Brain tumors

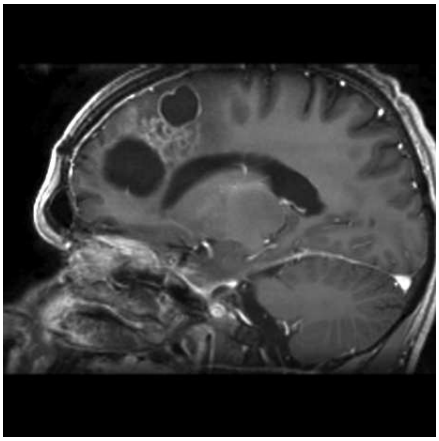
Meningiomas
Meningiomas are tumors originating in the arachnoid "cap" cells of the arachnoid villi in the meninges. However, they can occur at all locations where there are meninges, e.g. at the skull base or at the convexity (i.e. on the surface). Consequently, there are many different forms of meningiomas; these are named mainly after the locations at which they occur.

Fig.: MRI, sagittal incision into a meningioma of the dorsum sellae

For example, there are tentorial meningiomas, tuberculum sellae meningiomas, falcine and parasagittal meningiomas, olfactory groove meningiomas, etc. Depending on the location of the tumor, different surgical approaches are necessary (also with respect to the skull base).

Gliomas
Primary brain tumors originate in the brain itself and develop from the neuroglial or glial cells. Gliomas are classified as astrocytomas or oligodendrogliomas depending on the type of cells they contain. Gliomas are also classified according to grade. WHO grade I tumors, i.e. benign gliomas, are actually found only in children. Complete surgical excision results in a cure. Grade II tumors grow slowly but steadily; sometimes these tumors are only observed.

Grade III tumors (anaplastic astrocytomas) are malignant tumors usually associated with a limited survival time. Grade IV tumors are also designated as glioblastoma multiforme.



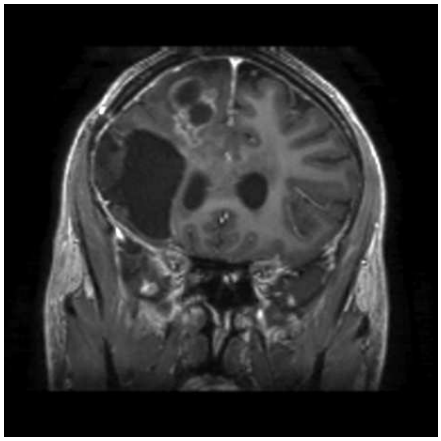
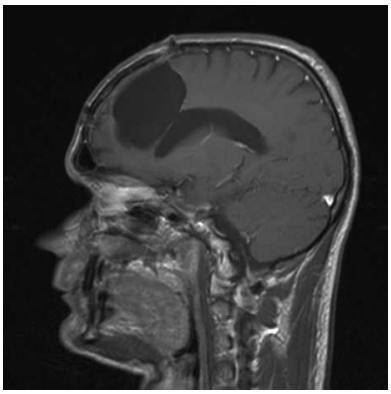
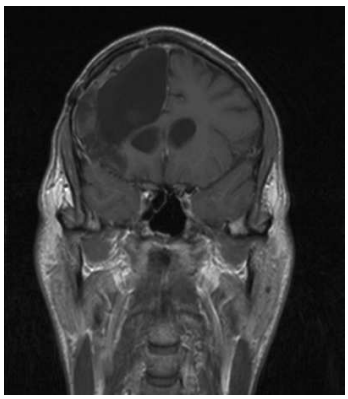


Fig.: Recurrent glioblastoma on MRI before surgical removal.





Early postoperative MRI: tumor tissue can no longer be demonstrated.

Absence of tumor on MRI postoperatively is considered a good precondition for improved survival. However, this goal cannot be achieved in all cases. Sometimes it is difficult to delineate the boundaries of these tumors intraoperatively. In other cases they lie very close to, or in the middle of, areas vital for brain function.

Several surgical strategies can be employed to treat glioblastomas with the goal of achieving the most radical removal possible. First, neuronavigation can be employed during surgery. With this technique, a data set prepared before the operation on the basis of MRI or CT images is used during the operation for navigation and/or delineating the tumor boundaries.

