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# DIAGNOSTICS AND SURGICAL TREATMENT OF TUMOR OF THE POSTERIOR CRANIAL FOSSA

## (Literature review and presentation of a clinical case)

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## Abstract

Extracerebral tumors of the posterior cranial fossa, due to the formation of complex topographic and anatomical relationships with the brainstem, often lead to a disruption of its function, but the degree of brainstem damage is most often determined only on the basis of clinical data. Signs of brainstem damage in tumors of this localization are observed in 65-80%, among them, irritation symptoms predominate, which make up 65%, conduction disorders are noted in 38%, damage to the cranial nerves on the side of the tumor is observed in 28%..

**Keywords:** **Metabolic changes in the brainstem in the form of a slight or moderate increase in lactate levels with normal values of other metabolites were most often observed in patients admitted in the subcompensation stage or in the moderate decompensation stage.**

## Introduction

Extracerebral tumors of the posterior cranial fossa, due to the formation of complex topographic and anatomical relationships with the brainstem, often lead to a disruption of its function, but the degree of brainstem damage is most often determined only on the basis of clinical data. Signs of brainstem damage in tumors of this localization are observed in 65-80%, among them, irritation symptoms predominate, which make up 65%, conduction disorders are noted in 38%, damage to the cranial nerves on the side of the tumor is observed in 28%. With tumors of this localization, varying degrees of compression, deformation and rotation of the brainstem are observed. The resulting hypoxia causes a disruption in the trophism of brain tissue and the development of edema with subsequent dystrophic changes in nerve cells [3, 5, 10, 13]. Microscopic changes in the brainstem in meningiomas of the posterior cranial fossa are accompanied by rarefaction phenomena, a porous state of the brainstem tissue is determined. In this case, myelin fibers are sharply changed, their swelling, demyelination is noted, some fibers are fragmented and thinned. In the brainstem, vessels with signs of pronounced perivascular edema are found, plasmorrhagia, dystrophic changes are detected, diapedetic hemorrhages are less common [1, 7, 15].

When studying the peritumorous zone of tumors of the cerebral hemispheres, along with hydration of the white matter of the brain adjacent to the tumor, a decrease in the amount of lipids was found, and since myelin fibers mainly consist of them, such changes were assessed by the authors as a demyelination process. In addition, they did not reveal a relationship between the histological type of tumor, localization, size, growth pattern, and the degree of expression of peritumorous edema [1, 8, 9, 12].

Metabolic changes in the brainstem in the form of a slight or moderate increase in lactate levels with normal values of other metabolites were most often observed in patients admitted in the subcompensation stage or in the moderate decompensation stage. Metabolic changes in the brainstem in the form of a more significant increase in lactate levels and a decrease in choline and creatine were most often observed in patients with a long history of the disease (more than 5 years), admitted in the moderate or severe decompensation stage, with multiple spontaneous nystagmus, bulbar disorders, and pelvic dysfunction in the clinical picture. It can be assumed that the relationship between metabolic changes in the brainstem and severe truncal ataxia indicates damage to the predominantly conducting cerebellar pathways. Some reports note that the appearance of a lactate peak is a sign of a nonspecific process and is possible not only with ischemic damage, but also with hypoxia of other genesis. In addition, there are reports that lactate diffuses from lactate-producing tumors into brain tissue, causing neuronal dysfunction in the brainstem [1, 11, 12].The morphological features of tumor displacements and deformations in the posterior cranial fossa are, on the one hand, determined by the compact arrangement of brain structures, blood vessels and cranial nerves in the bone-shell framework, and on the other hand, by the localization, histological variant, rate and direction of tumor growth [2]. Modern diagnostic methods allow visualizing the picture of structure dislocation depending on the histological structure and localization of the neoplasm [4, 5]. These data form the basis for planning surgical access, which is an effective way to reduce its trauma [15, 16]. Modern development of surgery for posterior cranial fossa tumors and increasing requirements for the accuracy and adequacy of surgical approaches make further development of anatomically sound methods for planning surgical approaches relevant.

