



CASE REPORT: NEUROLOGY

The Role of the Veterinary Nurse in the Diagnosis and Surgical Treatment of a Canine Meningioma

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Abstract

This case report follows a 7-year-old poodle mix from initial presentation for seizures through advanced diagnostics and surgical excision of a primary brain tumor. Monitoring intracranial surgery requires extensive knowledge of brain physiology. The veterinary nurse plays a crucial role by obtaining a history, monitoring anesthesia and recovery, and communicating postdischarge instructions to the client.



Take-Home Points

- Obtain a thorough neurologic history when a patient presents for seizures or changes in behavior.
- Patients presenting with seizures can have a normal neurologic exam. Therefore, it is important to take into consideration all possible differentials when creating and implementing an anesthetic protocol.
- Advanced diagnostics, such as magnetic resonance imaging, are needed to obtain a diagnosis, and surgery may be indicated. Both require general anesthesia, and neuroprotective protocols should be used when a space-occupying lesion is suspected.
- The veterinary nurse should have advanced knowledge of brain physiology and perianesthetic monitoring and be aware of all possible complications and treatments during this process.

Meningioma is the most common primary brain tumor (PBT) found in dogs.¹ Meningiomas originate in the meninges of the brain and spinal cord. They are extra-axial (outside of the brain tissue). Because of the peripheral location of the meningioma in this case report, the otherwise healthy patient was a good candidate for surgery and carried a favorable prognosis.²

SIGNALMENT, HISTORY, AND PRESENTATION

“Freddy,” a 7-year-old neutered male 10-kg (22-lb) poodle mix with a 4-month history of seizures was presented for a neurology consult. The veterinary nurse is responsible for obtaining a full neurologic history from the owner with an accurate description of the episode(s). The first episode consisted of falling off the couch and convulsing. This lasted about 1 minute, and the patient recovered quickly with a very minimal postictal phase. He had a total of 4 similar witnessed events over the 4-month period.

Because neither the veterinary nurse nor the neurologist witnessed the episodes, the owner’s description was key to differentiating between a seizure and other types of abnormal episodes such as a vestibular, ischemic, or possible syncopal episode. The presence of convulsions, postictal phase, loss of consciousness, and the fact that the patient was reportedly normal in between episodes with no exercise intolerance and seemed to be responding to anticonvulsant therapy suggested these were more consistent with a generalized seizure.

A complete blood count (CBC) and serum biochemical profile were performed and found unremarkable.

Orthogonal thoracic radiographs were also normal. The patient was previously prescribed 2 anticonvulsants, first phenobarbital (3.24 mg/kg PO q12h) and then levetiracetam (25 mg/kg PO q8h) when seizure control was not adequate.

NEUROLOGIC EXAM

After obtaining the patient history from the client, the veterinary nurse assists the neurologist with full neurologic and physical exams. Freddy’s neurologic and physical exams were both normal. The neuroanatomic localization was to the prosencephalon (forebrain) based on the history of seizures. Clinical signs for patients with a forebrain lesion include seizures, behavior changes, decreased or absent menace response, head turn, postural reaction deficits contralateral to the lesion, neck pain, and hemineglect syndrome.³

Based on his history, signalment, and normal CBC and serum biochemical profile, the top differentials were neoplasia, idiopathic epilepsy, and autoimmune/inflammatory diseases such as encephalitis. The typical age of onset for idiopathic epilepsy is 1 to 5 years, making it less likely but still a possibility.³ PBTs usually present in dogs and cats over 5 years of age but can occur at any age.³

ADVANCED DIAGNOSTICS

About 1 week after he was evaluated by the neurologist, Freddy was seen for a follow-up exam and advanced diagnostics. The owner reported to the veterinary nurse that Freddy was circling and pacing occasionally, which was suspicious of a forebrain lesion. No additional seizures were witnessed.



Magnetic resonance imaging (MRI) is the preferred modality for advanced imaging of the brain. Veterinary nurses are responsible for monitoring general anesthesia and obtaining quality diagnostic MRI images.

