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Parasagittal Falcine-Sagittal Sinus Angle Meningioma of the Left Frontal Lobe of the Brain

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Abstract: The use of high-tech microsurgical techniques in operating on patients with extracerebral intracranial tumors has increased the degree of radicality of the intervention, reduced the incidence of relapses, shortened the length of hospital stay after surgery, and decreased the incidence of postoperative complications and deaths [1–3]. However, disability in patients after meningioma removal reaches 28.8–47.5% [4]. This justifies the need for an in-depth study of the mechanisms of development of clinical manifestations of the disease in patients operated on for a brain tumor using modern techniques. Meningiomas are the most common benign tumors of the central nervous system, originating from the arachnoid cells of the arachnoid membrane. Parasagittal and falx meningiomas account for approximately 25% of all intracranial meningiomas and present significant surgical complexity due to their proximity to the superior sagittal sinus. Total resection (Simpson I) in such cases is the optimal strategy, ensuring a minimal risk of recurrence.

Keywords: tumor, meningioma, falx, Simpson.

Purpose of the study— using morphometric analysis of patients with extracerebral intracranial tumors in the pre- and postoperative period, to study the morphological basis of neurological disorders based on the clinical case of one patient.

Materials and methods.A total of 50 patients with extracerebral intracranial tumors were examined, including 17 men and 33 women; the average age was 52.8±11.6 years. The space-occupying process was located supratentorially in 31 patients (62%), predominantly in the frontal lobe (11) and parietal lobe (8). Motor disorders were assessed using a standard 6-point scale. Headache intensity was determined using the Visual Analogue Scale (VAS). The frequency of epileptic seizures was determined from the anamnesis. Neuropsychological examination was conducted according to the method of A.R. Luria with quantitative assessment of data according to J.M. Glozman (1999). Cognitive disorders were assessed using a 4-point scale (0 - no disorders, 1 - mild disorders, 2 - moderate disorders, 3 - severe disorders). The presence and degree of arterial hypertension were assessed before, one year and two years after the intervention. MRI diagnostics were performed before the surgery and 1 and 2 years after the intervention. A Signa Infinity 1.5 T HI Speed plus tomograph (General Electric, USA) was used. The following pulse sequence method was used: Spinecho (SE) — T1 weighted image (VI) with TR/TE (ms)=550–650/20–23; T2 VI with TR/TE (ms)=2500/110; Gradient echo (GRE) — T2 BI with TR/TE (ms)=780–800/25–27. Scanning was performed in the sagittal, frontal and axial planes, with a slice thickness of 5 mm. The SPM5 package based on MATLAB 7.0 (MathWorks, 2005, USA) was used for image processing and subsequent morphometry. The volume of tumor tissue, postoperative cyst, and continued tumor growth were calculated. Structural changes in brain tissue and cerebrospinal fluid-containing spaces were assessed using MRI data. The

presence of leukoaraiosis, characterized by an increase in T2 signal intensity periventricularly or subcortically in the white matter of the brain, was studied. The number of foci was determined by counting them on each slice and then summing them up. If a lesion fell into two slices, it was considered a separate lesion each time. Particular attention was paid to the study of cerebral atrophy, which was manifested by an increase in the size of the ventricular system (central or predominantly subcortical atrophy) and the subarachnoid spaces of the cerebral hemispheres (mainly cortical atrophy). Using axial T1-weighted magnetic resonance images, the width of the lateral ventricles in the area of the anterior horns and bodies on the right and left, the average width of the convexital sulci, and the interhemispheric sulcus were measured [5, 6]. The relationship between MRI indicators and the severity of clinical symptoms (headache, hemiparesis, epileptic seizures, cognitive deficit, degree of arterial hypertension) was also determined.

Patient M., 53 years old (born in 1972), was admitted to the neurosurgical department with complaints of periodic intense headaches, dizziness, weakness and numbness in the right limbs, as well as decreased performance and memory over the past year.

