

Primary Brain Tumors in Two Dogs Treated by Surgical Resection in Combination with Postoperative Radiation Therapy

Munekazu NAKAICHI, Yasuho TAURA, Sanenori NAKAMA, Akira TAKEUCHI¹⁾, Naofumi MATSUNAGA²⁾, Kazuyu EBE²⁾, and Akiteru AMIMOTO³⁾

Departments of Veterinary Surgery, ¹⁾Veterinary Hospital, Yamaguchi University, Yamaguchi 753, ²⁾Department of Radiology, School of Medicine, Yamaguchi University, Yamaguchi 755, and ³⁾Amica Pet Clinic, Yamaguchi 755, Japan

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ABSTRACT. Primary brain tumors in two dogs were surgically removed followed by postoperative radiation therapy. The two tumors were confirmed histologically to be astrocytoma and meningioma, respectively. After the surgery, the neurological status of each dog improved dramatically and a total dose of 40 Gy was delivered to the surgical site to treat residual tumor tissue. Although the dog with astrocytoma died 6 months after surgery due to unknown causes, the dog with meningioma has lived for over 24 months with a degree of neurological disorder less severe than that before treatment. These results suggested the effectiveness of this type of therapy on brain tumor in dogs and therapeutic modality should be positively planned to treat canine brain tumors. — **KEY WORDS:** brain tumor, radiation therapy, surgery.

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With the increased access of veterinarians to modern imaging procedures including computed tomography and magnetic resonance imaging (MRI), it has become easier to assess central nervous system abnormalities accurately in dogs and cats [2, 7, 11, 12]. Among these abnormalities, neoplastic diseases are known to occur commonly in dogs and cats [1]. Currently, brain tumors in small animals can be successfully treated by surgery in combination with radiation therapy and are considered to be controllable [3–5, 8, 13]. However, in Japan, there are few reports on the treatment of brain tumors. In this paper, we describe two dogs with brain tumors which were treated by surgery and radiation therapy.

Case 1 was a male 5-year-old Pomeranian that was referred to the Veterinary Hospital of Yamaguchi University because of progressive ataxia. At physical examination, the dog showed marked ataxia of both the thoracic and pelvic limbs. On neurological examination, conscious proprioception, hopping and placing were absent in the right fore limb. A complete blood count and serum chemistry profile yielded normal findings. Radiographic evaluation of the head and the neck revealed no abnormalities. MRI (MRP-20, 0.2T, Hitachi Medical Co., Japan) revealed a mass lesion in the left frontal lobe that appeared as a low- and high-signal-intensity area in T1- and T2-weighted images, respectively. Compression of the ventricle and midline shift were also observed. A tentative diagnosis of brain tumor was made. Surgical resection of the mass lesion was planned three weeks after the MRI diagnosis.

The dog was premedicated with atropine sulfate (0.05 mg/kg, sc). Dexamethasone (0.5 mg/kg, im) was used to reduce the postoperative brain edema. Anesthesia was induced with sodium thiopental (15 mg/kg, iv), and maintained with isoflurane. Controlled hyperventilation was used to maintain the lower arterial carbon dioxide tension to decrease intracranial pressure. The head was fixed to a stereotaxic frame and prepared for aseptic surgery. A midline skin incision was made on the head, and the temporal muscle was retracted. Craniotomy was performed as described by Hoerline and Oliver [6]. First, four burr holes were opened

on the skull using a dental drill, and a bone flap of about 2 cm² in size was created over the lesion. The bone flap was carefully opened. After incision of the dura mater, slightly brownish tumor tissue was easily identified (Fig. 1A). Large vessels supplying the mass were cauterized using a bipolar unit and the tumor tissue was bluntly dissected with a spatula (Fig. 1B). Bleeding from the brain parenchyma was



Fig. 1. Gross observation of the brain in case 1 during craniotomy. The slightly brownish tumor tissue can be seen (A). The tumor tissue is bluntly resected using a spatula (B).

controlled by electrocautery and gentle digital pressure. After repair of the dura mater and the bone flap, the skin was closed in a routine manner. The postoperative recovery was uneventful.

A few hours after the surgery, the dog showed seizure, therefore, dexamethasone (1 mg/kg, im), midazolam (0.5 mg/kg, im) and mannitol (1 g/kg, iv) were administered immediately. From the next day of operation, dexamethasone (0.5 mg/kg, im, bid.) and phenobarbital (2 mg/kg, po, bid.) were used to prevent further onset of seizures. Antibiotics (piperacillin, 30 mg/kg, iv, bid.) were also used. Dexamethasone was tapered every three days and stopped on the 11th day after surgery. Anticonvulsant and antibiotics were discontinued on the 24th day after surgery. No further seizures occurred. Histopathological examination of the surgical specimen revealed an astrocytoma.

Case 2 was a female 10-year-old mixed-breed dog that was referred for evaluation of an intracranial lesion that had produced neurological disorders including severe seizures, circling and ataxia. The dog showed loss of proprioception in the right fore and hind limbs, but no other abnormal findings in either blood examination or radiography were observed. MRI revealed a large mass on the left cerebral falx that was clearly enhanced by intravenously administered contrast medium (Fig. 2). The mass showed a dural tail sign in the sagittal image, strongly suggestive of meningioma. The dog underwent craniotomy as in case 1, and an intracranial mass was observed. The tumor tissue was debulked by blunt dissection with a spatula. The diagnosis of meningioma was confirmed by histopathological examination of the surgical specimen. The dog recovered well after surgery. Dexamethasone and antibiotics were used until the 12th day after surgery. No seizures were observed after surgery.