Freddy was placed under general anesthesia for an MRI of the brain. He was premedicated with butorphanol (0.2 mg/kg IV) for its sedative qualities. Anesthesia was induced with midazolam (0.2 mg/kg IV) and propofol (4 mg/kg IV to effect). The veterinary nurse uses advanced knowledge to create a multimodal anesthetic protocol that reduces the potential for increased intracranial pressure (ICP) caused by drugs such as α_2 -agonists, dissociatives, and inhalants above minimum alveolar concentration (MAC). A possible intracranial lesion should always be considered when creating an anesthetic protocol if the cause of seizures is unknown.

The MRI showed a left-sided extra-axial cystic mass in the left olfactory region along the left frontal bone. On sagittal and axial T2-weighted images, fat, cerebrospinal fluid (CSF), and edema appear hyperintense, making this sequence ideal for showing pathology. On T1-weighted precontrast images, CSF and fluid appear hypointense. The fluid-attenuated inversion recovery (FLAIR) sequence improves contrast to help differentiate free fluid from edema. On Freddy's T2-weighted sequences, the rostral portion of the mass was isointense compared to gray matter, while the larger caudal two-thirds of the mass was hyperintense (**FIGURE 1A AND 1B**). On T1-weighted imaging, the caudal two-thirds of the mass was hypointense but did not suppress on FLAIR. These imaging findings were consistent with a cyst. The radiologist noted a strong contrast enhancement on T1-weighted postcontrast images (**FIGURE 1C AND 1D**), revealing the mass to be

