# Brainstem Oligodendroglioma in a Puppy

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## ABSTRACT

**A 5 mo old male golden retriever presented for evaluation of an acute onset, progressive neurologic disease. Although computed tomography (CT) was unremarkable, MRI identified an ill-defined mass located in the medulla, which was considered likely responsible for the clinical signs. The imaging features closely resembled the classic features of human brainstem gliomas in the pediatric population. Histopathologic examination confirmed the lesion to be an anaplastic oligodendroglioma.**

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## Introduction

Gliomas are neuroepithelial tumors derived from glial cells (i.e., astrocytes, oligodendrocytes, and ependimocytes), representing approximately 36% of primary intracranial neoplasia in adult dogs.[1] Their occurrence in young dogs is uncommon, with the few reports of gliomas in puppies being predominantly astrocytomas.[2–5] Specific MRI features for both oligodendrogliomas and astrocytomas have been described, but in such reports, prosencephalic lesions represented the majority of cases and there were no specific descriptions for brainstem lesions.[6,7] In human medicine, brainstem gliomas are a well-defined entity, accounting for 10–20% of all central nervous system (CNS) pediatric tumors, and they have been classified according to their MRI features.[8–10] Brainstem oligodendrogliomas in humans are exceedingly rare, but have still been classified according to their MRI features.[9–11] Such classification is lacking in veterinary medicine due to the low number of cases reported in pediatric domestic mammals. This report describes the MRI features of a brainstem oligodendroglioma in a 5 mo old puppy.

## Case Report

A 5 mo old male golden retriever presented for evaluation of acute onset and progressive neurologic disease of 2 wk duration that was unresponsive to steroid therapy. Owners described loss of attention episodes, lasting 2–3 min, that were present at the time of adoption (1 mo previously). One wk before consultation, the animal developed proprioceptive ataxia, which was treated with prednisone[a] (1 mg/kg *q* 12 hr) for 1 wk by the referring veterinarian. No improvement in his neurologic status was appreciated. On presentation, physical examination of the puppy was unremarkable. Neurologic deficits included obtundation, circling to the left, reduced postural reactions in all four limbs with the left side more severely affected, and intact myotactic reflexes. Cranial nerve examination revealed that menace response, facial sensation, and palpebral and gag reflexes were reduced bilaterally. Those neurologic signs were compatible with a left-sided focal lesion involving the pons and medulla. Differential diagnoses included inflammatory diseases (infectious and noninfectious), congenital abnormalities, or neoplasia. Blood cell count, serum biochemical analysis, and cerebrospinal fluid analysis (via cerebellomedullary cistern tap) were normal. A pre- and postcontrast[b] (2.2 mL/kg IV) computed tomography (CT) of the head were obtained and were unremarkable. An MRI scan was thereafter obtained.

On MRI, a pontomedullary expansion with a mass effect, ill-defined borders, lengthening of relaxation times, and scattered areas of cystic components were seen (**Figures 1**, **2**). There was no enhancement after IV injection of paramagnetic contrast material[c]

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CNS *central nervous system;* CT *computed tomography;* GFAP *glial fibrillar acidic protein*

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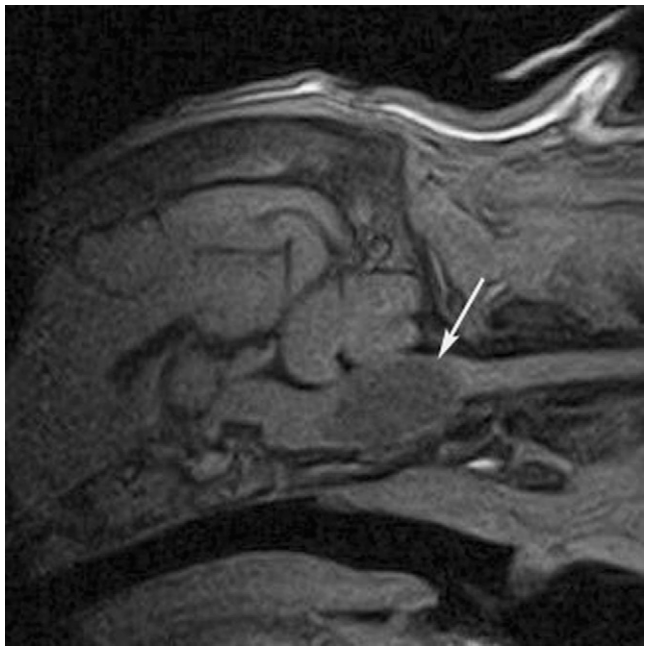