Resection is the main treatment measure in patients with tumors of the posterior cranial fossa (PCF) [2, 4, 6, 7, 14].Microsurgical resection is the method of choice for most of these lesions, but variable localization, large size at diagnosis, frequent involvement of neural and vascular structures, and their potentially invasive behavior are some of the features of these tumors that make their resection challenging [2, 11, 15]. The main criterion for choosing an adequate surgical approach in surgery for posterior fossa tumors is its ability to ensure the most radical removal of the tumor with minimal damage to brain structures and vascular-nerve structures [4, 9, 10, 13]. Access planning with an analysis of the nuances of its implementation and possible conditions arising during surgery is considered in modern neurosurgery as a way to prevent possible complications [1, 3]. A method of computer 3D reconstruction of tomograms of patients for individualization of the relative positions of bone landmarks and sinuses of the dura mater in planning lateral suboccipital access in skull base surgery has been proposed [8, 11, 12]. According to a number of authors, the computer neuronavigation system is the most effective method of planning and implementing surgical access in real time [5, 7].

## Materials and Methods

Presentation of a clinical case.Patient M., 40 years old, was admitted to the Department of Neurosurgery of the Multidisciplinary Clinic of Samara State Medical University on March 21, 2022 with complaints of constant pain in the right occipital region and neck, which intensifies when turning the head, memory loss, tinnitus on the right, difficulty maintaining balance and numbness in the legs.

From the anamnesis it is known that he considers himself ill for 7 years, does not specify the cause of the disease. Symptoms were headaches, which intensified when turning the head, and progressed with the above symptoms. In recent months, unsteadiness of gait when walking, impaired coordination of movement and balance were observed.

Clinical and neurological examination revealed the following: General condition of moderate severity, free breathing, vesicular breathing on auscultation, muffled, rhythmic heart sounds. Blood pressure 120/80 mm Hg. Pulse 72 beats per minute, rhythmic. The abdomen is soft, painless. Pelvic organ functions were not impaired. Consciousness is clear. Glasgow scale 15 points. General cerebral symptoms were determined in the form of headache, dizziness and loss of coordination, tinnitus on the right. Meningeal symptoms were absent. Cranial nerve functions were not impaired. Pupils D=S, photoreaction is preserved. No motor or sensory disturbances in the limbs were observed. Statocoordination tests were performed with intentions. Unstable in Romberg's position. No pathological reflexes were observed.

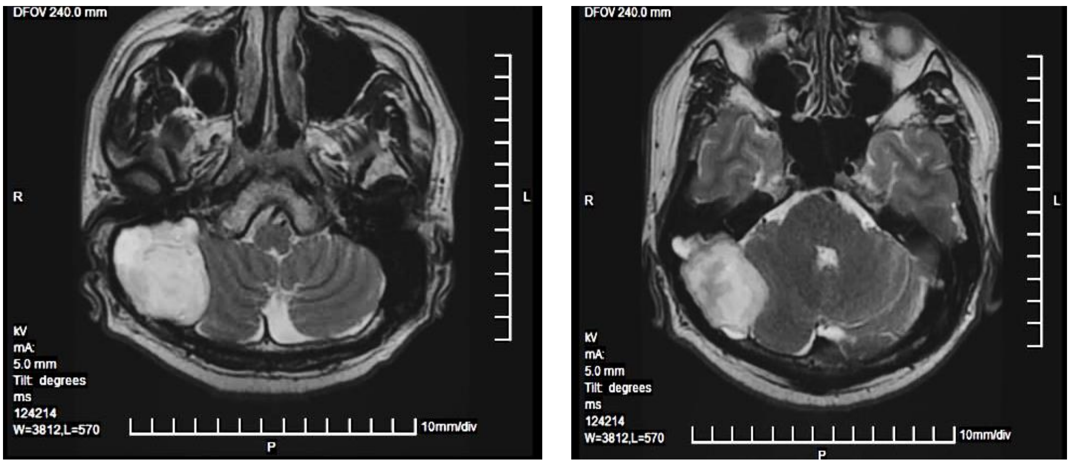
The patient was routinely prescribed MRI, MRI with contrast, MR spectroscopy, determination of the amount of neurospecific protein S-100 in the blood, and standard laboratory tests.