Tumor removal and increasing loss of cerebrospinal fluid during the operation may cause displacement of cerebral structures give rise to inaccuracies of the neuronavigation system. In such cases other techniques must be used, such as intraoperative ultrasound or elastography, to distinguish between tumor tissue and normal brain tissue. The ALA Method, which is based on the uptake of a fluorescent dye by tumor tissue, can also be useful. All of these techniques are available at Sana Kliniken Duisburg and can be used either singly or in combination during neurosurgical procedures.

Pituitary gland

Not all processes in the pituitary gland require surgery. Certain types of tumors, e.g. prolactinomas, can be treated with medication which shrinks the tumor or at least prevents further growth.

Pituitary adenomas, however, may cause problems. They may exert pressure on the optic chiasma causing major visual disturbances or even blindness. Because these tumors can produce hormones, they can cause massive derangement of the hormonal balance and the salt and fluid balance. This can give rise to disorders such as acromegaly or Cushing's disease.

In patients with hormone-producing pituitary adenomas, in particular, it is necessary to remove the entire pathological tissue so that the disease can be cured. However, a non-hormone-producing (hormonally quiet) pituitary tumor can cause hormonal deficiencies, owing to the pressure it exerts on the surrounding tissue. These patients frequently present with extreme fatigue and decreased work capacity and sometimes even with a change in body hair patterns.

In general pituitary adenomas are removed through the nose: the surgeon works in deep layers with microsurgical or endoscopic instruments inserted through one nostril. The tumor is then removed with ring curettes – instruments consisting of rings at different angles used to remove tumor tissue. The use of grasping forceps to remove tumor tissue in the pituitary is generally not recommended because of the proximity to the carotid artery, the optic chiasma and delicate vessels in the brainstem.

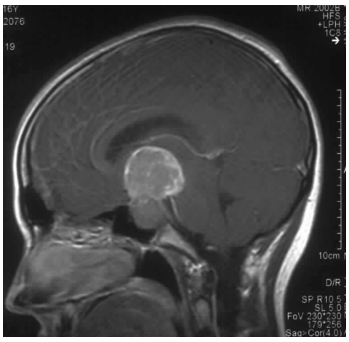


Fig.: Large macroadenoma of the pituitary gland with acute hemorrhage and deterioration of visual acuity.

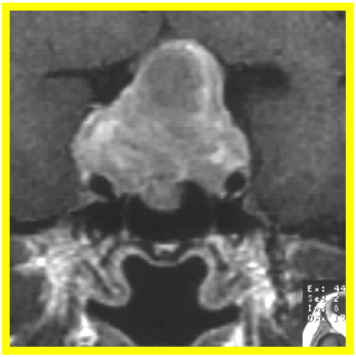


Fig.: MRI image of a large pituitary adenoma. The patient's nose is visible on the lower left. An endonasal approach was chosen for this procedure.

Endoscopic techniques have proved to be favorable for transnasal operations since structures in deep tissue layers can be better recognized.
In general sealing the boundary between the surgical cavity and the fluid spaces is an important consideration after the operation. Lower abdominal fat is used for this purpose. In exceptional cases, a lumbar drain must be left in place (on the patient's back) for several days to lower the overall CSF pressure.

In special cases, e.g. in patients with very large tumors, a transcranial approach may be chosen. In these cases as well, fatty tissue is used as a sealant to prevent cerebrospinal fluid rhinorrhea, i.e. leakage of cerebrospinal fluid through the nose. Recurrent tumors can be removed with even greater safety using neuronavigation.

Metastases
Brain metastases are a common problem. Twenty percent of all tumors found in the brain are metastases of malignant tumors in other parts of the body. For example, pulmonary and bronchial tumors (e.g. bronchial carcinoma), breast cancer, intestinal cancer and even malignant melanoma can metastasize to the brain.

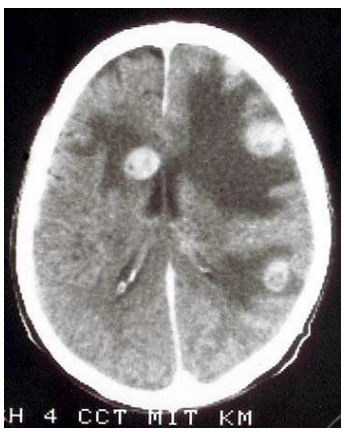


Fig.: Several brain metastases accompanied by pronounced edema.