**FIGURE 1** *Sagittal T1-weighted image (repetition time/echo time/slice thickness/matrix were 23/8/1 mm/192 × 192) demonstrates an enlarged medulla and pons with marked hypointensity* (arrow).

(0.1 mmol/kg IV). In the ventrolateral left side of the lesion, a small cystic lesion was seen, characterized by its hypointensity on both T1-weighted and fluid-attenuated inversion recovery images and hyperintensity on T2-weighted images (Figures 2A–C). The basilar artery was easily visualized and was partially engulfed by the mass (Figure 2C). Mild dilation of the lateral and third ventricles was also observed. Those findings suggested a brainstem glioma. Due to the poor prognosis and the progressive nature of clinical signs, the dog was euthanized and necropsied.

Gross macroscopic changes consisted on the presence of a white-colored mass located on the ventral surface of the brainstem. The mass had a soft and gelatinous consistency, and extended from the medulla to the pons. The basilar artery was displaced by the mass, but neither enlargement nor obstruction was noted. Mild dilation of the ventricles was confirmed.

Histopathologic examination of the lesion demonstrated a moderately to highly cellular tumor, predominantly uniform in cellular and nuclear size and shape. The tumor was highly infiltrative into the adjacent parenchyma, and clear margins could not be established. Tumor cells were characterized by round and hyperchromatic nuclei with inconsistent nucleoli and either clear or lightly stained cytoplasms. Numerous fine-branching capillaries were present. In some regions of the tumor, nuclear polymorphism was present (**Figure 3A**). Neoplastic cells did not express immunoreactivity for glial fibrillar acidic protein (GFAP), but small GFAP positive cells were occasionally found around blood vessels, and they were considered to be reactive astrocytes (**Figure 3B**). The neoplasm also presented microcystic areas with an accumulation of pale acidophilic material. Mitotic figures were occasionally seen. According to those findings, the neoplasm was diagnosed as an anaplastic oligodendroglioma.

## Discussion

CNS tumors are the second most common neoplasms (27% of all tumors) in immature dogs (< 6 mo), with gliomas accounting for 37% of all pediatric brain tumors.[2] Nevertheless, reports describing naturally occurring CNS tumors in young animals are