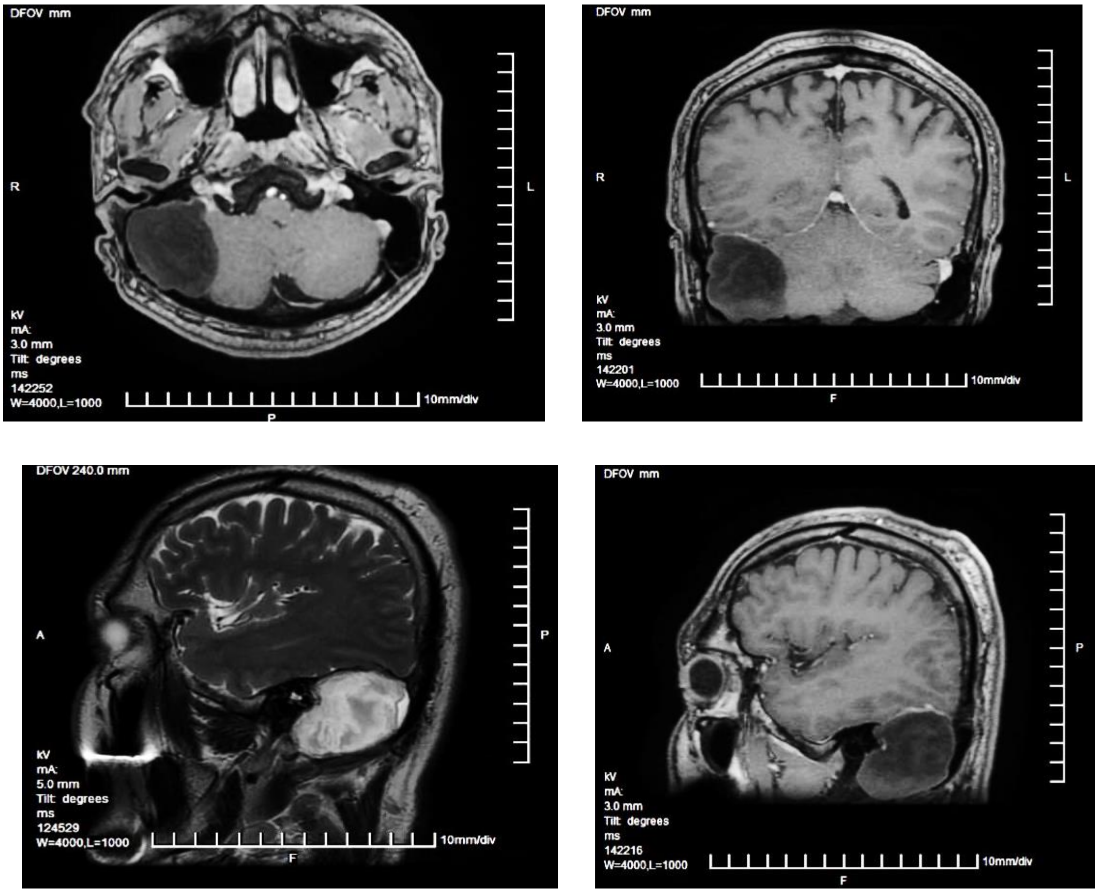
MRI revealed signs of a volumetric extracerebral formation in the posterior cranial fossa on the right, communicating with the cavity of the mastoid process of the right temporal bone, with compression of the cerebellum into the brainstem.

MRI data before contrast: Volumetric extracerebral formation of heterogeneous structure, hyper-hypointensity on T2-WI, FLAIR and DWI, hypointensity on T1-WI with clear external contours.

MRI data after intravenous contrast: after intravenous contrast, no pathological foci of MR signal enhancement were observed (Fig. 1).