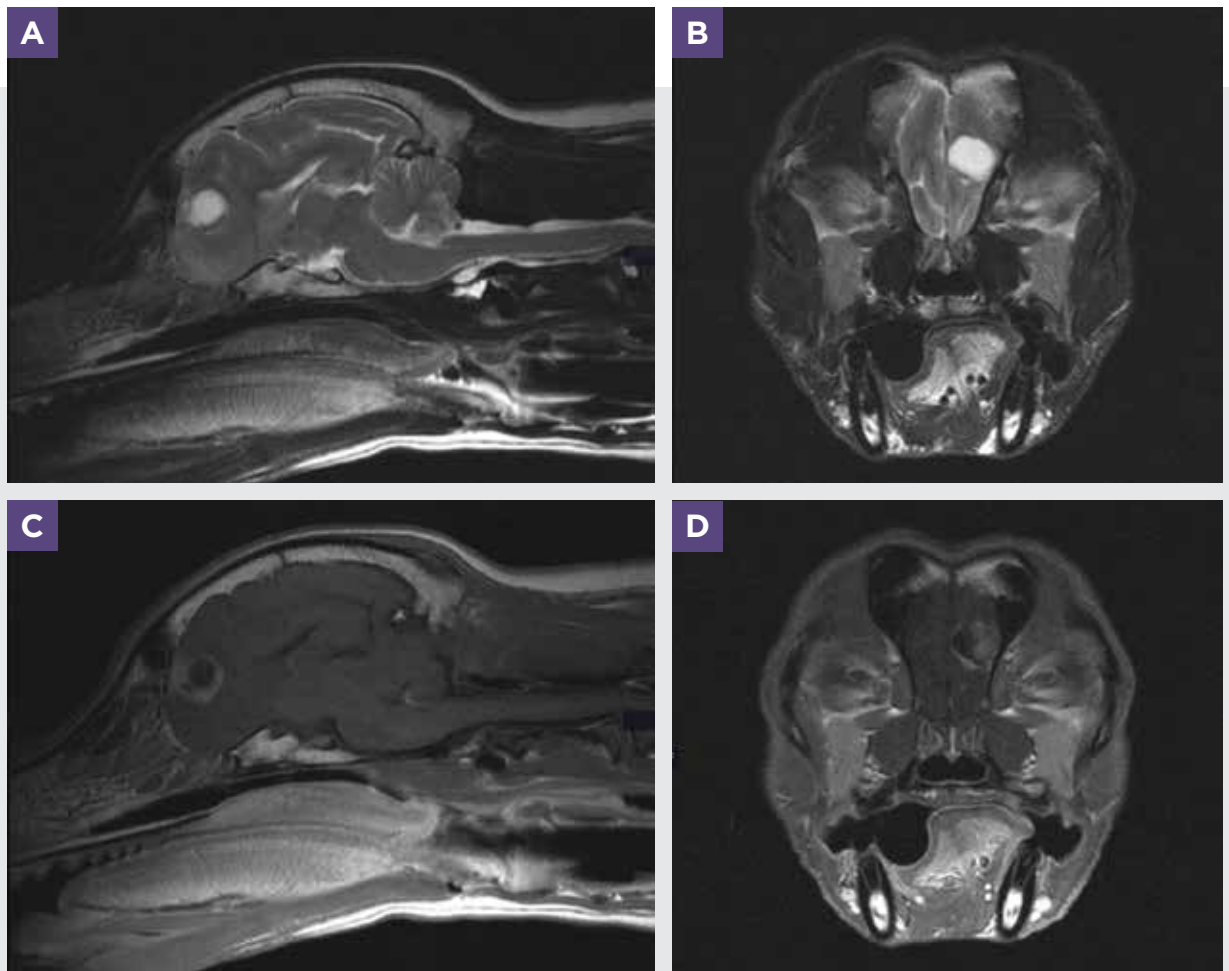


FIGURE 1. Freddy's magnetic resonance imaging study of the brain showed a cystic mass in the left forebrain. **(A)** Sagittal T2-weighted view. **(B)** Axial T2-weighted view. **(C)** Sagittal T1-weighted view post contrast. **(D)** Axial T1-weighted post contrast.



crescent-shaped with a rim enhancement surrounding the cystic component that did not pick up contrast and remained hypointense. There was also a dural tail sign at the margins of the mass, which led the radiologist to a top differential of cystic meningioma.¹

It was confirmed that the cause of Freddy's seizures was likely a PBT. He was given an injection of dexamethasone sodium phosphate (SP) (0.1 mg/kg IV) and prescribed prednisone (0.5 mg/kg q12h) to be tapered to reduce inflammation and edema associated with the PBT.²

The owner was given the options of palliative care with steroids and anticonvulsants, surgery to excise the mass, or surgery followed by radiation therapy. Surgery without radiation therapy was elected.

SURGICAL INTERVENTION

Freddy was admitted to the hospital 2 weeks later for a transfrontal craniotomy. The veterinary nurse obtained vital signs and an updated neurologic history from the owner. The owner reported no witnessed seizures. The neurologic exam and all vital signs were normal the morning of the procedure.

Peripheral 20-G intravenous catheters were placed in the left and right cephalic veins and the right lateral saphenous vein in preparation for multiple constant-rate infusions (CRIs). The veterinary nurse placed a 22-G arterial catheter in the left dorsal pedal artery. The arterial line allows for both invasive blood pressure monitoring and arterial blood gas sampling if needed perioperatively. Preanesthetic medications consisted of maropitant (1 mg/kg IV), dexamethasone-SP (0.1 mg/kg IV), cefazolin (22 mg/kg IV q90min), fentanyl (5 µg/kg IV), and lidocaine (2 mg/kg IV). Anesthesia was induced with midazolam (0.2 mg/kg IV) and propofol (3 mg/kg IV to effect). The patient was intubated with an 8-mm guarded endotracheal tube to help prevent occlusion during positioning for the procedure.