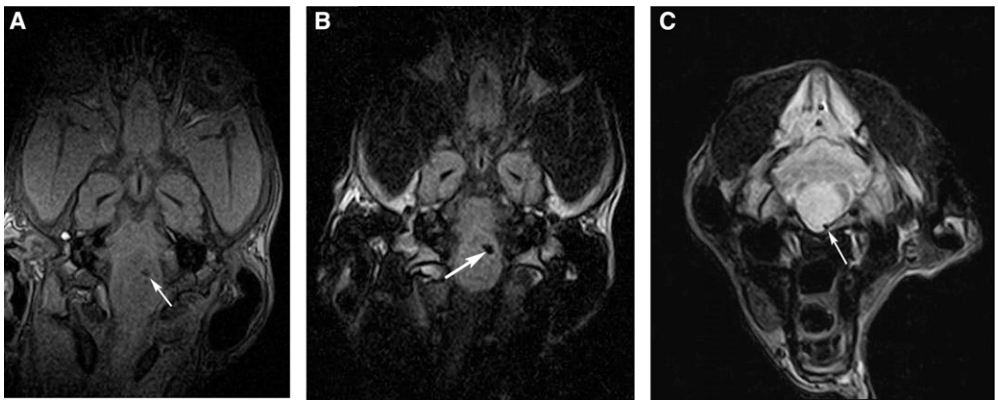


**FIGURE 2** A: *Dorsal T1-weighted image (with a repetition time/echo time/slice thickness/matrix of 23/8/1 mm/102 × 192) with gadolinium demonstrates the nonenhancing tumor and the left hypointense area corresponding with a cyst* (arrow). B: *Dorsal fluid-attenuated inversion recovery image (with a repetition time/echo time/flip/matrix of 2,025/29/90/192 × 195) at the same level of Figure 2A. Notice the hyperintensity of the lesion except for the cystic component* (arrow) *that appears hypointense, demonstrating its cerebral spinal fluid content.* C: *Transverse T2-weighted image (with a repetition time/echo time/slice thickness/matrix of 1,969/87/3.5 mm/192 × 195) at the level of the medulla showing the hyperintense lesion engulfing the basilar artery* (arrow).

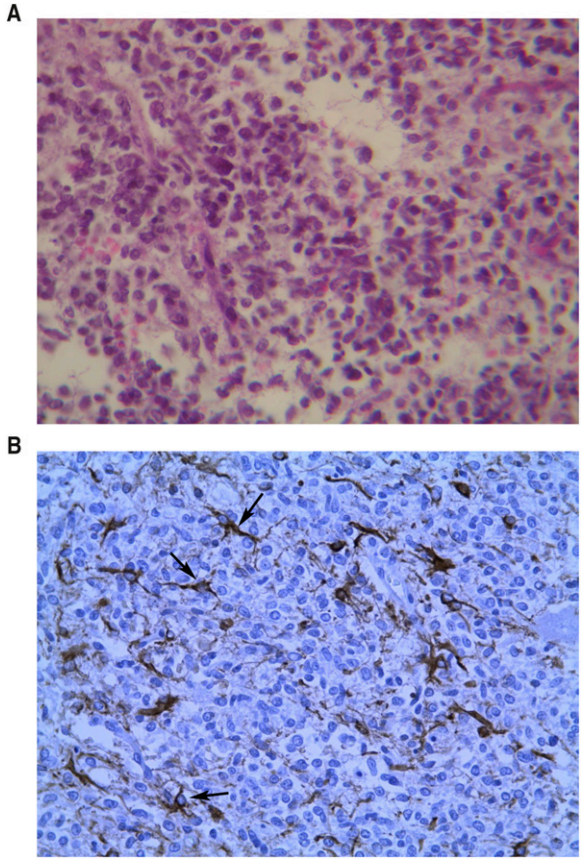


**FIGURE 3** A: *Transverse histologic section at the level of the medulla. Notice the characteristic fine branching capillaries and nuclear pleomorphism. Hematoxylin and eosin staining, original magnification ×200.* B: *Reactive protoplasmic astrocytes (*arrows*) are present between neoplastic cell population. Glial fibrillar acidic protein (*GFAP*) staining, original magnification ×400.*

scant, and most of those reports correspond to astrocytomas.[2–5] In human medicine, CNS tumors are the most common form of childhood solid malignancies and are the leading cause of cancer-related morbidity and mortality.[12] Many classification schemes have been devised to categorize brainstem tumors, and despite some differences all authors agree in categorizing brainstem gliomas as either diffuse (infiltrative lesions with indistinct margins) or focal (demarcated lesions) gliomas.[11] Diffuse gliomas are the more frequent form, accounting for 60–80% of all pediatric brainstem tumors.[9–11] The epicenter of the lesion is usually within the pons, but can also occur in either the medulla or midbrain.

MRI findings of human brainstem diffuse gliomas can be summarized based on the following descriptions: intra-axially located lesion centered on the pons with indistinct margins and diffuse infiltration of the brainstem; hypointensity on T1-weighted images and hyperintensity on T2 and fluid-attenuated inversion recovery weighted images (i.e., lengthening of relaxation times); a variable degree of contrast enhancement, but usually absent or poor; the basilar artery is frequently embedded in the mass; the cerebellar peduncles are frequently affected; and the presence of scattered areas of low signal in all sequences, consisting of calcifications.[9–11] It is noteworthy that those features, except the last one, closely resemble what was found in the current case.