**Fig. 1. MRI of the brain in T1, T2 and Flair modes.**

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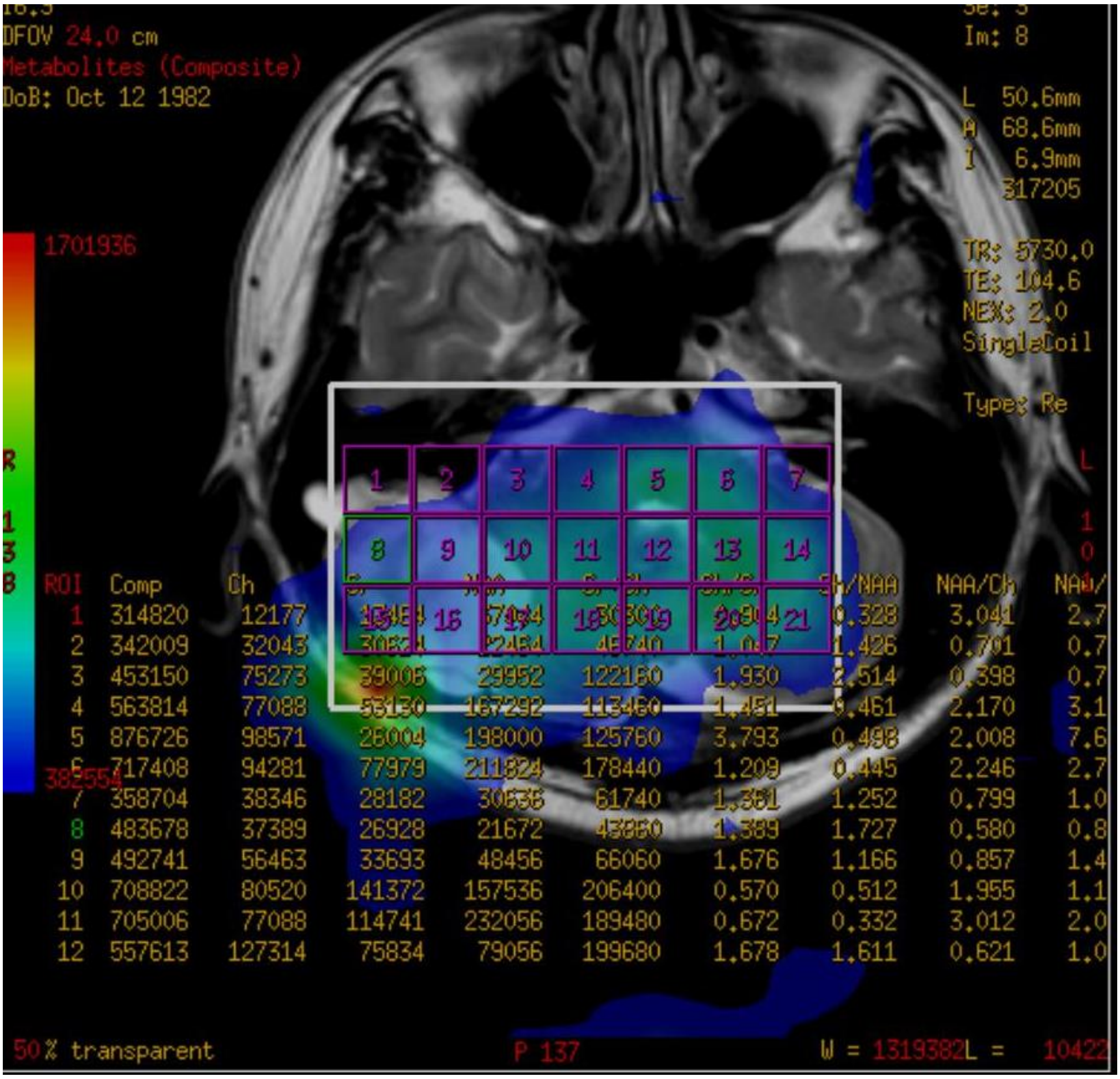



