CT and MRI: What Is It and When Is It Useful?

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- A 10 year old mixed breed male dog is circling to the right and acts demented.
- A 5 year old German Shepherd has a unilateral nasal discharge for 2 months.
- A 10 month old Newfoundland is lame from a problem in the right shoulder.

After performing a thorough physical examination and basic blood work, what are the options for finding the diagnosis? Our goal as veterinarians is to provide the owner with the best treatment options for their pet and to give an accurate prognosis.

Survey radiography has been the most important tool for diagnostic imaging in veterinary medicine for years. It has the advantage of being available in most practices and is affordable to most owners. The images seen on the radiographs are the summation of shadows that are created by the x-ray beam. A serious disadvantage is that there is superimposition of structures in the image generated in this 2-diminsional picture. This can allow pathology that lies between or within organs to remain undetected.

With the availability of computers, cross sectional imaging is made possible. This allows a 3-diminsional examination of structures, minimizing superimposition. Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are the current modalities in use to perform cross sectional imaging. The anatomical area to be examined, the size of the animal, and the ability of the animal to undergo anesthesia will determine which advanced imaging modality will be recommended. The images are sent electronically to ACVR radiologists experienced in CT and MRI imaging and their report returned within 90 minutes to 24 hours, depending upon the urgency of the patient.

Computed Tomography

CT is an imaging modality that provides images generated by x-rays in a third dimension. In general, an x-ray beam is passed through a patient in the same location from a variety of angles. This action produces a single 'slice' of the patient. The CT computer displays the images of interest as a variation of a shade of gray. The structures outside the area of interest will be displayed as all black or all white. CT images have increased contrast resolution compared to 2-diminsional survey radiographic images.

Spiral CT scanning is now available at the Animal Emergency Center. With this unit, the x-ray tube has a continuous circling movement, acquiring information volumetrically for fast scanning. For example, the nasal cavity and paranasal sinuses on a large dog can be scanned in approximately 5-10 minutes once the dog is positioned. The images are viewed on a video monitor and stored on the hard disc of the computer. Two CT scans are typically performed, the first without contrast, the second utilizing intravenous iodinated contrast media. The contrast study can demonstrate abnormal structures as an area that is whiter when compared to the noncontrast study.

Most studies are done with the animal under heavy sedation or anesthesia. Below is a listing of some of the various conditions that are amenable to diagnosis with a CT scan:

1. Nervous System
    a. CT scan can detect skull lesions or bleeding within the brain tissue. This makes it an ideal tool for assessing head trauma patients. However, MRI better

evaluates pathology (other than hemorrhage) within the soft tissues of the brain. Unstable patients with brain lesions, however, may be evaluated with the CT rather than MRI due to the minimal time required for the imaging study.

b. Spinal lesions such as herniated intervertebral discs, neoplasia in the spinal cord, discopondylitis and variations of lumbosacral instability and nerve root compression may be evaluated.

2. Nasal cavity and paranasal sinuses are scanned, looking for lesions due to neoplasia or fungal diseases. The scan can help differentiate between acute and chronic rhinitis/sinusitis. The extent of the pathology can be assessed.
3. Orbits and bullae- Neoplasia, retrobulbar abscesses, and myositis of intraocular muscles within the orbits and pathology of the bullae can be diagnosed by CT.
4. Orthopedics- Joints and lesions of bone origin can be evaluated, especially useful for elbow, tarsus and fracture fragments (i.e., osteochondrosis lesions).
5. Thorax- CT is valuable to evaluate and diagnose lesions within the lung and mediatinum. CT is more sensitive than radiographs for detecting metastatic nodules in the lungs. The oncologist prior to determining a chemotherapy regime often recommends A CT scan of the chest.
6. Abdomen- The location and extend of disease within the liver, spleen, kidney, pancreas and adrenal gland can be detected. Location and extent of mass lesions can be evaluated.

Magnetic Resonance Imaging

The MRI also provides cross sectional imaging without ionizing radiation. Aligning the water molecules of the body within a strong, stable external magnetic field generates the image. A radiofrequency pulse is applied which causes the water molecules to lose their alignment with the main magnetic field. As the molecules begin to realign themselves, they emit signals which are detected by the MRI machine. The signals are processed by a computer, which creates the image. In general, portions of the body that do not contain a lot of water (i.e., lung, bone) will not produce any significant signal. Contrast studies with the MRI utilize a paramagnetic substance (godalinium) injected intravenously, which alters the area in which it accumulates. It shows up as a whiter area in the image compared to the non-contrast study. In general MRI has superior soft tissue resolution

MRI studies are done with the animal under general anesthesia. The scan can take 90-120 minutes once the animal is anesthetized and properly positioned. To detect lesions within the nervous tissue, a pre and post-contrast examination is generally performed. Below is a listing of some of the various conditions that are amenable to diagnosis with a MRI scan:

1. Nervous tissue: Lesions detectable in the brain are neoplasms, encephalitis, granulomatous meningoencephalitis, infarcts, edema and hemorrhage. Animal showing neurological abnormalities localized to the brain may benefit from an MRI. An MRI should be done prior to a CSF tap when possible. The scan can provide evidence of increased intracranial pressure or hemorrhage that might predispose to brain hernia ion subsequent to a CSF tap.
2. Joints – MRI can evaluate the soft tissues structures within the joints.

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