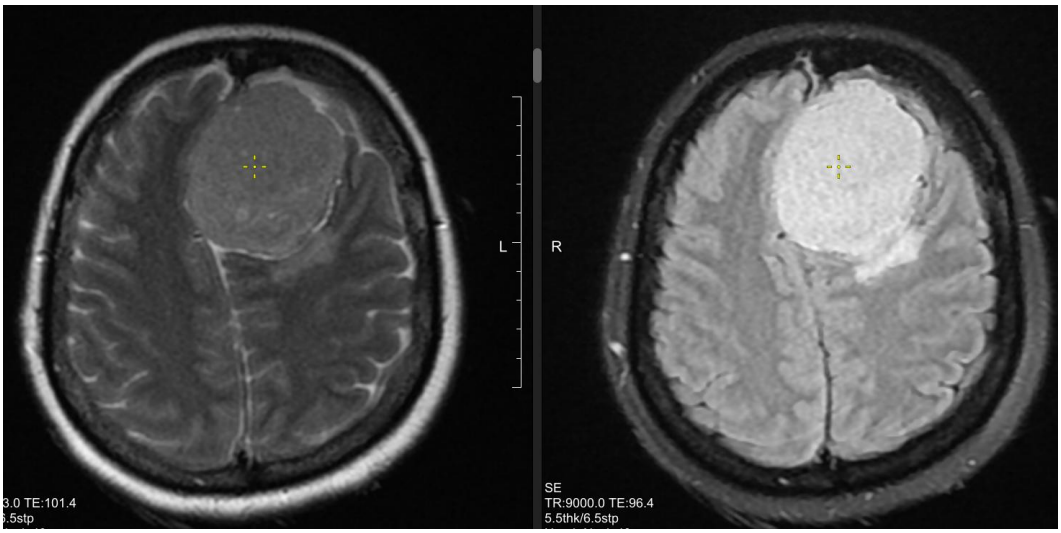
Neurological status: mild right-sided hemiparesis (4 points on the MRS scale), mild motor aphasia, increased tendon reflexes on the right, pathological Babinski reflex on the right. Consciousness is clear, orientation is preserved.

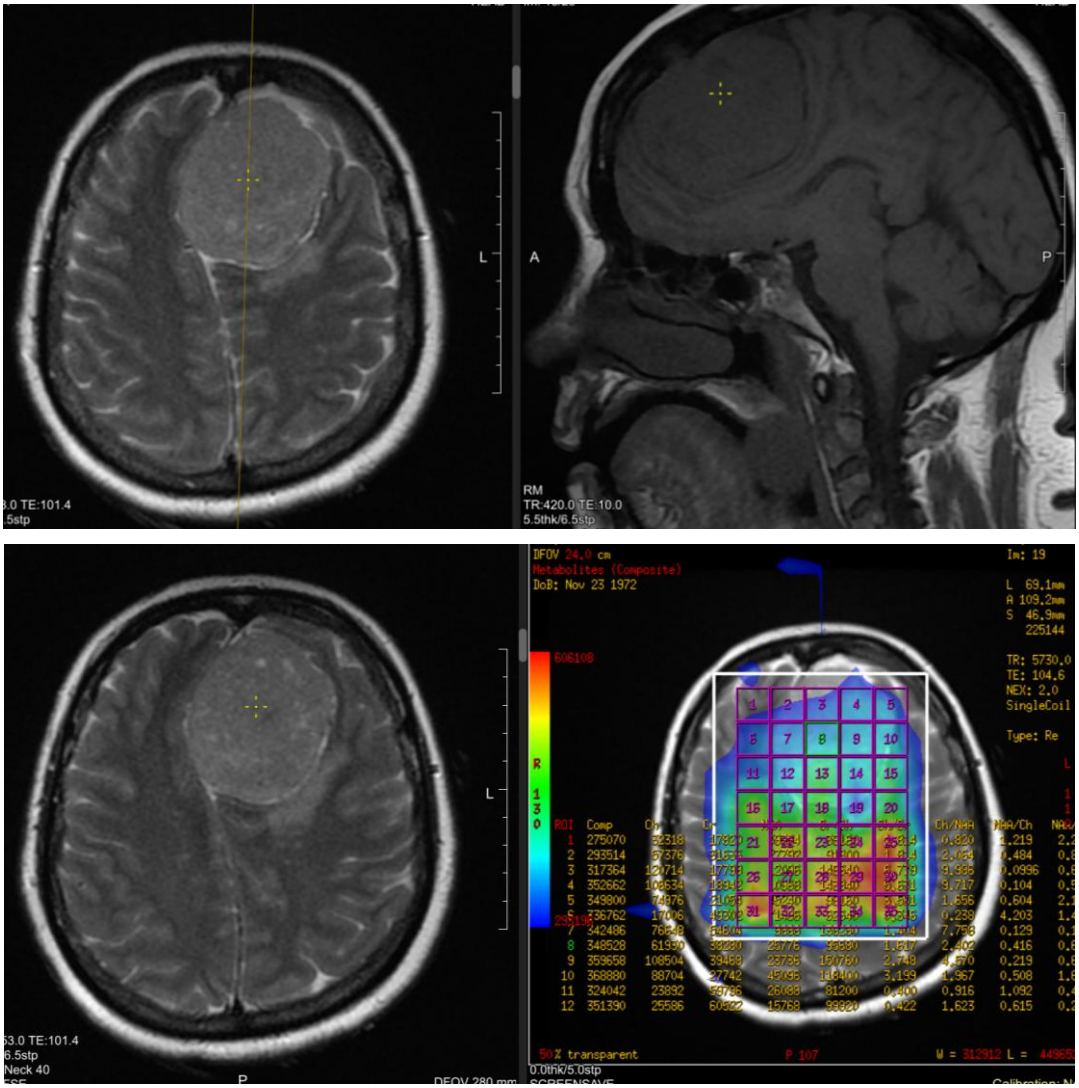
A contrast-enhanced MRI of the brain revealed a mass in the anterior parasagittal region of the left frontal lobe, measuring 40 x 36 x 32 mm, with clear margins and intense and uniform contrast enhancement. The tumor originated from the dura mater along the falx cerebri, adjacent to the wall of the superior sagittal sinus, with no signs of invasion into its lumen.

