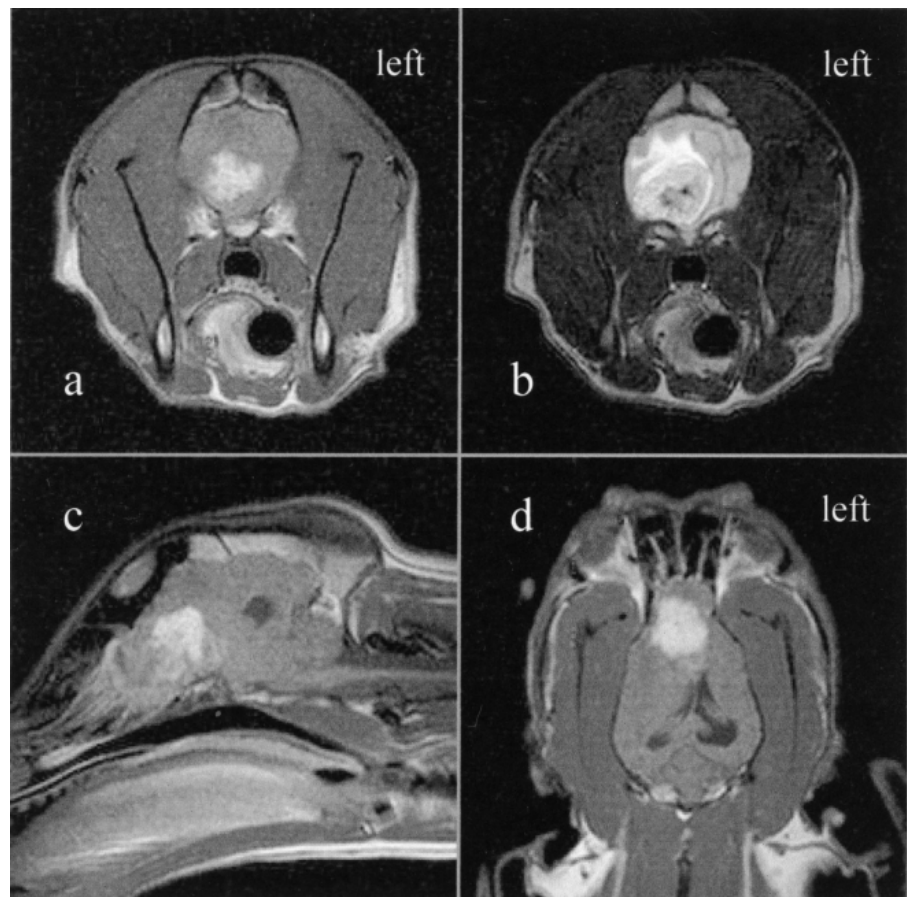


Fig. 2

(a) **Post-contrast T<sub>1</sub>-weighted transverse slice at the level of the rostral frontal lobe, just caudodorsal to the bulbus olfactorius.** A round mass is evident on the right but crosses the midline to involve a fairly large portion of the left frontal lobe. Homogenous contrast uptake is evident centrally. Mild heterogenous contrast uptake is noted peripherally. A poorly defined hypointense 1 mm rim surrounds the mass, as well as a poorly defined hypointense area, which extends dorsally into the parietal white matter.

(b) **T<sub>2</sub>-weighted slice at the same level as A.** The intensity of the mass varies with an irregular hypointense signal evident from the centre, and a heterogenous periphery, giving it a 'popcorn-like' appearance. It is surrounded by a 1 mm hyperintense rim (fibrous capsule?). This in turn is surrounded by another 5 mm hyperintense zone which extends dorsally into the parietal white matter. The latter most likely represents peritumoral oedema.

(c) **Post-contrast median T<sub>1</sub>-weighted sagittal slice.** Homogenous contrast uptake is evident in the caudal aspect of the mass, with architectural distortion evident in the ventral portion of the frontal lobe and olfactory bulb. Mild, poorly defined contrast uptake is present here. A marked mass effect evidenced by the reduced size of the lateral ventricle is seen. An oval, hyperintense, soft tissue mass is attached to the roof of the frontal sinus; its significance is uncertain.

