CT versus MRI in brain lesions. When is CT the modality of choice?

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Introduction

Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are both used as cross-sectional imaging methods for the detection of a variety of brain lesions in humans and animals. Each method has specific advantages and disadvantages to detect selected lesion characteristics.

CT VERSUS MRI

CT	MRI
X-rays	magnetic field
widespread available	not widely available
less expensive	expensive
short imaging times	long imaging times
transverse plane (+ reconstructions)	different planes
suitable for patients with implants	not suitable for patients with metallic implants
ionated contrast (more adverse effects)	gadolinium based contrast
excellent resolution of bony detail	excellent soft-tissue contrast
beam hardening artefacts (dense bone)	motion artefacts

When is CT modality of choice?

MRI is the preferred imaging modality for ***intracranial tumors*** due to the better soft-tissue contrast and the sensitivity to detect increased amounts of water which is the case in most pathological conditions. MRI is more accurate in defining the extent and morphology of tumors than is CT. However, neither of these techniques provides absolute specifity. Most intracranial tumors can be visualized on CT. Caudal fossa lesion can be missed on CT due to beam hardening artefacts. Intravenous contrast agents should be used for both CT and MRI studies if a tumor is suspected.

Inflammatory brain disease can effect brain parenchyma (encephalitis), meningen (meningitis) or both (meningoencephalitis) and can be subdivided into infectious inflammatory and non-infectious inflammatory disorders. Lesions can manifest as multifocal or focal diffuse lesions. Some diseases have signal attenuation similar to surrounding tissue and little or no contrastuptake and can be missed on CT. MRI sequences such as FLAIR (Fluid Attenuated Inversion Recovery) suppress cerebrospinal fluid signals and have a higher sensitivity for subtle changes than the normal spin echo sequences and CT. Hence MRI is in these cases also the modality of choice.

Congenital and developmental anomalies can be detected on CT. Ventricular size in dogs or cats with hydorcephalus, the size of an intra-arachnoid cyst, cerebellar herniations can be diagnosed with CT. But also in these cases MRI gives a more accurate soft tissue contrast and underlying causes will be picked up earlier on MRI. CT can be used for follow-up assessment of changes in the ventricular size.

Metabolic, nutritional, toxic en degenerative disease give in many cases subtle changes or normal appereances on CT. Bilateral symmetric hypodense lesions, ventriculomegaly, enlarged sulci can be an indication for these kind of diseases. MRI is overall more sensitive in these cases.

In ***cerebrovascular disease*** CT is the modality of choice in acute hemorrhagic strokes. In edema and lacunar infarctation MRI is more sensitive.

CT is the primary procedure for evaluating intracranial complications after ***acute skull trauma*** in the first 24 hours. Acess to monitoring of the unstable patiënts is easy and scan times are relatively short compared to MRI. CT images are very sensitive for acute hemorrhage and intracranial gas. Excellent bony detail makes CT the best modality for assessing fractures of the skull base and calvaria.

	CT	**MRI**
Neoplasia		✓
Inflammatory & infectious disease		✓
Congenital and developmental anomalies		✓
Metabolic, nutritional, toxic, degenerative disease		✓
Cerebrovascular disease	(✓ acute hemorrhagic)	✓
Skull trauma	✓	

<u>Comparison study</u>

CT and MRI studies were compared to look at the agreement between CT and MRI for the detection of suspected intracranial lesions in dogs and cats. Over a period of 2 years, 58 patients with a suspected brain lesion underwent both CT and MRI studies of the brain. The following parameters were evaluated: presence of an intracranial lesion, pattern of occurrence (solitary or multiple), lesion localization (lobe or region), aspect of margins (well-defined or ill-defined), pre- and post-contrast size of the lesions presence of mass effect, and presence and pattern of enhancement (homogeneous, heterogeneous or ring enhancement). In 38 patients a lesion was detected on CT and/or MRI. On 30 patients the lesion was detected both on CT and MRI. Seven lesions detected on MRI were not detected on CT. These lesions included 3 suspected infarctations, 2 patients with only edema and 2 patients with suspected diffuse inflammatory disease. These lesions were missed on CT because MRI is more sensitive for subtle soft tissue changes and different sequences can be used to differentiate normal brain parenchyma from pathological conditions. The lesion that was seen on CT and not on MRI was a suspected diffuse multifocal lesion. Delayed contrast enhancement could be the cause of this missed lesion. Only 26 of the 30 lesions were identically classified as solitary or multifocal on both imaging modalities. In view of the clinical importance, the degree of disagreement between CT and MRI for detection of intracranial lesions should be regarded as clinically relevant. Once a lesion is detected, however, CT and MRI may be considered concordant for the most diagnostically important imaging characteristics (ie mass effect and contrast agent enhancement). The lesion dimensions may direct treatment, and the poor agreement between CT and MRI may thus be clinically relevant. Altough substantial agreement between modalities was achieved for the localization of lesions to specific

anatomic brain for most regions, the degree of agreement was highly variable especially for lesions in the brainstem and the pyriform lobe, and this could influence diagnosis. Although this study had limitations (no confirmed diagnosis, single slice CT-scan, 4mm slices and small sample size) we can overall conclude and suggest that MRI is the preferred technique to document intracranial pathology. However, the data also indicate that CT may be regarded a valuable alternative to detect intracranial lesions and selected lesion characteristics when MRI is unavailable.