For adjuvant therapy, both dogs received postoperative X-ray irradiation, which was performed under general anesthesia with medetomidine (0.04 mg/kg, im) and pentobarbital (4 mg/kg, iv). An orthovoltage X-ray radiation unit (Shimazu Co., Japan) was employed and a total dose of 40 Gy, fractionated into 10 doses twice a week (200 kVp, 20 mAs, filter=1.0 mm Cu + 1.0 mm Al), was delivered. In both cases, the applied doses were calculated to deliver the prescribed doses of 40 Gy to the tumor center based on MRI measurement and the standard percentage depth dose tables. One portal perpendicular beam was used. All therapeutic procedures were accomplished without any problems related to anesthesia. No harmful side effects were seen during the radiation therapy except for slight pigmentation of the irradiated skin (Fig. 3).

After the surgery, the clinical symptoms of both cases were resolved dramatically. Case 1 was able to stand up and walk unaided from the 3rd day after surgery and remained in good physical condition after the discontinuance of corticosteroid administration. Case 2 underwent second MRI evaluation when the radiation therapy was completed, which revealed residual tumor tissue. However, the dog is



Fig. 2. Gd-DO3A enhanced MR imaging in case 2. A large mass with marked contrast enhancement is noted on sagittal section.

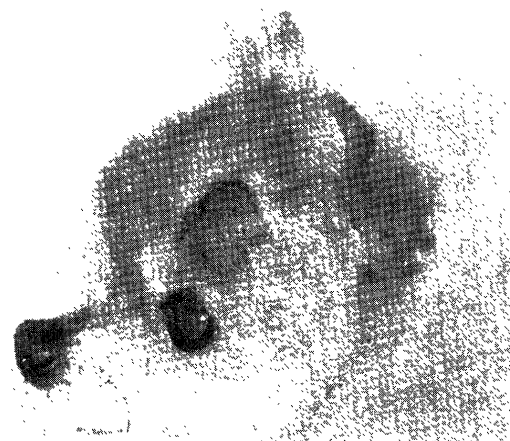


Fig. 3. Gross appearance of the dog in case 1 after radiation therapy. The irradiated skin is hairless and pigmented.

still alive over 24 months after surgery. After craniotomy, the dog showed aggressiveness for several months, a feature not evident before surgery. However, this change in behavior had gradually ceased. No neurological abnormalities except for intermittent circling were found after the completion of therapy. Case 1 died 6 months after surgery, however postmortem necropsy was not permitted.

The survival of dogs with brain tumors has been reported previously by several institutions [4, 5, 8, 9, 13]. According to these reports, symptomatic therapy using corticosteroid and anticonvulsants improved the clinical signs for several months, but the survival periods were rather short [4, 10]. The efficacy of radiation therapy for brain tumors has been proved [4, 5, 8, 13]. Evans *et al.* reported longer survival of affected dogs that were treated by radiation alone or in combination with surgery [4]. Other reports have also confirmed the therapeutic efficacy of radiation [5, 8, 13].

In contrast, the value of surgical excision of brain tumors in dogs has been controversial. In Heidner's report, the survival of dogs treated by surgery alone was quite short, and when radiation was used as an adjuvant therapy, the

survival was not longer than that after treatment with radiation alone [5]. Furthermore, Evans *et al.* mentioned that attempts at excisional surgery might be contraindicated because of the shorter survival reported elsewhere and severe postoperative complications including seizures and infection [4].

On the other hand, the need for excisional surgery or biopsy has been described elsewhere [1, 9]. Surgical resection is undoubtedly the most effective decompression procedure [1]. In addition, the histological diagnosis of brain tumors is very important because the prognosis of affected dogs depends on the tumor type. Heidner *et al.* reported that dogs with meningioma survived significantly longer than dogs with other tumor types [5]. The histological confirmation of tumor type requires a surgical specimen. Therefore, surgical resection or, at least, biopsy is necessary in order to plan the most effective therapeutic protocol and to obtain a more accurate prognosis.

In our cases, the intracranial mass was fortunately superficial and accessible to surgical resection. Palliation of the clinical signs was achieved after surgery and postoperative complications were well controllable. From these results, surgery appeared to be an effective therapeutic modality for the treatment of superficial brain tumors. Further investigations are needed to confirm the necessity of surgery for brain tumors in dogs. In the case 1 dog, a clear tumor-free surgical margin could not be obtained because the glial tumor showed extensive infiltration, and in the case 2 dog, surgery was limited to debulking. Therefore, both dogs underwent postoperative irradiation to reduce the residual tumor tissue, which undoubtedly contributed to the survival of the two dogs.

In conclusion, antitumor therapy including surgery and radiation could improve clinical symptoms of the dogs with brain tumors. These results indicate the possibility of treatment for accessible brain tumor by this type of therapy.

Therefore, antitumor therapeutic modalities should be positively planned to treat canine brain tumors, with the aim of going beyond mere palliation.

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