Freddy's fur was clipped from the nose to the level of the occipital protuberance with approximately 4 to 5 cm on each side of the dorsal midline. The veterinary nurse confirmed the surgical area with the neurosurgeon, and it was aseptically prepared with povidone-iodine. The patient was positioned in sternal recumbency, with his head elevated at a 15° to 30° angle to allow cerebral venous draining and decreased ICP.⁴ His head was

GLOSSARY

Anisocytosis* Presence in the blood of erythrocytes with excessive size variation

Anisokaryosis* Inequality in the size of the nuclei of cells

Cerebral blood flow Delivers blood and glucose to brain tissue and enables the brain to match the blood supply with the metabolic demand

Cerebral metabolic rate The rate of oxygen consumption by the brain

Dural tail sign A finding on contrast-enhanced magnetic resonance images that shows thickening of the dura mater adjacent to a mass and resembles a tail extending from it; considered highly suggestive of meningioma but not pathognomonic

Extra-axial Outside of the brain tissue

Fluid-attenuated inversion recovery A magnetic resonance imaging sequence that improves the contrast between fluids/edema and the surrounding areas to highlight lesions in close proximity

Hyperintense An area on imaging that is bright compared to its surroundings; intensity may change when viewed as a different type of weighted image

Hypointense An area on imaging that is dark compared to its surroundings; intensity may change when viewed as a different type of weighted image

Isointense An area on imaging that appears the same as its surroundings; intensity may change when viewed as a different type of weighted image

Microcystic meningioma* A rare, benign type of meningioma characterized by small cysts

Palisade* The arrangement of cells or cellular structures side by side in rows, like pickets in a fence; it is characteristic of cells seen in tissue sections in certain normal and disease states

Postictal Period that begins when a seizure subsides and ends when the patient returns to baseline

Prosencephalon The forebrain

*Definition from Dorland's Medical Dictionary Online. Accessed October 16, 2024. [dorlandsonline.com](https://www.dorlandsonline.com)



positioned using a vacuum cushion that did not put pressure on the jugular veins, which could increase ICP. The veterinary nurse and neurosurgeon worked together to position the patient to ensure that the site was accessible and avoided the aforementioned potential complications from positioning.

The veterinary nurse monitored anesthesia, which was maintained using partial intravenous anesthesia (PIVA) (**FIGURE 2**) and 0.6% to 0.8% isoflurane with oxygen at 1 L/min. PIVA was achieved with CRIs of fentanyl (7.5 µg/kg/hr), lidocaine (50 µg/kg/min), and propofol (0.1 to 0.2 mg/kg/min). This protocol provided adequate anesthesia and analgesia and allowed the isoflurane to be kept below MAC, decreasing unwanted side effects such as increased ICP. Lactated Ringer's solution was administered at 5 mL/kg/hr. Freddy was placed on an anesthetic ventilator to maintain his end-tidal carbon dioxide between 33 and 40 mm Hg. The arterial catheter was used for invasive blood pressure monitoring so the veterinary nurse could respond quickly to hypotension or hypertension with an associated bradycardia that could indicate a Cushing response. The patient's temperature was monitored and kept between 34.4 °C and 35.6 °C (93.9 °F and 96.1 °F).



FIGURE 2. Multiple constant-rate infusions are used to achieve partial intravenous anesthesia for a craniotomy.

A midline skin incision was made from the caudal edge of the nasal bone to the caudal margin of the frontal sinus. Once the calvaria was exposed, a diamond-shaped window was made using a sagittal saw (**FIGURE 3**). The veterinary nurse, anesthesiologist, and neurosurgeon communicate throughout the procedure to address any complications and manage them. The neurosurgeon alerted the veterinary nurse when the brain tissue was exposed, and a CRI of mannitol (0.5 g/kg over 20 minutes) was administered prophylactically when dissection of the mass began. Hypotension (mean arterial pressure <60 mm Hg) was managed by increasing heart rate (67 beats per minute) with glycopyrrolate (5 µg/kg IV) and, when that did not work, atropine (0.02 mg/kg IV). The hypotension was further treated with a 10 mL/kg lactated Ringer's solution bolus and ephedrine (0.05 mg/kg IV). Mannitol was administered a second time during the excision to help reduce associated edema.

