“Everybody Needs SomeBUDDY to Love”

Intraspinal Meningioma in a Dog

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Introduction

Meningiomas are tumors that arise from the meningeal layers of the central nervous system. They can occur anywhere along the central nervous system but are most commonly seen intracranially or within the cervical spinal cord.[8,9] Boxers and Golden Retrievers are overrepresented especially with intracranial meningiomas. These tumors are seen more commonly in middle to older age dogs with a mean age at diagnosis of 9 years.[1] Meningiomas cause neurological deficits due to the compression of the neural parenchyma in the affected area. Surgical excision is the treatment of choice, with radiation or chemotherapy to follow surgery since complete margins are very difficult to achieve without causing additional damage to the nervous system.[4] Meningiomas have a high rate of recurrence regardless of treatment so follow up imaging is often warranted, especially if signs begin to recur.[7]

History and Presentation

Buddy, a ten-year old male neutered Poodle mix, presented to the MSU Veterinary Specialty Center on June 8th, 2018 with a 48-hour history of circling and ataxia. Upon presentation, Buddy was quiet, alert and responsive and weighed 9.2kgs with an ideal body condition score of 5/9. His vital parameters were within normal limits, with a temperature of 102.3 degrees Fahrenheit, pulse of 100 beats per minute, and a respiratory rate of 36 breaths per minute. His mucus membranes were pink and moist with a capillary refill time of less than 2 seconds, indicating adequate hydration. Cardiothoracic auscultation revealed normal bronchovesicular sounds and no murmurs or arrhythmias. The remainder of the general physical exam was within normal limits. Neurologic examination revealed that Buddy was weakly ambulatory with a severe cerebellovestibular ataxia. He was able to take a few steps before

falling to the right. A right-sided head tilt was also present. Buddy's postural reactions were decreased in all four limbs, with the left side being more severely affected than the right. The remainder of his neurological examination was unremarkable. Neurological examination findings were consistent with a left paradoxical vestibular lesion.

A complete blood count (CBC) and serum chemistry panel were performed on initial presentation to screen for hematologic or electrolyte abnormalities. The CBC revealed mildly decreased platelets, lymphocytes, and monocytes; these findings were considered clinically insignificant. The chemistry panel revealed a slightly elevated ALT. Due to Buddy's history and neurological exam findings, advanced imaging was recommended. Prior to MRI, thoracic radiographs were performed to rule out pulmonary metastatic disease. His radiographs were within normal limits, so Buddy was placed under general anesthesia for an MRI of the brain and cervical spine. Buddy's MRI showed a large intradural extramedullary T2 and T2 FLAIR hyperintense well-defined, contrast enhancing left-sided mass located at the junction of the medulla oblongata and the spinal cord. The mass was causing severe ventral and right lateral compression of the brainstem and proximal cervical spinal cord.

Based on neurologic examination and diagnostic imaging findings, Buddy was presumptively diagnosed with a primary spinal cord tumor, with meningioma and nerve sheath tumor being the top differential diagnoses. Buddy's owner elected surgical debulking of the tumor. Buddy was scheduled for a modified foramen magnum decompression the following week and in the meantime was discharged on prednisolone. An abdominal ultrasound performed by Buddy's primary veterinarian for the purpose of complete pre-operative staging was unremarkable. Buddy returned to MSU for surgery on June 18th, 2018.

At the time of Buddy's return for surgery, his owners reported that he had been progressively declining. He was quiet, alert and responsive but had lost a kilogram over the previous week. His vitals were all within normal limits as was his general physical examination. Neurological examination revealed nonambulatory tetraparesis with the left side continuing to be more affected than the right. Postural reactions were decreased in the right pelvic limb and absent in the other three limbs. Spinal reflexes were hyperreflexive on the left side, and he had spastic muscle tone in all limbs. A ventral strabismus was also present in the left eye, a new finding compared to his initial examination. Buddy was admitted to the intensive care unit for overnight monitoring prior to surgery the following day.