**Fig. 2. MR spectroscopy of the brain.**

***MR spectroscopy revealed an increase in lactate levels and a decrease in NAA, creatine, and choline levels.***

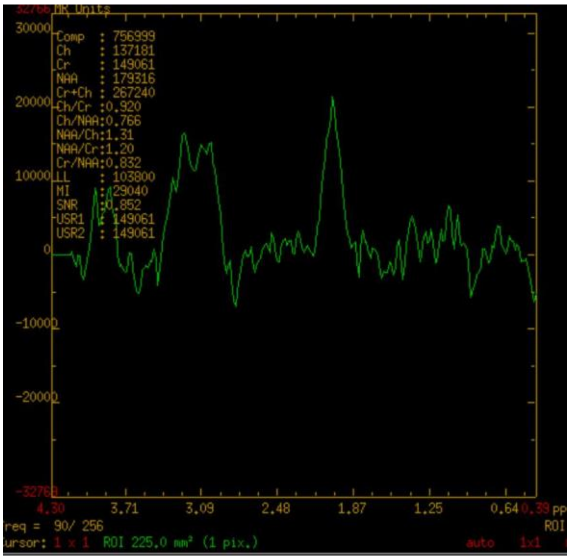
**Table of the ratio of trace elements in different areas of the brain**

**(Table 3).**

| Field | NAA | Creatine | Choline | Lactate |
|---|---|---|---|---|
| 8 | 21672 | 26928 | 37389 | 208681 |
| 10 | 157536 | 141372 | 80520 | 150240 |
| 11 | 232056 | 114741 | 77088 | 90840 |
| 12 | 79056 | 75834 | 127314 | 75960 |
| 14 | 179316 | 149061 | 137180 | 103800 |

**Table 3**

| Field | NAA | Creatine | Choline | Lactate |
|---|---|---|---|---|
| 8 | 21672 | 26928 | 37389 | 208681 |
| 14 | 179316 | 149061 | 137180 | 103800 |
| Ratio 8/14 | 8,274 ↓ | 5,535 ↓ | 3,668 ↓ | 2,010 ↓ |



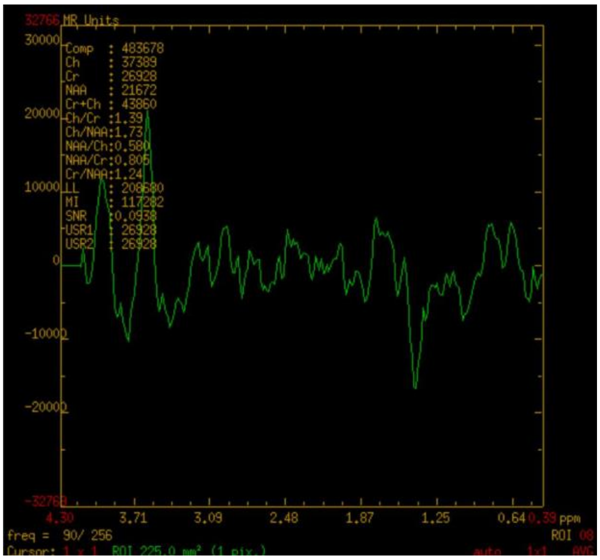




**Fig. 3. MR spectroscopy of the ratio of trace element levels in the pathological area of the brain.**

This table demonstrates that the ratio between the pathological field (8) and the peripheral (14) has a large difference in the amount of microelements. This is due to the tumor structure and metabolic processes in the area of tumor growth and along the periphery of the process spread.

ECG: metabolic changes in the myocardium of the posterior wall of the left ventricle. Ophthalmologist's examination: visus = 1.0, visual fields are not narrowed. The optic discs are pale pink, their borders are clear, the arteries of the fundus are moderately narrowed, the veins are dilated, there are no focal changes. Conclusion - bilateral retinal angiopathy.