(d) **Post-contrast T<sub>1</sub>-weighted coronal slice.** Homogenous contrast uptake is evident in a focal rostral portion of the right frontal lobe and caudal olfactory bulb. Axially, a thin hypointense rim surrounds the mass. An obvious mass effect, evidenced by a moderate midline shift to the left, a moderately reduced size of the right lateral ventricle and occlusion of the rostral portion of both lateral ventricles, is present. In the region of the caudal part of the right frontal lobe and the parietal lobe white matter, a poorly defined area of hypointensity is evident. This area most likely represents peritumoral oedema, which is largely responsible for the mass effect. Moderate, most likely obstructive, hydrocephalus is present on the left.

interpreted to be peritumoral oedema. The left lateral ventricle was moderately enlarged.

On T<sub>2</sub>-weighted images the mass was of mixed signal intensity, with an apparently multi-lobulated hypointense centre and a heterogenous hyperintense periphery, giving it a 'popcorn-like' appearance. The previously described hypointense rim on T<sub>1</sub>-weighted images, was hyperintense on T<sub>2</sub>-weighted images and was in turn surrounded by another very thin

hypointense rim.

Post-contrast T<sub>1</sub>-weighted images showed a homogenous uptake in the central portion of the mass. Mild heterogenous contrast uptake was noted peripherally. Based on the above findings, a diagnosis of a space-occupying lesion (most likely tumour) with associated unilateral (left) obstructive hydrocephalus, was made (Fig. 2).

In light of the MR findings and the presence of elevated intracranial pressure,

CSF collection at the cisterna magna was considered too risky and therefore not performed. CSF collection in the lumbar region was not attempted.

Treatment consisted of initial intravenous corticosteroids in combination with intravenous osmotic and loop diuretics. Phenobarbitone (Epiphen, Vetoquinol UK) was administered orally at a dose of 3 mg/kg twice daily in an attempt to control the seizures. The loop diuretic treatment was tapered over a few days. The dog improved gradually over the next 4 days and was discharged with a view to commencing radiotherapy the following week. During the ensuing week the dog deteriorated and became more depressed. The owner decided against further treatment and requested to have the animal euthanased.

The head was submitted for pathological examination.

### Pathology

On macroscopic examination of the head, muscular and skeletal structures were essentially normal. The meninges were congested. In the brain, the right olfactory bulb, medial and lateral olfactory tracts, the rhinal sulcus and the ventral part of the frontal lobe were effaced by an extensive subdural red-black rubbery blood clot (approximately 40 × 20 × 15 mm) which extended rostrally to the cribriform plate (Fig. 3). The cut surfaces of the brain showed this to extend caudally to approximately the level of the genu of the corpus callosum, dissecting rostrally between the right and left cerebral hemispheres. The left cerebral hemisphere was slightly displaced to the left (Fig. 4). The cerebellum was flattened and slightly caudally displaced.

On microscopic examination, poorly defined haemorrhage blended with areas of crisply defined blood-filled vascular channels of variable size. Each was lined by orderly, well-differentiated factor VIII-positive endothelial cells upon a delicate basement membrane, and supported by an arborescent trabecular glial fibrillary acid protein (GFAP)-negative collagenous stroma without neural parenchymal tissue. At the margins with adjacent neural tissue, vascular channels impinged irregularly without encapsulation. A diagnosis of cavernous haemangioma was made.