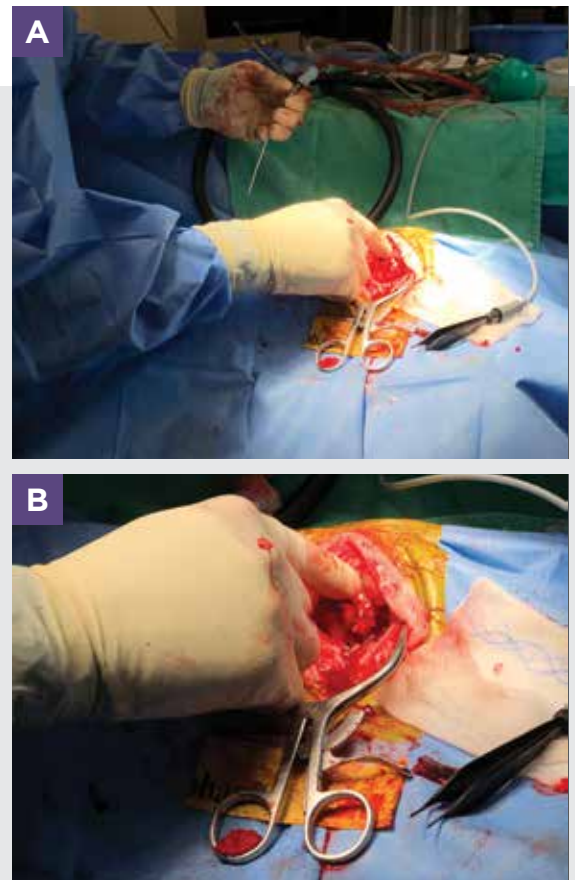


FIGURE 3. The surgeon prepares to excise the mass in the patient's left forebrain. **(A)** The surgeon operating. **(B)** Close-up of the surgical site.



BOX 1

Histopathology Report

Histologic Diagnosis

Extra-axial, left forebrain mass: Meningioma, microcystic variant, grade I out of III

Comment

The left forebrain mass is a meningioma, microcystic subtype. The submitted sample does not include neuroparenchyma; hence, invasion cannot be evaluated. The cellular features support a grade I out of III, based on the human World Health Organization (WHO) system. Canine meningiomas typically occur as solitary, well-demarcated tumors that grow by compressive expansion with infiltration into the underlying parenchyma. There is no

accepted grading scheme for canine meningiomas; however, the human WHO system is used in dogs, which comprises grade I (most benign), grade II (atypical), or grade III (rare malignant-type) tumors. Only pulmonary metastasis has been reported rarely in malignant meningiomas in dogs.

Histologic Description

Extra-axial, left forebrain mass (1 slide; 1 fragmented section): The section is characterized by a densely cellular neoplasm without sampled neuroparenchyma. The neoplasm is characterized by poorly defined whirls, and thick streams supported by a delicate fibrovascular stroma

with occasional prominent blood vessels that neoplastic cells palisade around. The neoplastic cells are oval to elongated, with indistinct cell margins and a moderate amount of pale eosinophilic, fibrillar cytoplasm. The nuclei are mostly round to slightly indented, with finely stippled, open chromatin, and most frequently 2 small nucleoli. Anisocytosis and anisokaryosis are moderate, and there is a single mitotic figure in ten 400× fields (2.37 mm²). In large areas, the neoplastic cells exhibit marked cytoplasmic vacuolation (microcystic change) in up to 50% of the neoplasm. Occasional rosette-like structures are noted in a few areas. Rare inflammatory cells infiltrate the neoplasm.

The surgery lasted 2.5 hours. After the mass was excised, the cranial bone was reattached using 2-0 monofilament polypropylene suture (**FIGURE 4**). Bone wax was used to fill any remaining gaps, and the incision was closed with 2-0 polydioxanone and 3-0 poliglecaprone 25 sutures.