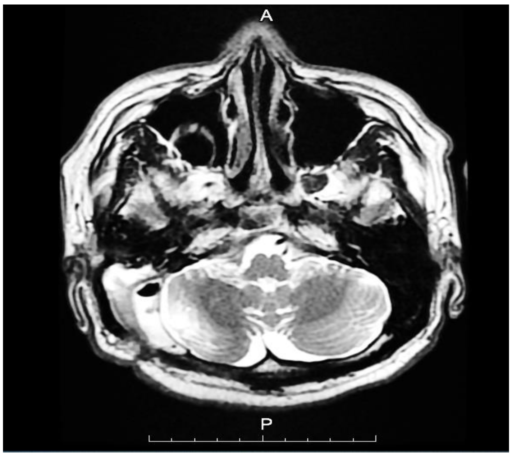
Laboratory tests: complete blood count: red blood cells = 4.40×1012/l, hemoglobin = 114 g/l, white blood cells = 7.60×109 /l (white blood cell count: band cells = 2%, segmented cells = 63%, eosinophils = 2%, lymphocytes = 27%, monocytes = 6%), platelets = 235×109 /l, ESR = 6 mm/h. Blood sugar = 5.77 mmol/l, total bilirubin = 16.9 mmol/l, creatinine = 109.8 µmol/l. Wasserman reaction is negative. Blood group III (B), Rh +. Complete urine analysis is within normal limits.

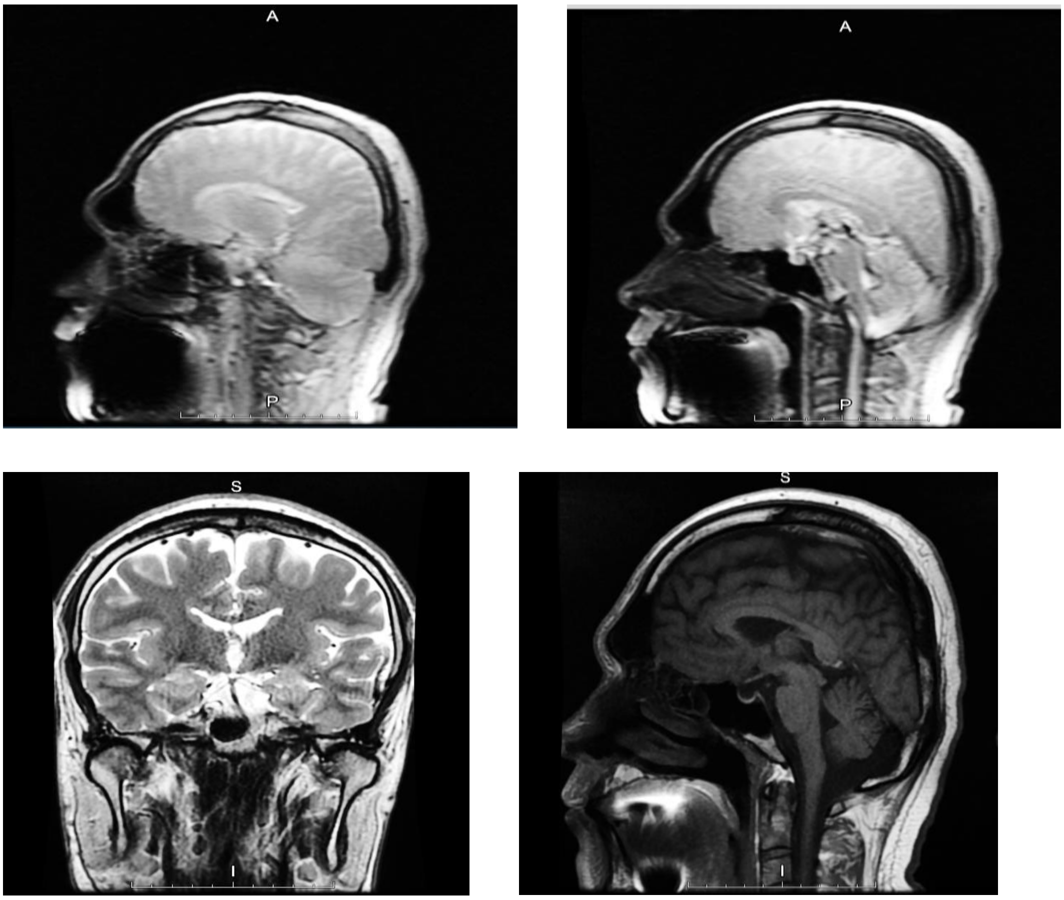
After collecting all the clinical, neurological, laboratory and instrumental data and the conclusions of the above-mentioned specialists, a planned operation was scheduled. Under general endotracheal anesthesia, an incision was made in the skin and soft tissues of the head using a suboccipital paramedian approach. After widening the surgical wound, a burr hole was made in the right occipital region of the skull bone and resection retrosigmoid suboccipital trepanation was performed in the occipital region in the direct and paramedian directions using bone scissors. An osteotomy was performed in the occipital region and a tumor mass was identified in the epidural space, compressing the right hemisphere of the cerebellum. During revision with instruments through the epidural space to the mastoid process of the temporal bone, the spread of the tumor mass was determined, which filled the cavity and led to the destruction of the spongy tissue of the mastoid process. The tumor mass was a soft, fatty, light yellow mass (Fig. 5), which was removed completely using special instruments. Careful hemostasis was performed. Pulsation of the brain was restored. A vinyl chloride tubular drainage was left in the epidural space. Iodine, alcohol compress, aseptic bandage was applied.