### DISCUSSION

In the central and peripheral nervous systems of humans, tumours of vascular origin are considered to comprise true neoplastic proliferations (capillary haemangioblastomas and angiosarcomas) and a range of vascular hamar-

tomas<sup>4</sup>. The latter include capillary telangiectases, cavernous angiomas, arteriovenous malformations and venous malformations. The incidence of such cerebrovascular malformations in human autopsy material ranges from 0.1% to 4% in different studies<sup>6,12</sup>, and are most

commonly observed in the 3rd to 5th decades of life. Multiple cavernous haemangiomas (cavernomas) are common in humans. Although cavernomas can cause seizures and rarely, clinically manifested brain haemorrhage, many are discovered incidentally. They

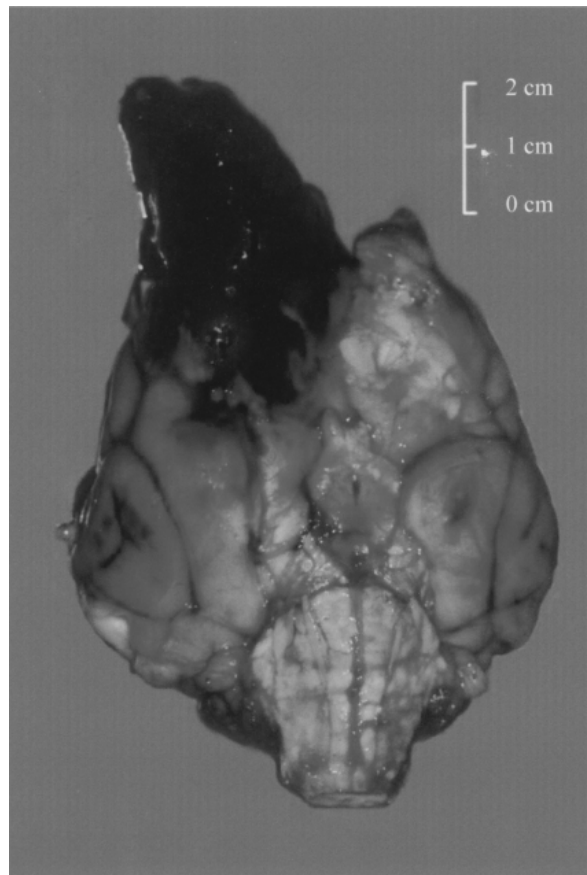


Fig. 3: Ventral aspect of the brain showing the large blood clot affecting the right olfactory bulb, medial and lateral olfactory tracts, rhinal sulcus and ventral portion of the frontal lobe.

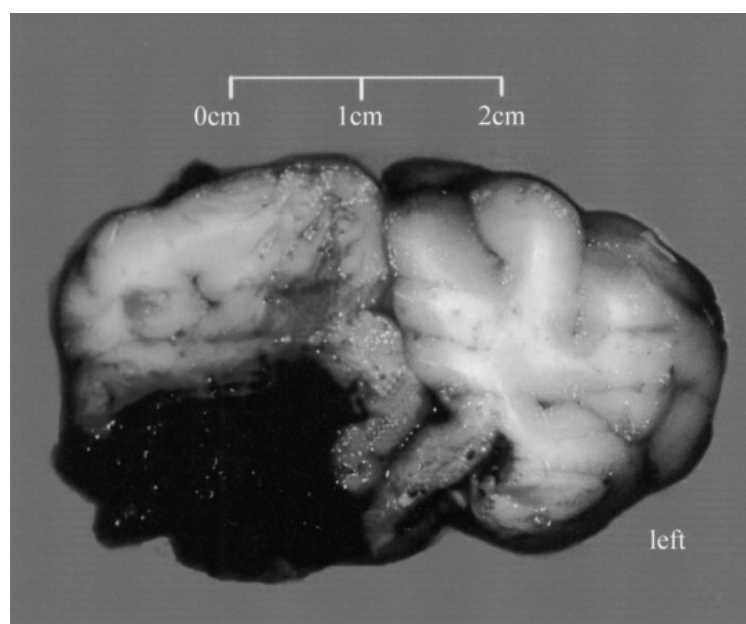


Fig. 4: Transverse section through the rostral aspect of the cerebral hemispheres demonstrating compression of the right cerebral hemisphere by the blood clot, with a shift of the mid-line to the left.

may be associated with venous malformations especially if located in the brainstem<sup>2</sup>.