Freddy was slowly weaned off the ventilator by the veterinary nurse to ensure the return of spontaneous ventilation and slowly returned to normothermia. He was extubated and recovered in an oxygen cage at 40% oxygen and positioned at a 15° angle in the intensive care unit (ICU). The neurology veterinary nurse rounded the overnight ICU veterinary nurse and discussed potential postoperative complications. The ICU veterinary nurse closely monitored Freddy's heart rate, blood pressure, and respiration rate for signs of increased ICP. He became agitated approximately 15 minutes after extubation and was given acepromazine (0.01 mg/kg IV) for sedation. The CRIs of fentanyl (3.75 µg/kg/hr) and lidocaine (25 µg/kg/min) were continued overnight. He received mannitol (0.5 g/kg IV over 20 minutes) once more during the night. Phenobarbital (3.24 mg/kg IV q12h) and levetiracetam (25 mg/kg IV q8h) were continued. Cefazolin (22 mg/kg IV q8h) was continued prophylactically.

No seizures were witnessed overnight. The following morning, Freddy was removed from oxygen supplementation. The fentanyl/lidocaine CRI was discontinued, and buprenorphine (0.15 mg/kg IV q8h) was administered for analgesia. He received dexamethasone-SP (0.1 mg/kg IV q24h) for inflammation. He was offered food in the morning and had a great appetite. He was monitored by the veterinary nurses in the ICU throughout the day. His neurologic exam was normal.

The excised mass was placed in formalin and shipped to Cornell University for histopathologic evaluation. The mass was confirmed to be a grade I meningioma with a microcystic variant (**BOX 1**).

OUTCOME

Freddy was discharged from the hospital 2 days after surgery. He was comfortable, strongly ambulatory with a normal gait and no proprioceptive deficits, and interacted well with the staff.

On discharge, he was prescribed continued anticonvulsant therapy with phenobarbital (3.24 mg/kg PO q12h) and levetiracetam (25 mg/kg PO q8h), prednisone (0.5 mg/kg PO q12h on a tapering dose)

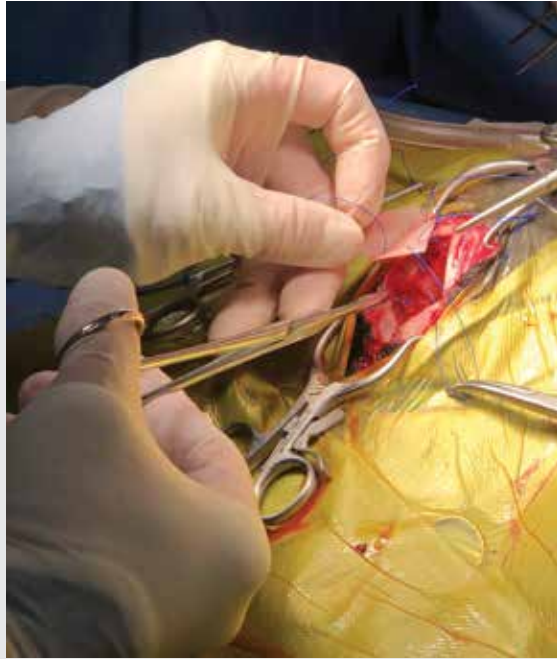


FIGURE 4. The bone plate was reattached using suture.

for inflammation, cephalexin (25 mg/kg PO q12h) prophylactically, and tramadol (2.5 mg/kg PO q8h to q12h) and gabapentin (10 mg/kg PO q8h to q12h) for analgesia. The owner was instructed to monitor the incision for swelling or discharge and limit Freddy's activity to crate rest and short leash walks for 4 weeks. The veterinary nurse was available for any owner concerns during the recovery period.

A suture removal was scheduled for 12 days postoperation. At that time, no seizures were reported. Freddy was comfortable and acting normally at home; his neurologic exam was normal.

One month postoperation, Freddy was still seizure free with no abnormal behavior noted by the owner. His

neurologic exam was normal, and he was finished with prednisone, gabapentin, tramadol, and cephalexin. The owner was instructed to continue the phenobarbital and levetiracetam indefinitely.