**MRI after surgery (Fig. 4).**

**SPO with bone-trepanation defect of the occipital bone on the right.**

**Subatrophy of the right cerebellar hemisphere. Signs of intracranial hypertension.**



The postoperative period was uneventful. Movements in the limbs were in full range, and the functions of the pelvic organs were preserved.

The patient notes that the recovery period after the treatment was 3 months - there was a gradual restoration of balance, walking, a decrease in the frequency of headaches. Subsequently, the condition stabilized. At the time of the survey, the complaints indicated periodic headaches without nausea and vomiting, after which the recovery of well-being takes several days; unsteadiness when walking; sleep disturbance; decreased memory, some slowdown in the speed of thinking, increased fatigue from mental and physical activities. According to the Karnofsky scale, the score is 80 points. The patient basically copes with his health. He is treated on an outpatient basis, is under the supervision of a neurologist at his place of residence.

Pathological examination reveals: Cholesteotoma.

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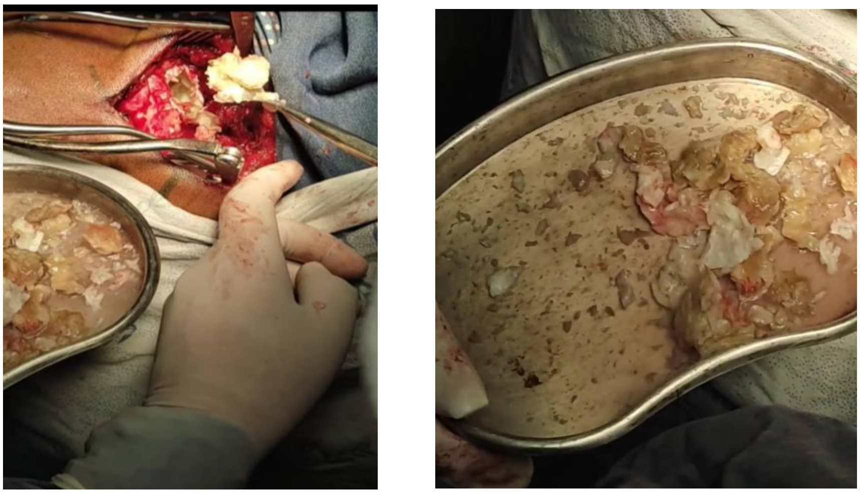

**Fig. 5. Intraoperative images of removed tumor tissue.**

## Conclusion

1) In patients with epidermoid tumors admitted for surgical treatment in the subcompensation stage or in the moderate decompensation stage, changes in metabolism in the brainstem are characterized by a slight or moderate increase in lactate levels with normal levels of other metabolites in MR spectroscopy.
2) In a patient with severe clinical disorders of the brainstem with a long history, a significant increase in lactate and a decrease in NAA, choline, and creatine were observed.
3) Changes in lactate levels in our cases do not correlate with the degree of compression of the brainstem and the size of the extracerebral tumor of the PCF, namely the epidermoid..

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