Vascular malformations of the nervous system are uncommon in domestic animals and few cases have been described<sup>19</sup>. Furthermore, criteria for discriminating between hamartomatous and neoplastic lesions have only recently been suggested, and are not established in the veterinary literature<sup>18</sup>. Thus a limited range of variously classified angiomatous proliferations are catalogued, affecting dogs, cats, horses and calves<sup>1,7,8,10,11,14,15,18,19</sup>.

The macroscopic and histopathological appearances of the tumour in this case were consistent with cavernous haemangioma. Cells lining vascular sinusses labelled positively with antibodies against factor VIII, whilst the intervening trabeculae failed to label with antibodies against GFAP. This is a pattern considered characteristic of haemangioma, rather than hamartoma, in a recent description of 5 cases of cerebral hamartomas of dogs<sup>18</sup>. Whether this entity is truly a vascular neoplasm or a hamartomatous vascular malformation remains debatable but the age of the animal may favour the latter. The lesion may have been latent since birth, with subsequent catastrophic haemorrhage explaining the acute onset of clinical signs. One other similar case has been described in the dog, notably also in the forebrain of a young Golden retriever<sup>20</sup>. Two cases of compression of the spinal cord by these tumours have also been described in dogs<sup>8</sup>.

MR has proved to be a very sensitive and highly specific means of differentiating cavernous haemangiomas from other vascular malformations in humans<sup>9,16,21</sup>. Human CNS cavernomas have a characteristic appearance on MR images: the mass is sharply margined and lobulated, often without surrounding oedema<sup>2</sup>. The lobules have different signal characteristics, giving the lesion a 'popcorn-like' appearance. A hypointense peri-lesional corona of haemosiderin on T<sub>2</sub>-weighted images is almost diagnostic of cavernous haemangioma<sup>5</sup>. The specificity of MR, without the necessity of administering contrast media, makes MR the modality of choice in children with suspected cavernous malformations<sup>2</sup>.

In our patient, a thin peri-lesional rim was seen on T<sub>2</sub>-weighted images. The mixed signal intensity of the multilobulated mass seen on T<sub>2</sub>-weighted images gave the lesion the characteristic

'popcorn-like' appearance. No associated venous malformations were detected on post-contrast images. The extensive oedema and mass effect in the dog in this report, is not typical for this condition in humans<sup>2</sup>. The fact that this was also seen in the other reported canine case on CT images, may indicate that it is more typical for canine cavernous angiomas or alternatively, may have been associated with acute haemorrhagic incidents prior to presentation in both these cases<sup>20</sup>. Peri-lesional haemorrhage in the current case was confirmed histopathologically. The appearance of the cavernous haemangioma in the MR images of this dog approximates that seen in humans and therefore MRI may have the same specificity for detecting these lesions in dogs. However, more cases need to be studied to confirm this hypothesis.

Prior to the widespread use of CT and MR, the diagnosis of cavernous haemangioma in humans was usually made on *post mortem* examination. A recent study of hereditary, cerebral cavernous angiomas in 57 French families, showed seizures to be the most common symptom, followed by brain haemorrhage and focal neurological deficits<sup>13</sup>. They classified the cavernomas into 4 types, depending on the MR findings. The MR findings in our patient seem to be consistent with the Type II cavernomas described in humans (hypointense signal on T<sub>1</sub>-weighted image and hyperintense signal on T<sub>2</sub>-weighted image).

Surgical treatment had a favourable outcome in 1 human study<sup>16</sup>. However, in this case the lesion was considered too extensive and deep to contemplate surgery.

The fact that the 2 documented cases of this rare tumour, in a similar location, are both in Golden retrievers, may well be coincidental, but could indicate a breed association. MRI of the siblings and parents of future affected dogs may thus be of benefit.