Compared to MRI, CT scanning was useless in detecting this lesion, despite its large size. This can be due to the low soft-tissue resolution and beam-hardening artifacts when imaging the caudal cranial fossa. In human medicine, diffuse gliomas have been described as hypodense lesions with a nonspecific pattern of enhancement. Nevertheless, because of the high soft-tissue resolution MRI can provide, CT scans are being set aside progressively in the diagnosis of caudal cranial fossa lesions. Furthermore, currently on the basis of MRI findings, in human medicine, no further studies such as biopsies are required to confirm diagnosis of diffuse brainstem gliomas.[10,13] On the other hand, some authors advocate the need for biopsies to study their genetic and biologic characteristics to tailor specific treatments.[14]

Although histologic type varies depending on the examined series, it is generally accepted that the majority of intracranial lesions in young humans are pilocytic astrocytomas; however, approximately 80% of pediatric brainstem gliomas are diffuse, infiltrating astrocytomas (most frequently fibrillary). Of those, about 50% are histologically malignant at presentation.[15] This is in accordance with other brain gliomas described in puppies.[2–5] The current case was finally diagnosed as anaplastic oligodendroglioma based on the pathologic findings, which were classic for this kind of tumor. As mentioned earlier, this kind of tumor is exceedingly rare in human medicine and has not been previously described in pediatric dogs.[8] Immunohistochemistry allowed clear characterization of the tumor due to the fact that neoplastic cells were GFAP-negative. GFAP is an intermediate filament protein found in astrocytes and ependimocytes, but not in mature oligodendrocytes; therefore, GFAP is expressed in astrocytomas, but not in oligodendrogliomas, which are derived from either oligodendrocytes or a glial precursor cell that lacks this protein. A predilection for oligodendrogliomas in brachycephalic dog breeds such as boxers, Boston terriers, and bulldogs has been recognized.[16] They mainly affect dogs older than 5 yr, but a 15 mo old golden retriever has also been described.[17] These tumors are frequently found in either the white matter of the cerebral hemispheres or the diencephalon, but they can also be located in either the brainstem or the spinal cord.[6,15,18] The occurrence of multifocal oligodendroglioma not detectable on MRI has also been described.[19] In a recent report describing their MRI features in

adult dogs, oligodendrogliomas were presented typically as round or ovoid masses with defined margins. Signal intensity was T1-hypointense, T2-hyperintense, and uniform in intensity before contrast enhancement, which was present in 73% of the tumors, mainly as ring-like.[6] Cystic areas, hemorrhage, and perilesional edema are also frequent findings in oligodendrogliomas.[6] This case presented some of these features (i.e., cystic areas, signal characteristics), but differed in location of the tumor and the absence of contrast enhancement. However, none of those features are specific for oligodendrogliomas, and it is not currently possible to differentiate between the different kinds of gliomas on the basis of MRI findings alone.[6] Absent contrast enhancement would suggest a low grade glioma.[6,19] In this case, clinical signs appeared when the mass was very large; therefore, the authors of this report assume that it had been growing slowly over time. Nevertheless, this slow growth was not correlated with pathologic findings (i.e., anaplasia and the highly infiltrative nature of the neoplasia), which were characteristic of aggressive tumors.

The differential diagnoses for diffuse brainstem lesions consist mainly of either infections or abscesses, which can be promoted by foreign bodies. The most valuable MRI finding for its differentiation from brainstem gliomas is the presence of ring-like enhancement on postcontrast studies, but this is not mandatory.[20] Detection of a migration tract from an extraneural tissue source toward the place of a brain lesion nearly always indicates a brain abscess, but this finding is infrequent.[21]

## Conclusion

This case report describes the MRI diagnosis of an intracranial anaplastic oligodendroglioma in a 5 mo old dog with unusual localization. Brainstem gliomas should be included in the differential diagnosis of suspected focal brainstem lesions of dogs of any age. MRI allowed the antemortem diagnosis of brainstem glioma. The MRI findings closely resemble MRI features that have been widely reported in human medicine.

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FOOTNOTES

[a] Dacortin comp. 5 mg; Merck Farma y Química, SA, Barcelona, España

[b] Omnipaque; GE Healthcare, Bios-Sciences, SA, Alcobendas, España

[c] Magnograf 0.5 mmol/m: solución inyectable; Schering España, SA, Madrid, España

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