This often happens before the patient even knows that he or she has cancer. The symptoms include hemiplegia (paralysis of one side of the body), a speech disorder or psychological abnormalities. Brain tumors also frequently cause seizures. Today brain surgery is performed selectively through a limited incision. Several lesions may be removed during the operation if necessary. In patients with multiple lesions, it is sometimes more expedient to remove only the large symptomatic tumor that is threatening the patient's life. This strategy wins valuable time during which the smaller tumors can be combated with other therapeutic modalities, e.g. radiation treatment and/or chemotherapy.

Craniopharyngiomas
Craniopharyngiomas originate in structures in the pituitary stalk and are considered benign. They are found especially in children. Owing to their proximity to the optic system and the pituitary gland, they can trigger visual disturbances or hormonal disorders. The tumors frequently recur and may contain calcium deposits. In such cases, radiation treatment or endoscopic treatment may be considered in addition to microsurgical treatment. The treatment of these tumors requires very close cooperation with endocrinologists.

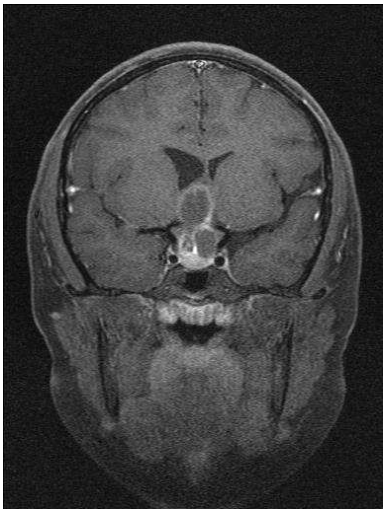


Fig.: A typical craniopharyngioma with both solid and compact tumor portions seen on MRI coronal section.

Skull base surgery
Term "skull base surgery" is generally used to describe surgical procedures in the anterior, middle or posterior skull base. This kind of surgery is normally employed to treat various benign or malignant tumors. We place great importance in this context on creating an access tailor-made for the individual patient; the procedure should be as minimally invasive – and at the same time as radical – as possible. In individual cases, however, only incomplete resection can be performed because of the risk of neurological deficits posed by complete resection. In such cases surgery is combined with special radiation treatment, e.g. stereotactic fractionated irradiation.

In many cases, an interdisciplinary approach is necessary for the operation. There is excellent collaboration between our department and the Department of Otorhinolaryngology at St. Anna's Hospital run by the Maltese Cross in Duisburg-Huckingen and the departments of maxillofacial surgery at the University of Duisburg-Essen and Ruhr University Bochum. Moreover, because of the importance of monitoring the functions of the cranial nerves (e.g. the facial nerve) during the treatment, we have equipment for such monitoring at our department.

