Optimizing Brain MRI in Canine and Feline Patients

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Scanning veterinary patients requires a mindset shift from scanning human patients. Veterinary patients tend to be fully anesthetized and intubated for scans, which requires some flexibility in positioning to accommodate the endotracheal tube. In our hospital, patients undergoing spinal and brain MRI tend to be kept anesthetized using total intravenous anesthesia, with only oxygen flowing through the endotracheal tube. This allows us to control ventilation to help reduce movement artifacts, while ensuring oxygen saturation is maintained, as elevated end tidal carbon dioxide measurements are associated with increased intracranial pressure [1]. Care should be taken to not kink the endotracheal tube, and to make sure drip lines are patent and working in the magnet.

The nature and severity of intracranial disease is typically estimated by a neurological assessment prior to anesthesia, including degree of conciousness or blindness. An assessment of cranial nerves may also be involved. Setting the patient up in the magnet tends to take longer than a human patient, given the complexity of positioning the head and associated tubing (endotracheal, intravenous). It also takes some time to ensure that the body is positioned so the lungs can still inflate (i.e., the patient is not wrapped too tightly).

Positioning

Place the patient in a prone position (in sternal recumbency) to minimize any increase in intracranial pressure. Even when the patient is under anesthesia, make every attempt to keep the dog or cat comfortable on the table cushion. Elderly patients may need padding under their hocks and you might need to avoid extending their hips (Fig. 1). Uncomfortable patents will have a higher heart rate and require increased anesthesia.

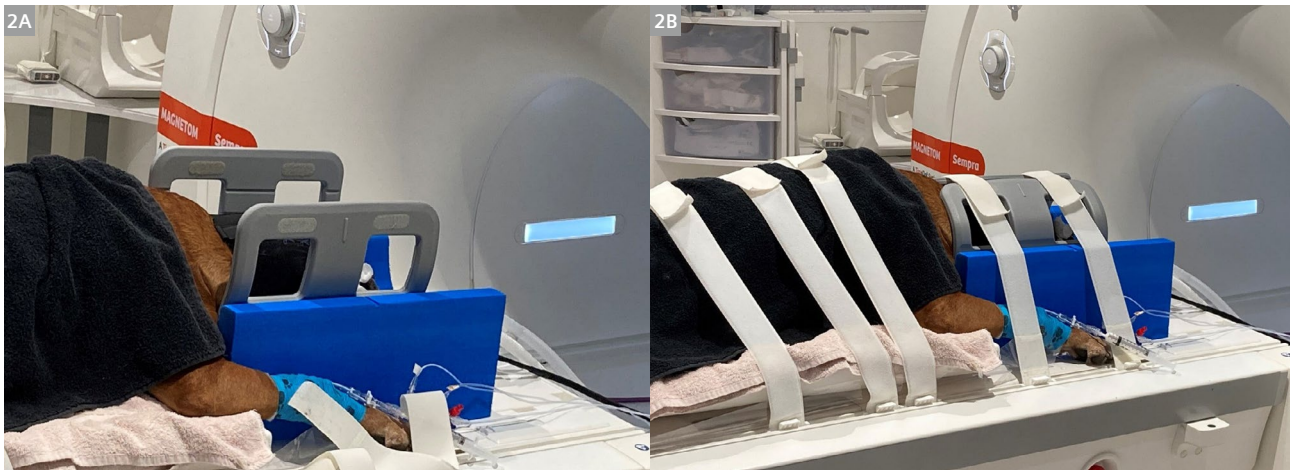
We prefer using the flexible body coils for veterinary patients rather than the custom human-head coils. This is because it can be easier to position a flexible coil around the head and endotracheal tubing in a dog or cat without kinking the tubing. Additionally, canine and feline patients ventilate better in sternal (prone) recumbency than in dorsal (supine) recumbency, where their lungs are compressed.

Wrap the flexible coil snuggly around the head to allow the endotracheal tubes to exit without kinking, and to maximize coil signal (Fig. 2A). Make sure you use the appropriate coil for the size of the head. Forelimbs are placed outside the coil (Fig. 2B). Center the laser beam localizer in the middle of the coil/head.

Coil examples

Flex Small 8, Flex Large 8, Extremity 12, Flex Body coil.

1 Small canine patient (estimated body weight ~ 10 kg) positioned for brain MRI. Note the padding under the body for comfort.



2 Mixed-breed dog (20 kg)
(2A) Positioned in sternal (prone) recumbency with head in the flexible coil. **(2B)** Final position, with flexible coil wrapped around head (toward the bore), and thoracic limbs placed outside the coil. Note the straps for securing, and that the patient is wrapped in a dark coloured blanket.

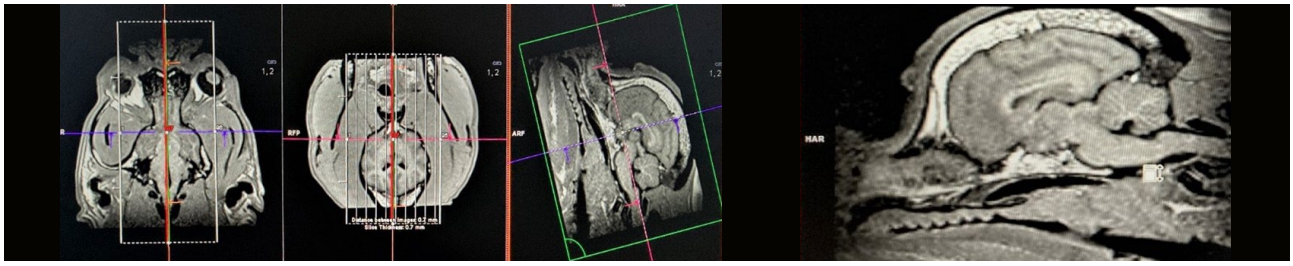
Sequences

Sequence selection will be guided by the neurological evaluation and patient status. In a patient with high incranial pressure, a truncated study may be required to minimize anesthesia time.

