Meningiomas are the most common intracranial primary brain tumours in dogs and cats. They develop from the cells of the arachnoid – meningothelial cells – more precisely from the arachnoid granulations. There are several histopathological subtypes of meningiomas: transitional, fibroblastic, anaplastic, sand-like, meningothelial (7, 12, 15, 16).

Features of benign varieties of meningioma are: moderate pleomorphism of the cell nucleus, few mitotic figures and lack of infiltration into the nerve tissue. Malignant varieties are characterised by more intense cell proliferation and the presence of foci of necrosis and haemorrhages, and they rarely lead to metastases in adjacent or remote organs. Although the metastatic potential of canine meningioma is low, this cancer is locally invasive. Its growth causes damage to the adjacent brain tissue, and as a result, tissue oedema, inflammation and bleeding (12, 13, 18, 20, 23).

The histological picture of meningiomas and the mechanisms of their expansion into surrounding tissues are varied. There are exclusively intracranial tumours that cause compression of the brain, as well as plane infiltrations into the dura mater and isolated masses inside the skull vault. In some cases, meningiomas proliferate under the skin after destroying bone structures, which causes severe deformation of the head (1, 11, 18).

In the case of suspected brain cancer, the most reliable additional examinations are magnetic resonance imaging and computed tomography. They allow us in visualising the tumour itself and in evaluating the structures adjacent to the tumour. It has a considerable impact on the prognosis and enables planning of surgical access. A 10-year-old Belgian Shepherd was presented with strongly expressed neurological symptoms. CT examination revealed a heterogenous, hyperdense, oval focallesion within the olfactory bulbs in the forebrain. After a CT scan of the brain, due to a clearly bad prognosis, the owner decided not to wake the animal up from anaesthesia and to euthanize it. During the autopsy of the animal, brain tumour fragments were collected for histopathological examination. Based on the histological features and presence of two types of cells that form the tumour structure, the observed mass was classified as a transitional (mixed) meningioma.

Keywords: brain, tumor, meningioma, computer tomography, dog

Case report

The ULS Clinic in Lublin examined a female Belgian shepherd aged 10 and weighing 25 kg. It was a working animal, fed with complete commercial food and had constant access to water. The dog was protected against ecto-parasites, regularly dewormed, and received vaccinations against rabies and other infectious diseases.
Two months before the occurrence of worrying neurological symptoms, the dog was diagnosed with purulent inflammation of the uterus and underwent surgery.

In the described case, 2 weeks later, seizures suddenly occurred, three times during one day. An hour elapsed between the first and second attack, followed by the third attack four hours later, at which point the owner consulted the clinic. Between the attacks, the dog was agitated and confused. On night duty, the animal’s condition was stabilised, and no abnormalities were found in the clinical examination. The dog was discharged in a stable condition and returned the next day with recommendations to expand the diagnostics, consult a neurologist and introduce antiepileptic drugs. The owner was also informed that cluster seizures are linked to a high probability of further fits.

The owner returned to the clinic after two days, and according to his description, the dog’s condition had gradually deteriorated. While waiting for a neurological consultation, he had consulted another clinic, where Phenobarbital had been initiated – the seizures had been alleviated, but they still occurred. Moreover, the owner reported that new pathological symptoms from the motor system and difficulties in eating had occurred.

In the clinical examination, the dog demonstrated altered consciousness and disturbed behaviour – it was confused and reacted aggressively to external stimuli. The movement and posture of the animal were abnormal – there was a loss of motor coordination, the dog could not walk on its own, was unable to maintain a standing or sitting position on its own – it only lay on its side with its neck bent backwards and its head on its back (opisthotonus). No threatening reaction and no direct and indirect pupil reflex were observed (dilated pupils), but the eyelid reflex was preserved. There was positional nystagmus. No snout asymmetry was observed. The gag reflex was absent. The deep pain sensation was preserved and spinal reflexes were weakened. The tonus of the pectoral and pelvic muscles was reduced in contrast to the neck muscles, where tension was increased. The proprioceptive positioning test result was abnormal in all limbs.

Due to the exacerbation of symptoms, it was decided not to refer the patient to an MRI examination, which would have required waiting again, but to perform computed tomography, which was available at the clinic. Prior to the examination, the animal was administered medetomidine (Narcostart 1 mg/ml, Livisto, Poland) at a dose of 10 µg/kg body mass i.v. and butorphanol (Morphasol 4 mg/ml, Livisto, Poland) at a dose of 0.1 mg/kg body mass i.v., and then put under general anaesthesia using propofol (Plofed 1%, Polfa Warszawa) at a dose of 3.0 mg/kg body mass i.v.

After a CT scan of the brain, due to a clearly bad prognosis, the owner decided not to wake the animal up from anaesthesia and to euthanize it.

**CT examination.** The examination was performed using a 16-slice Philips MX. Images were obtained using a soft algorithm in the soft tissue window. The soft tissue algorithm included unenhanced and contrast-enhanced phases. The image acquisition parameters were 120 kV, 200 mAs/slice, pitch 1.0069, slice thickness 1.0, slice increment 0.5 mm, collimation 16 × 0.75, and rotation time 0.75 s. The images were sent to the Philips IntelliSpace Portal.