Buddy was placed under general anesthesia and positioned in sternal recumbency with his head flexed at a 90-degree angle. A midline incision was made along the dorsal cervical region and caudal cranium extending from the occipital protuberance to the spinous process of C4. A craniectomy of the caudoventral portion of the occipital bone and craniodorsal aspect of the C1 vertebra was performed, and following durotomy the majority of the grossly visible mass was removed using steady traction. An Acell (swine intestinal submucosa, or SIS) graft was then placed over the durotomy site and sutured to the dura using 5-0 PDS in a simple interrupted pattern. A fat graft harvested from the right coxofemoral region was then placed over the SIS graft. The incision was closed in a 3-layer fashion. Buddy recovered from surgery and anesthesia uneventfully. The excised mass was submitted for histopathology and was confirmed to be a Grade II Meningioma.

Pathophysiology

Meningiomas are the most common primary neoplasia affecting the central nervous system, accounting for about 40% of all primary brain tumors.[7,8] They can arise from any of the three meningeal layers but most commonly arise from the arachnoid granulations.[1] Approximately 14% of canine meningiomas occur within the spinal cord, with 40-77% of spinal meningiomas occurring in the cervical region.[9] Spinal meningiomas are usually slow growing, locally invasive, and have a low rate of metastasis.[4] Although intracranial meningiomas seem to be more common in certain breeds such as Boxers and Golden Retrievers, spinal meningiomas do not appear to have any breed predisposition.[1,4,6] The mean age of diagnosis is 9.5 years, and studies have shown a male: female predominance of 2:1.[1]

Clinical signs seen with meningiomas vary greatly depending on the anatomic location of the mass. Neurological deficits are caused by compression of the spinal cord and are often slowly progressive over 1 to 3 months.[7] Meningiomas may be tentatively diagnosed based on characteristic computed tomography (CT) or magnetic resonance imaging (MRI) features, but histologic evaluation of the tumor is needed for a definitive diagnosis. Histologically, meningiomas are classified into three types: benign (Grade I), atypical (Grade II), and anaplastic (Grade III or malignant).[8] This grading scheme is based on the World Health Organization (WHO) classification of human meningiomas, which uses criteria such as mitotic figures and Ki-67 index. Ki-67 is a nuclear protein found only in the proliferative phase of the cell cycle. It is considered the most reliable marker in human brain tumors and is easily distinguished with immunohistochemical staining.[7] Studies have shown Ki-67 to be present in canine and feline meningiomas, allowing for the WHO classification system to be accurately adapted for use in these species.[7]

Grade I tumors have a low Ki-67 index (<4-5%) with few mitotic figures.[7,8] This is the most common grade in canines.[8] Grade II tumors are characterized by high mitotic figures (>4 mitoses per 10 high power fields) or having 3 or more of the following features: increased cellularity, small cells, nuclear atypia, tumor necrosis, or pattern less cell sheets.[8] Grade III tumors have overt malignant cytology, a high mitotic index (>20 mitosis per high power field), and a high Ki-67 index (>15%).[7] In humans, WHO tumor grading has both predictive and prognostic value, with Grades II and III directly correlated with a worse prognosis. In dogs however, the WHO grading system does not provide as much prognostic information. This is mostly due to the fact that Grade II tumors are relatively common in dogs and often not associated with worse prognosis than Grade I tumors.[6] On the other hand, Grade III tumors in dogs are almost always associated with a worse outcome.[6,7]

Diagnostic Approach/Considerations

Although definitive diagnosis of meningiomas is dependent on histopathology, there are several MRI characteristics that are considered highly suggestive of a meningioma. On MRI, meningiomas are typically intradural-extramedullary in location and well circumscribed.[5] They have a hypo- to isotense appearance on T1-weighted images, a hyperintense appearance on T2-weighted images, and are usually strongly contrast enhancing.[5] Meningiomas also classically have a “dural tail” sign, characterized by strong linear enhancement at the border of the tumor adjacent to the meninges.[1,5] Although not definitively diagnostic, some studies have shown up to 100% correlation between MRI diagnosis based on these characteristics and histopathological diagnosis of meinigomas.[7]

