# CT in small animal brain diseases

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MR and CT are both widely used to diagnose brain diseases in animals. The first reports of CT scans of small animals were published in the 1980s and dealt with the normal CT brain anatomy and various types of tumours detected in dogs and cats. Because MR offers better soft- tissue contrast, it is more suitable than CT to diagnose brain tumours and to visualize secondary tumour features, such as oedema, cyst formation, and necrosis. However, most space-occupying processes can be detected with CT, because the mass displaces the normal anatomical structures (mass effect) and disturbs the normal brain symmetry. CT cannot clearly show lesions within the medulla oblongata, cerebellum and the piriform lobe; this is because this area is surrounded by highly opaque structures. These bony structures, such as the hard petrous temporal bones of the skull base, create an artefact, called Beam Hardening, which makes demonstration of lesions in the caudal fossa of the skull difficult, or even impossible. In these cases, MR is indicated.
Unfortunately, different kinds of masses can create almost identical images, so it is not always possible to distinguish between neoplastic and non-neoplastic diseases. Certain tumours, such as meningiomas, can be easily recognized, but in most cases, a biopsy is necessary to determine the exact nature of the lesions.

**Some specific features:**

- Meningiomas are extra-axial lesions. They usually show a homogeneous contrast enhancement and are well delineated. Sometimes regions of calcification are present; this type of tumour hyperostosis can be seen in 50 percent of cat meningiomas. A typical feature of this tumour is the presence of a so- called “Dural tail,” which connects the tumour to the neighbouring meninges.
- Astrocytoma and oligodendroglioma are intra-axial lesions that usually have a very variable pattern. After intravenous contrast administration, the image produced can show peripheral contrast uptake with a central hypo-dense region, as well as heterogeneous, non-uniform contrast uptake. Peripheral contrast uptake is a relatively non-specific sign that could indicate a brain abscess or inflammation which can appear similar.
- Choroid plexus tumours are typically intra- ventricular, well-defined, hyper-dense masses that are enhanced after intravenous contrast administration.
- Large pituitary tumours, which can be identified by their typical localisation at the level of the sella turcica, show a uniform contrast uptake.

Non-neoplastic processes, such as infection and inflammation, can be visualized by CT and MR. However, even with MR, differentiation of neoplastic versus non-neoplastic space-occupying lesions is not always clear. The presence of multifocal, granulomatous lesions in several parts of the brain is specific for primary inflammatory disorders such as granulomatous meningo- encephalitis. Multifocal regions of reduced opacity are typical for necrotizing encephalitis which is mainly seen in Yorkshire terriers.
Although an asymmetric increase in the size of one of the lateral ventricles is often associated with pathology, it is also a common finding in healthy dogs and must always be related to the clinical picture. There is limited available information about ventricle size and normal variants in the different breeds.
To determine the type of brain tumour, a biopsy or surgical excision of the mass remains the best and only appropriate option. Analysis of cerebrospinal fluid is used to differentiate infectious lesions from neoplasia, but it has its limitations.
The use of CT-guided brain biopsy with the free hand is described in the dog. The most accurate method for biopsy of cerebral masses in dogs is CT-guided stereotactic biopsy. The animal’s head is placed in a frame whilst the orientation and location of the biopsy site is determined by coordinates derived from the CT images. Several CT-guided stereotactic devices for dogs and cats have been developed. Biopsy of brain masses larger than 6-9 mm in diameter is now possible with the correct equipment.
CT is the best procedure to detect an acute stroke which appears as a homogeneous, hyper-dense area associated with a mass effect during the first 72 hours; the lesion then becomes isodens and,

after a week, hypodens.
Intracranial lesions that can be visualised include fluid- filled spaces in the brain. Hydrocephalus can be seen with both imaging techniques CT & MRI and the aetiology can sometimes be determined.
In trauma cases, CT can easily demonstrate skull fractures, whereas MR is more sensitive for both intra- and extra-cerebral parenchymal lesions.
Tumours of the skull are visible on CT where bone lysis, secondary to a soft-tissue process that surrounds and invades the skull, is often present.
In a Chiari-like malformation, the size of the skull's caudal fossa is not in proportion to the volume of the cerebellum and brainstem. In these cases, the cerebellum may protrude caudally through the foramen magnum, blocking the cerebrospinal fluid flow, which may cause fluid-filled cavities called syringomyelia to develop inside the spinal cord. Although usually MRI is performed to determine this condition, CT can be of help in case MRI is not available.
CT usually adds no value to detect inflammation and tumours of the cranial nerves, whereas MR is the best procedure to allow visualisation of most disorders of the cranial nerves.

**In CT, intravenous contrast agents should be administered to:**
a) Determine the perfusion of the tissues; and
b) Distinguish between normal and abnormal tissue.
Contrast studies are extremely useful for specific examination of the meninges, the choroid plexus, and the pituitary gland, all of which contain fenestrated capillaries that allow the contrast agent to enter their interstitium. In normal brain tissue, the contrast agents do not cross the blood-brain barrier, so they cannot get into the parenchyma. However, with lesions, including inflammation and tumours, the agents will cross the blood-brain barrier and pathological tissue will enhance.

**Indications for CT of the brain:**

- Mainly bony lesions
- Congenital anomalies
- Infection/inflammation such as osteomyelitis
- Haemorrhage, acute and chronic
- Neoplasia, usually visible after contrast administration or
- bony changes, including bone hyperostosis in meningioma
- Skull trauma with bone destruction