CT examination in the unenhanced phase revealed a heterogeneous, hyperdense, oval, extra-axial focal lesion with ill-defined edges and the following dimensions: length 2.3 cm, width 1.9 cm, height 2.3 cm. The lesion was adjacent to the presphenoid bones, within the olfactory bulb, and extended to the frontal lobe on the left and pushed the longitudinal fissure of the brain to the right. In the left frontal lobe, caudally from the tumour, a hypodense, irregular area was revealed, which suggested oedema. Deformation and thickening of the cribriform plate on the left and osteolysis of the presphenoid bone on the right were also observed.

After intravenous administration of a contrast agent based on iohexol (Omnipaque 300 mg/ml, GE Healthcare AS, Oslo, Norway) at a dose of 2 ml/kg body weight i.v. in the 1st arterial phase, the tumour image was rapidly and intensely enhanced. The saturation of the tumour with contrast agent was uneven, with areas of lower saturation, which may indicate a parenchymal infiltration or foci of necrosis. The examination confirmed that the described lesion had reached the frontal lobe on the left and pushed the longitudinal fissure of the brain to the right. Caudally from the tumour, features of oedema were observed.

**Histopathological examination.** During the autopsy of the animal, brain tumour frag-
ments were collected for histopathological examination. The tissue material was fixed in 10% buffered formalin with pH = 7.2 and then immersed in increasing concentrations of alcohol solutions, acetone and xylene and transferred to paraffin blocks in a tissue processor (Leica TP-20). Tissue slices with a thickness of 4 µm obtained using a sliding microtome (Leica SR-200) were transferred onto slides. The preparations for the histopathological examination were stained with haematoxylin and eosin (HE) and assessed in a light microscope (Nikon Eclipse E-600) according to the WHO’s histological classification of tumours of the nervous system of domestic animals (12, 27). In a microscopic image, a structure rich in cells, consisting of two types of cells with different morphology was observed. Most were meningothelial cells, mostly polygonal with eosinophilic cytoplasm with indistinct cell margins with round-to-oval, finely stippled nuclei and small and indistinct nucleoli. Among them, spindle cells resembling fibroblasts with oval, finely stippled nuclei were visible. The cells formed lobular structures embedded in collage or arranged in bands or whorls forming concentric spirals around small capillaries (Fig. 2). In the stroma, especially in the peripheral growth zone, focal infiltration of inflammatory cells with a predominance of neutrophilic granulocytes and also lymphocytes were observed.

Based on the histological features and presence of two types of cells that form the tumour structure, the observed mass was classified as a transitional (mixed) meningioma.

**Discussion**

Meningiomas are a group of tumours with a very diverse histological structure. In humans, there are 15 histological subtypes. The WHO’s classification for animals includes the following variants of meningiomas: meningothelial, fibrous, transitional, psammomatos, angiomaticus, papillary, granular-cell, myxoid, and anaplastic (27).

Despite the diverse microscopic picture, most are benign tumours with the first degree of histological malignancy and similar biological behaviour. The exception is anaplastic meningioma, which is of malignant nature and – together with papillary meningioma and rhabdoid meningioma in humans – is classified as a third-degree meningioma with a significantly increased risk of recurrence (27).

Atypical, chordoid, and clear cell meningiomas are classified as second-degree malignancies in humans. However, currently, according to the latest WHO classification of CNS tumours in humans, the determination of the second or third degree of meningioma malignancy requires not only morphological criteria for a given histological subtype, but also other prognostic biomarkers, regardless of the subtype of meningioma (12, 27).

Neurological symptoms vary depending on the location of the meningioma in the brain. In dogs, the most common clinical symptom are seizures. Other symptoms include ataxia, blindness and behavioural changes. In the neurological examination, minor disorders, such as a weakened threat test or weakened posture reactions, are commonly observed (3, 6, 7, 9, 10, 14, 17, 25). Additional examinations – blood tests, abdominal ultrasound and thorax radiography – do not show changes associated with the disease, unless a metastatic form of cancer occurs. In the examination of cerebrospinal fluid, there is often a normal picture of cellular elements and elevated protein level, although it happens that all the parameters are normal (4, 7, 16, 17).

The most important additional examination in the case of brain cancer is magnetic resonance imaging. The information obtained during this examination provides a more accurate – compared with computed tomography – visualisation of the tumour and assessment of adjacent structures. It has a considerable impact on the prognosis and enables planning of surgical access (17, 19, 24).

In a CT image, brain tumours are usually visible as hyper dense areas of various shapes – most often round, lobular or planar. Less often, such lesions are partially or fully isodense. The border of the tumour is usually clearly visible. Tumours can be completely calcified. When they are partially mineralised, either their peripheral or central part is calcified. After the administration of a contrast agent, they are intensely enhanced, especially in areas not affected by calcification (25). Undifferentiated meningiomas manifest as ill-defined lesions. The presence of parenchymal infiltration and foci of necrosis inside such lesions leads to heterogeneous enhancement of the image after the administration of a contrast agent. The lesions are most often accompanied by oedema of neighbouring tissues (17, 22, 26). These features were also observed in the presented case.

In T1-dependent MRI images, the signal of meningiomas is lower than the one of brain tissue. In T2-dependent images, the signal from these lesions is heterogeneous and high. Their image is strongly
enhanced after the administration of a contrast agent (8, 21).

The treatment of choice is surgical removal of the tumour if it does not cause significant expansion into neighbouring tissues and if the clinical condition of the animal allows it (2, 17).

The transitional meningioma diagnosed in the presented study was found to be locally invasive, caused damage to the surrounding brain tissue, which resulted in strongly expressed clinical symptoms.

References


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