Treatment and Management

Once a tentative diagnosis of a meningioma is made, the initial treatment of choice is surgical excision or debulking.[4,7] The mean survival time of patients receiving only palliative therapy consisting of glucocorticoids is typically 1 to 3 months.[7,9] Patients that undergo surgical treatment alone have a mean survival time of 7 months.[4,9] However, surgical excision combined with post-operative radiation or chemotherapy has shown the greatest mean survival times of all treatment options.[4] Patients that have received the combined therapy have survival times ranging from 17 to 30 months.[9] Despite surgery and radiation, meningiomas have a high rate of recurrence which owners must be made aware of in considering treatment options. Recent studies suggest that stereotactic radiation could allow for comparable or greater survival times alone or when combined with surgery.[2,9] However, due to limited availability and lack of prospective research, surgery and traditional radiation therapy remain the preferred method of treatment with the greatest survival times.[9]

Case Outcome

Buddy was admitted to the intensive care unit immediately following surgery. An indwelling Foley urinary catheter was placed, and Buddy was maintained overnight on constant rate infusions (CRIs) of dexmedetomidine, fentanyl, and lidocaine. Several hours after surgery, his pulse oxygenation decreased which quickly responded to flow-by oxygen support. On June 20th, Buddy again had difficulty oxygenating; a mild cough and harsh lung sounds were noted at that time. Thoracic radiographs revealed an alveolar pulmonary pattern characterized by border effacement of the cardiac silhouette, lobar sign, and air bronchograms. These findings were considered consistent with aspiration pneumonia. He was placed in oxygen and treated with

Baytril (10mg/kg IV q24h), Unasyn (30mg/kg IV q8h), and nebulization and coupage every 6 hours. Buddy's respiratory rate and effort progressively improved over the subsequent few days, and he was successfully transitioned out of the oxygen cage on the 22nd of June.

As Buddy continued to recover, he was transitioned to oral pain medications (Tylenol 4 2mg/kg PO q8h and gabapentin 10mg/kg PO) and oral antibiotics (Clavamox 21 mg/kg PO q12h and Baytril 20mg/kg PO q24h). Passive range of motion was started on all four limbs in order to encourage movement and prevent joint contracture. On June 27th, Buddy was enrolled in formal physical rehabilitation to continue to help with his mobility, which yielded progressive steady improvement. Recheck thoracic radiographs performed on June 26th showed improvement of his previously diagnosed pneumonia. Buddy began a definitive course of radiation therapy on July 11th, 2018. He received a total of 35.75 Gy administered over 11 treatments (3.25 Gy per treatment) and was started on hydroxyurea (20 mg/kg PO 3 times weekly) to enhance the effects of radiation therapy.

On July 27th, 2018 Buddy was discharged from the hospital after completing his course of radiation therapy. He was discharged on hydroxyurea (20 mg/kg PO three times weekly), and his owners were instructed to continue to gradually increase his activity level at home. At the time of discharge, his neurological status was continuing to improve. His ventral strabismus had resolved, and all other cranial nerves were within normal limits. Buddy continued to have a very mild ataxia and proprioceptive deficits in both left limbs. Since the time of discharge, Buddy has been doing well at home and his owners report continued improvement. He currently only has mild neurological deficits present in his left pelvic limb.

Conclusion

This case report describes the diagnostic approach to and multimodal treatment of a canine patient diagnosed with a histologically confirmed spinal meningioma. While clinical signs may vary greatly depending on tumor location, neurological deficits allow for general neurolocalization. Magnetic resonance imaging is useful in obtaining a tentative diagnosis of meningioma based on characteristic findings, however histopathology is required for a definitive diagnosis. The current treatment of choice for meningiomas is surgical excision or debulking followed by radiation therapy with or without hydroxyurea. This combination of therapies has shown mean survival time between 17 and 30 months in canine patients.

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