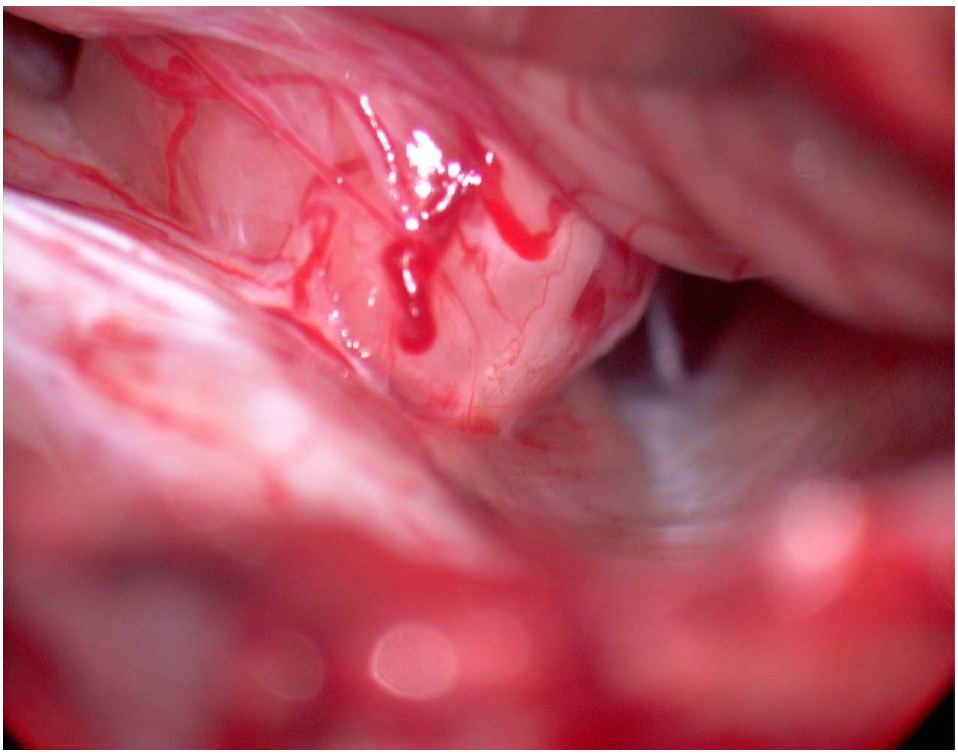


Fig.: Acoustic neuroma (also called a "vestibular schwannoma") at the exit of the internal acoustic pore – the internal auditory canal.

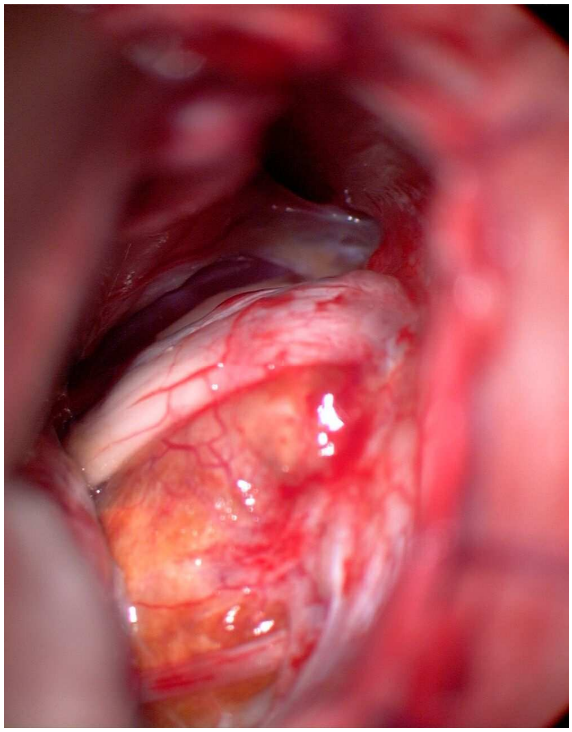


Fig.: A cholesterol granuloma in the posterior cranial fossa. Nerves VII and VIII have been displaced upwards.

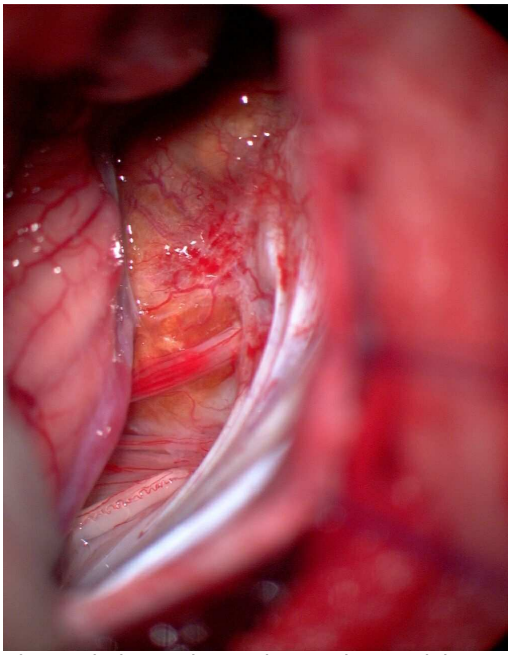


Fig.: A cholesterol granuloma: The caudal nerve group (IX, X) is visible at the lower margin.