Veterinary Diagnostic MRI at an Academic Medical Center: Tips, Tricks, and Pathological Confirmation

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Introduction: Currently, there are over 64.4 million (M) US households with pets consisting of 60M dogs and 70M cats and 72M households with pets in the EU. In fact, 43% of US households have pets, which is higher than the percentage of households with children, and many owners consider their pets a member of the family. Thus, it is not surprising that pet owners are seeking advanced diagnostic imaging in their pets. As with MRI in patients, veterinary neurological MRI scans predominant and are used to diagnose many spontaneous occurring disease in dogs and cats. In fact 350 of the 460 known diseases in dogs having similarities to human diseases. Whereas the interpretation of MRIs has many similarities to man, the prevalence and presentation of many diseases in dogs and cats may not mirror the human population. While many academic centers may have state-of-the-art MRI systems that exceed those available in private veterinary practices, performing veterinary imaging in pets requires expertise and training that may not be readily apparent. In this educational e-poster, we will provide some suggestions for performing veterinary MRI and present MRI case studies with histopathological confirmation of some commonly accepted radiological interpretations.

Primer on Veterinary MRI: While several centers have trained dogs to remain still during fMRI studies to perform awake MRI,[1,2] the acute nature of most MRI studies necessitates general anesthesia. Because many animals have other co-morbidities, a veterinarian and/or veterinary anesthesiologist is recommended for patient monitoring. Depending on state regulations, a veterinarian hospital license with a licensed veterinarian may be required to perform MRI studies in client-owned pets. General anesthesia with mechanical ventilation is preferred over injectable anesthetics especially for brain scans where increases in end-tidal CO_2 can adversely affect the pet. Short bore scanners are advantage to allow ready access to the patient while under general anesthesia. Because of the wide range in body habitus, the choice of imaging coils may vary, such as an extremity coil may be sufficient for brain scans in a cat whereas a conventional head coil may be preferred in a German Shepherd dog. As with pediatric MRI, imaging parameters may need to be tailored relative to the size of the pet. Because of the difference prevalence of certain diseases, interpretation of MRIs by a veterinary radiologist is recommended (see below). In addition, collaboration with veterinary specialists in orthopedics, neurology, cardiology, etc. to assist with imaging protocols and decisions on the appropriate imaging modality may be warranted. The need for additional equipment for monitoring and administered general anesthesia and additional personnel is often offset by the higher reimbursement that may be obtain from veterinary studies compared to human patients.

Interesting Veterinary MRI Examples: A large portion of the veterinary MRI caseload is spine MRI due to the high incidence of intervertebral disc disease (IVDD), particularly in chondrodystrophic breeds, such as the Dachshunds, Cocker Spaniels, and French Bulldogs,. Frequently Type I and II disc protrusions are seen affecting multiple discs on MRI and contrast-enhanced MRI may be utilized to discriminate between acute and chronic discs. Alternatively, Type III (projectile low volume, high impact, non-compressive) disc extrusions, while relatively rare, should be considered in cats or young animals with an acute onset of (tetra)paresis often associated with an injury or high energy activity (Fig 1).

Paresis and ataxia due to IVDD versus spinal or nerve root tumors can also be differentiated by MRI. Primary tumors typically involve single vertebral bodies. A canine MRI study demonstrating avid contrast uptake in several vertebral bodies could represent metastatic disease or granulomatous disease. An MR-guided biopsy provided definitive diagnosis of osteosarcoma in this case.

Brain MRIs are frequently performed in pets with mentation changes or signs suggestive of cranial nerve lesions. Head tilt in dogs may be caused by primary or metastatic tumors or otitis. Mass effects with isointensities to mild hyperintensties in T1w, T2w, and FLAIR images followed by hyperenhancement on T1w images after the administration of contrast is suggestive of meningioma and/or lymphoma. However, granular cell tumors in dogs, a rare tumor, may also appear similar with signs of peritumor edema on MRI (Fig 2).

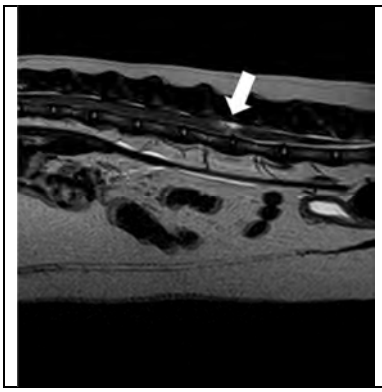

Fig 1: T2w MRI at 1.5T (Siemens Espree) in a cat with hind limb paresis that was found at the bottom of a stairs demonstrates hyperintensities without extradural compression that correlated with necrosis along the disc extrusion tract on histopathology (not shown). In less severe cases, total recovery of neurologic function may be possible.

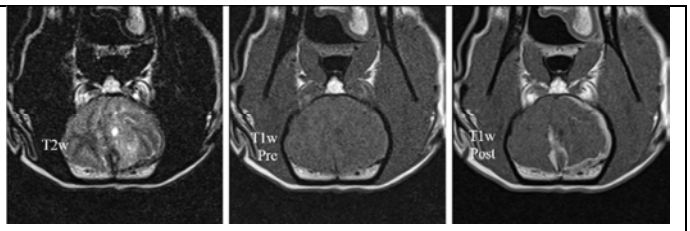

Fig 2: T2w and T1w imaging pre-contrast demonstrate mild peri-tumor edema and suspicion of a mass effect with a pronounced meningeal enhancement post-contrast (T1w Post). A granular cell tumor was demonstrated histopathologically that showed a high correlation to T1w post-contrast hyperintensities.

1 Jia, H. *et al.* Functional MRI of the olfactory system in conscious dogs. *PLoS One* **9**, e86362, doi:10.1371/journal.pone.0086362 (2014).
2 Berns, G. S., Brooks, A. M. & Spivak, M. Functional MRI in awake unrestrained dogs. *PLoS One* **7**, e38027, doi:10.1371/journal.pone.0038027 (2012).

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