Surgical treatment. The patient underwent a left-sided fronto-parasagittal craniotomy under an operating microscope using neuronavigation. After opening the dura mater, a dense tumor mass originating from the falx cerebri was visualized. The tumor was completely removed (Simpson I) with excision of the adjacent dura mater and coagulation of the implantation base. The venous sinus was preserved, and blood loss was minor (up to 200 ml).

Microvascular instruments, neuromonitoring, and microscopic techniques were used intraoperatively. Hemostasis was complete, and the dural membrane was reconstructed with an autodural flap.

Pic 1.Parasagittal falcine-sagittal sinus angle meningioma of the left frontal lobe of the brain.

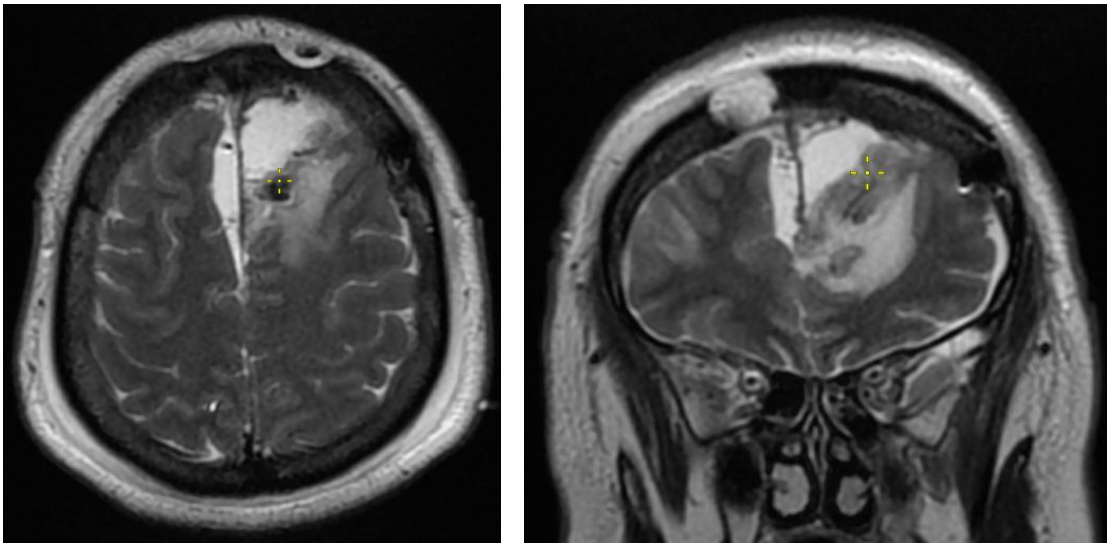


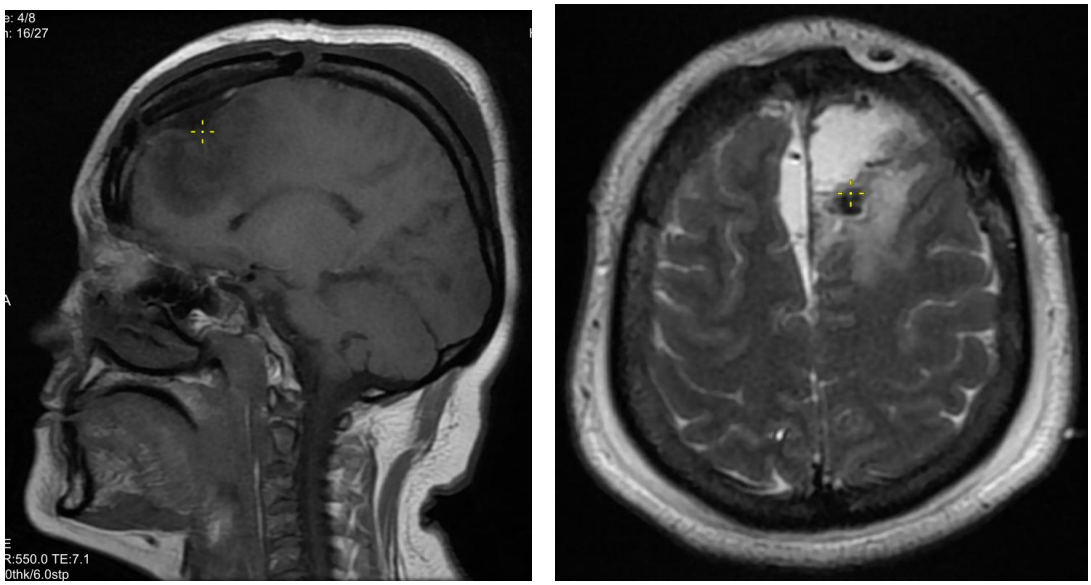


Results: Following surgery, a significant improvement in the patient's condition was noted: regression of right-sided hemiparesis to a minimal level (4.5 points), disappearance of headaches, and restoration of speech and cognitive functions. A follow-up MRI after 3 months showed complete removal of the tumor, with no signs of recurrence or residual tissue.

The patient was discharged in satisfactory condition, walking independently and socially adapted. Her neurological status is normal.

Pic 2. Post operation





Discussion. It was established that atrophic changes in the cerebral cortex, internal atrophy, and vascular foci in the white matter of the brain develop one year after the surgery. In 14 patients with a tumor of supratentorial localization, changes in the ventricular system in the form of diffuse or asymmetric expansion were observed one year after the surgery. A statistically significant difference was revealed between the values of the anterior horn of the right and left lateral ventricles in the observed group (5.90±1.43; 6.20±0.98 mm) and the control group (4.30±1.23; 4.50±1.65 mm), p=0.02 and p=0.015, respectively. Manifestations of diffuse atrophy of the cerebral cortex were determined in 10 patients. However, one year after the surgery, reliable differences in the width of the subarachnoid spaces in patients compared to the control group were not obtained. Compared with preoperative data (4 patients), the number of patients with foci of leukoaraiosis increased significantly (12 patients, p=0.03), with the average number of foci increasing to 5.4±2.3. The above-mentioned changes were progressive in nature, as 2 years after surgery, signs of external diffuse cortical atrophy were detected in 19 patients with resected supratentorial tumors (p=0.005). Internal atrophy in the form of dilation of the cerebral ventricles developed in 16 patients examined. The width of the anterior horn of the lateral ventricle on the right