#### ACKNOWLEDGEMENTS

The assistance of Dr A C Palmer in contributing critical comment and advice on this case is acknowledged with thanks. The authors would like to acknowledge Dr C Heinrich of the Comparative Ophthalmologic Unit, Animal Health Trust, for the fundic photograph from this case.

#### REFERENCES

1. Baker J C, Hultgren B D 1982 Disseminated cavernous haemangioma in a calf. *Journal of the American Veterinary Medical Association* 181: 172-173

2. Barkovich A J 2000 Abnormalities of cerebral vasculature In Barkovich A J (ed.) *Pediatric neuroimaging* (3rd edn). Lippincott, Williams & Wilkins, Philadelphia: 784-786.
3. Braund K G 1994 Neoplasia. In Braund K G (ed.) *Clinical syndromes in veterinary neurology* (2nd edn). Mosby, St Louis, Missouri: 198-211
4. Bruner J M, Tien R D, McLendon R E 1998 Tumors of vascular origin. In Bigner D D, McLendon R E, Bruner J M (eds) *Russell and Rubinstein's pathology of tumors of the nervous system*. Arnold, London: 239-293
5. Burger P C, Scheitauer B W 1994 *Atlas of tumor pathology: tumors of the central nervous system*. Armed Forces Institute of Pathology, Washington DC
6. Challa V R, Moody D M, Brown W R 1995 Vascular malformations of the central nervous system. *Journal of Neuropathology and Experimental Neurology* 54: 609-621
7. Cho C Y, Cook J E, Leipold H W 1979 Angiomatous vascular malformation in the spinal cord of a Hereford calf. *Veterinary Pathology* 16: 613-616
8. Cordy D R 1979 Vascular malformations and haemangiomas of the canine spinal cord. *Veterinary Pathology* 16: 275-282
9. Del Curling O, Kelly D L, Elster A D, Craven T E 1991 An analysis of the natural history of cavernous angiomas. *Journal of Neurosurgery* 75: 702-708
10. Fankhauser R, Luginbuhl H, McGrath J T 1965 Cerebrovascular disease in various animal species. *Annals of the New York Academy of Science* 127: 817-959
11. Gilmour J S, Fraser J A 1977 Ataxia in a Welsh cob filly due to a venous malformation in the thoracic spinal cord. *Equine Veterinary Journal* 9: 40-42
12. Jellinger K 1986 Vascular malformations of the central nervous system: a morphological overview. *Neurosurgical Review* 9: 177-216
13. Labauge P, Brunerea U L, Tournier-Lasserre E 1998 Hereditary cerebral cavernous angiomas: clinical and genetic features in 57 French families. *The Lancet* 352: 1892-1897
14. McGrath J T 1960 *Neurologic examination of the dog* (2nd edn). Lea and Febiger, Philadelphia
15. Palmer A C, Hickman J. 1960 Ataxia in a horse due to an angioma of the spinal cord. *Veterinary Record* 72: 611-613
16. Robinson J R, Awad I A, Little J R 1991 Natural history of the cavernous angioma. *Journal of Neurosurgery* 75: 709-714
17. Screbernik N, Appleby E C 1991 Breed prevalence and sites of haemangioma and haemangiosarcoma in dogs. *The Veterinary Record* 129: 408-409
18. Smith S H, Van Winkle T 2001 Cerebral vascular hamartomas in five dogs. *Veterinary Pathology* 38: 108-112
19. Summers B A, Cummings J F 1995 Tumours of the central nervous system. In De La Hunta A (ed.) *Veterinary Neuropathology*. Mosby, St Louis: 351-354
20. Woods P J, Cuddon P A, Schenkman D I 1992 Prefrontal cortical and diencephalic cavernous haemangioma in a dog. *Progress in Veterinary Neurology* 3: 126-130
21. Yamasaki I T, Handa H, Yamashita J, Paine J T 1986 Intracranial and orbital cavernous angiomas: a review of 30 cases. *Journal of Neurosurgery* 64: 197-208