Our typical sequence selection for a brain scan includes: 3-plane localizer, 3 planes T2_TSE, TRA_T1_TSE, TRA_DARK_FLUID, TRA_SWI, TRA_DWI, T1_MPRAGE, CISS, Post C+ T1_MPRAGE, TRA_T1_TSE, CISS.

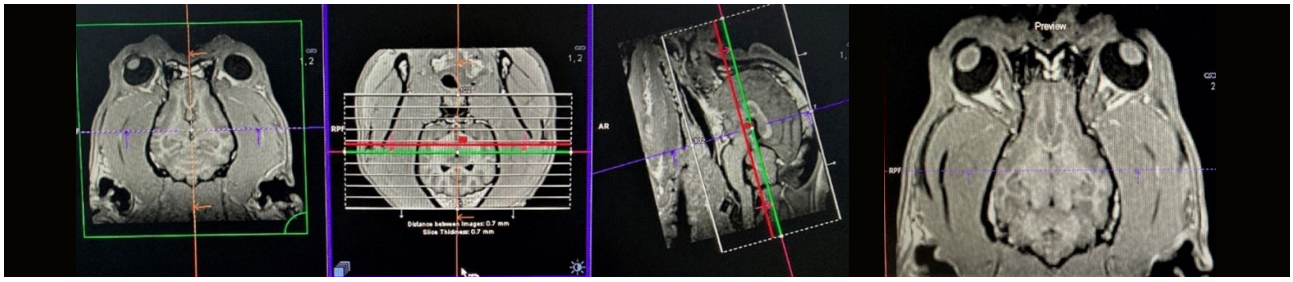
Series selection will very much depend on the familiarity and preference of your veterinary radiologist or neurologist, and the area of the brain that you are interested in. Common pathologies in canine and feline patients include brain neoplasia, with primary neoplasia being much more common than metastatic pathology. Congenital conditions (including hydrocephalus) may vary in different regions. Idiopathic epilepsy is relatively common. Inflammatory conditions (meningoencephalitis) are common. Hemorrhage stroke is relatively uncommon, and ischemic stroke does occur but with a much lower incidence than in human patients.

Sagittal brain



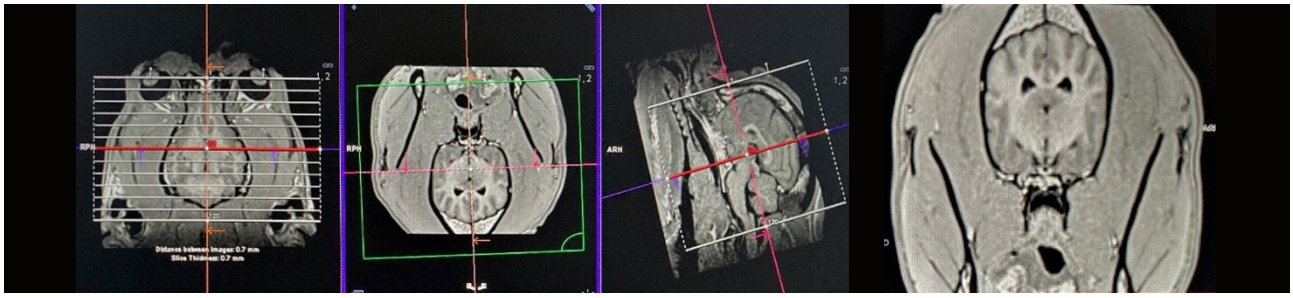
Plan the sagittal slices on the dorsal and transverse planes, and position the block parallel to the midline of the brain. Make sure that the slice number is sufficient to cover the entire brain, noting that the canine and feline brain are relatively small within the head (compared to the human brain). Performing a sagittal scan first helps to determine whether there is any mass effect in the caudal fossa and allows a risk assessment for herniation through the foramen magnum, which poses the greatest risk for brainstem compression.

Dorsal brain



Plan the dorsal slices on the transverse and sagittal planes, and position the block parallel to the soft palate in the sagittal plane and parallel to the temporal lobe in the transverse plane. Making it perpendicular to the midline of the brain. Make sure there are enough slices from the top to the soft palate, or depending on the region of interest (ROI). Performing the dorsal series first may improve accuracy of positioning of the sagittal and transverse series. This is useful if there is no evidence of a significant increase in intracranial pressure.

Transverse brain



Plan the transverse slices on the dorsal and sagittal planes. Angle the block perpendicular to the soft palate and ensure the angle alignment on the dorsal plane is on both orbits. The number of slices should be covering from the frontal sinus/ orbits to the line of occipital protuberance and will be significantly more than in the dorsal and sagittal planes.

References

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2 Mai W, editor. Diagnostic MRI in Dogs and Cats. Boca Raton (FL): CRC Press; 2018.
3 Wisner E, Zwingenberger A. Atlas of Small Animal CT and MRI. Hoboken (NJ): Wiley Blackwell; 2015.

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