and left (6.90±1.26; 7.20±1.54 mm), the anterior part of the interhemispheric sulcus (4.90±1.34 mm), the precentral (2.40±0.76 mm) and postcentral sulcus (2.60±0.23 mm) turned out to be statistically significantly higher than the values in the control group (p=0.001; p=0.04; p=0.02; p=0.01; p=0.03). Leukoaraiosis of varying severity was determined in 17 patients, the average number of foci increased to 7.2±2.6 (p=0.015). Two years after surgery, during a control MRI examination, continued growth of the supratentorial tumor was noted in 3 patients (9.6%). The headache intensity in patients with supratentorial tumors according to VAS before surgery was 4.65±2.13 points, during a repeat examination one year after surgery it significantly decreased and was 3.1±2.7 points, after 2 years — 2.78±1.30 points. The Spearman test revealed a correlation between headache, tumor tissue volume (R=0.5; p=0.024), and occlusive hydrocephalus (R=0.51; p=0.020). One year after the intervention, data were obtained on the effect of the degree of ventricular dilation on headache (R=0.44; p=0.043). The volume of the postoperative cyst did not affect the development of headache, and the continued growth of the supratentorial tumor was also not characterized by the appearance or intensification of headache. Motor deficit of varying severity was a common symptom of supratentorial tumors and was observed in 61% of those examined: deep hemiparesis in 5 patients, moderate hemiparesis in 7, and mild pyramidal dysfunction in 7. The data obtained indicate that the brain, regardless of tumor location (supra-,The subtentorial brain responds to surgery as a holistic system. Hemodynamic and metabolic processes are disrupted, which may explain the appearance of ischemic lesions and cortical and central atrophy in areas distant from the primary tumor node. Therefore, in this category of patients, therapy that affects brain metabolism is justified, provided that the benign tumor is completely removed. Parasagittal and

falx meningiomas are often associated with the risk of venous sinus damage and postoperative complications. The use of microscopic techniques, neuronavigation, and modern hemostatic materials allows for complete tumor removal (Simpson I) while preserving venous outflow. In this case, the absence of sinus invasion allowed for radical resection without neurological complications and with an excellent functional outcome.

Conclusion Morphometric analysis of the MRI image of the brain in patients with extracerebral intracranial tumors in the postoperative period demonstrates the development of atrophic and vascular changes in the operated brain, which may be a morphological substrate for neurological disorders.

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