The owner did not elect to pursue radiation postsurgery. However, an MRI of the brain was repeated at 6 months, 12 months, 18 months, and 24 months postoperation. All scans showed no regrowth of the tumor. Freddy remained seizure free.

DISCUSSION

Meningioma is the most common PBT found in dogs.¹ It is an extra-axial tumor, meaning it is located peripheral to the neuroparenchyma in the meninges and not deep within the brain tissue. Patients with meningiomas can show no clinical signs, and meningiomas sometimes present as an incidental finding on advanced imaging.¹ Those located in the forebrain can present with seizures or other cranial nerve deficits. Because of the superficial location, surgical removal often has a good prognosis.

Most meningiomas are benign and slow growing, which would classify them as grade I. There is no grading scale for dogs; therefore, the human World Health Organization scale is used. Limited data exist regarding mean survival times, but approximately 1 to 6 months with palliative care, approximately 10 months with surgery alone, and approximately 16 to 30 months with surgery and radiation have been reported.¹

The space within the cranium consists of blood, CSF, and brain tissue. A mass in the brain will alter this balance and can result in increased ICP.⁵ Manipulation of the brain tissue can cause increases in cerebral blood flow, edema, and hemorrhage, leading to increased ICP.² Intracranial surgery carries the added risk of sudden and profound increases in ICP, which can lead to ischemic events, herniation of the brain through the foramen magnum, and death.

The goal of anesthesia for intracranial procedures is to maintain homeostasis by reducing the risk of increased ICP. Inhalants such as isoflurane and sevoflurane can increase ICP with doses at or above MAC.⁵ PIVA was used to provide a balanced anesthetic protocol with drugs that can help lower ICP and decrease the unwanted side effects of inhalants. In addition, hyperventilation and hypothermia can help protect the

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brain during surgical procedures.⁵ A decrease in alveolar partial pressure of oxygen increases the pH of the blood, causing vasoconstriction and decreased cerebral blood flow.⁵ Hypothermia lowers the cerebral metabolic rate, which can protect the brain during an ischemic event, making it less detrimental. Mannitol, an osmotic diuretic, is also used to reduce edema associated with manipulation of the brain tissue and therefore was included in Freddy's treatment.⁴ Throughout the peri-anesthetic period, the veterinary nurse diligently monitored heart rate and blood pressure for signs of a Cushing response, which would indicate an increase in ICP and is characterized by hypertension and reflex bradycardia. If a Cushing response was suspected, it would be treated with hyperventilation and additional administration of mannitol to reduce ICP.⁴ Freddy, aside from mild hypotension and bradycardia that was easily corrected, did very well under anesthesia.

Veterinary nurses play a crucial role in these cases by obtaining an accurate neurologic history and assisting with neurologic exams. They work with the neurosurgeon and anesthesiologist to create and implement an anesthetic protocol unique to each patient and are prepared to address any complications. Veterinary nurses navigate the delicate balancing act of monitoring anesthesia with multiple CRIs and communicating with the neurosurgeon about patient care. Veterinary nurses monitor the patient closely during recovery, alerting the veterinarian to any adverse events. Veterinary nurses are also often the direct line between the owner and the veterinarian after the patient is discharged from the hospital.

Freddy surpassed the mean survival time and was given 4 normal, healthy years before succumbing to cardiac disease. He even did well under anesthesia for the 4 biannual MRIs to monitor for tumor regrowth. Freddy's outcome does not ring true for all patients, but it was a happy one. **TVN**

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Christine has been working in veterinary medicine since 2005 in New Jersey and Pennsylvania. She obtained her CVT credential in 2018 and achieved a VTS in neurology credential in 2022. She has worked since 2016 in the neurology department at BluePearl Pet Hospital in Levittown, Pennsylvania. Christine has lectured on topics such as seizures and anesthesia for the craniotomy, most recently speaking about anesthesia for the neurologic patient at the ACVIM Forum. She resides in Pennsylvania with her cat, Jellybean McStinkerson.

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