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THE IMPORTANCE OF COMPUTER AND MAGNETIC RESONANCE TOMOGRAPHY IN ASSESSING THE RADICALITY OF SURGICAL TREATMENT OF BRAIN TUMORS

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Annotation: The detection of an intensive growth in the development of oncological diseases of the central nervous system among the population of the Fergana Valley and the Andijan region in particular in the last decade cannot be considered a bad sign due to the fact that this fact rather indicates an increase in the level of early diagnostics of pathological conditions of the body, rather than any pathogenic factors, including the influence of lifestyle, ecology or heredity. The widespread, and what is important, affordable in financial terms appearance of neurovisual diagnostic rooms allows not only to detect pathology in its very infancy, but also, as they say, to observe its course and control its development at almost any stage, including after radical surgical treatment.

Key words: neuroimaging, radical surgery, brain tumors, postoperative complications.

Detection of the primary brain tumor, its metastases, and the degree of response to subsequent chemoradiation therapy is impossible without the use of modern neuroimaging methods such as computed tomography (CT) and magnetic resonance imaging (MRI). No less important is the diagnosis of complications of the early (in the first 2 days) postoperative period (hematoma, pneumocephalus , ischemic focus, edema and dislocation) and the assessment of the degree of radicality of the performed surgical intervention [4–6]. However, the capabilities of CT and MRI in assessing the radicality of the performed surgical intervention in the early postoperative period have been considered only in isolated studies [2, 7].

As an example, in the Andijan region in 2020-2024, only one child who underwent surgery for a brain tumor underwent MRI on the third day after surgery [1]. At the same time, attempts to increase the life expectancy of patients in the postoperative period are associated with the use of new chemotherapeutic and immune drugs, as well as various types of radiation therapy. For their effective use, objective information on the extent of tumor removal is necessary, which can currently only be obtained using CT and/or MRI in the early postoperative period [2]. Given the above , this work, dedicated to improving the effectiveness of CT and MRI in patients with brain tumors in the early postoperative period, seems relevant.

By using these modern methods of radiation diagnostics in the first 2 days after surgery on the brain, we tried to assess the volume of the resection performed and, in this regard, choose the most rational way of treating the patient in the postoperative period or decide on the need for repeated surgery to remove the remaining tumor masses.

Material and methods.

A total of 101 patients of the neurosurgical department of the Andijan branch of the Republican Scientific Center for Emergency Medical Care were examined. CT and MRI were performed in 56 patients before and after intravenous contrast both before surgery (no more than 2 weeks) and in the first 2 days after surgery, the remaining 45 patients underwent only CT in the postoperative period. If necessary, repeated studies were performed at a later date. CT was performed on a “Somatom” tomograph by Siemens (Germany). The step of the tomograph table and the thickness of the extracted slice were 5 mm. All studies were performed in the native mode and after intravenous contrast enhancement using 50 ml of the iodine-containing contrast agent Visipaque 320. In this case, residual

tumor masses were visualized quite clearly after intravenous contrast even against the background of postoperative hemorrhagic impregnation in the tumor bed and / or along the encephalotomy tract. MRI was performed on an Op a rt device by Toshiba with a magnetic field strength of 0.35 T before and after the introduction of a contrast agent - a paramagnetic in the amount of 0.2 ml per 1 kg of body weight of the patient. The age of the patients ranged from 31 to 70 years. They underwent operations for the removal of brain tumors. Thirty-five patients had malignant tumors (glioblastomas - in 16, anaplastic astrocytomas – in 10, metastases – in 9) and in 21 – benign (meningiomas – in 12, astrocytomas – in 5, oligodendrogliomas – in 2, teratoma – in 1, hemangioblastoma – in 1). In the left hemisphere, 26 tumors were localized, in the right – 30. The frontal region was affected in 12 patients, the temporal – in 20, the parietal – in 8, the occipital – in 4, the temporoparietal – in 4, the occipital - parietal – in 4, the cerebellar hemispheres – in 4.

Results. In this work, we deliberately do not dwell on the capabilities and comparative assessment of CT and MRI in identifying such complications of the early postoperative period as hematoma, hygroma , hemorrhage, focusing on their ability to determine the presence and size of a residual tumor depending on postoperative changes in the bed of the removed tumor. In all 56 patients, a contrast agent was accumulated to one degree or another during preoperative examination of the tumor. According to the surgical intervention, total tumor removal was performed in 32 patients, subtotal - in 18, partial - in 6, according to neuroimaging methods - in 30, 16 and 10 patients, respectively. CT clearly showed the absence of tumor masses in 26 (87%) of 30 patients, and in 4 the results of the study raised doubts due to the presence of severe postoperative edema. MRI in all observations clearly proved the radicality of the performed surgical intervention. As a result of the comprehensive assessment (data from surgical intervention, CT and MRI), residual tumor masses were determined in 26 (46%) of 56 patients. When performing CT, they were not visualized in 4 patients (15%) against the background of postoperative edema, in 4 (15%) the study results were questionable (in one case - against the background of postoperative edema, in the other - against the background of hemorrhage) and in 18 (70%) they were determined quite clearly. In MRI, in 6 patients (23%) against the background of hemorrhage , the residual tumor was not visible, and in 20 (77%) it was visualized. Only in 2 (8%) of 26 patients with subtotal tumor removal according to surgical intervention data, it was impossible to detect residual tumor masses against the background of postoperative hemorrhage using CT and MRI. On the other hand, in 2 patients with total tumor resection (according to intraoperative revision data), residual tumor masses were detected during MRI (CT gave false-negative results). In another 8 patients with subtotal resection (according to intraoperative revision data) of glioblastoma and anaplastic astrocytoma, only partial tumor resection was detected based on CT and MRI data. In 4 patients, subtotally resected tumor masses (according to intraoperative revision data) were visualized only by CT and were not visible by MRI due to postoperative hemorrhage. In total, CT and MRI data in the early postoperative period completely coincided in 42 (75%) of 56 patients. In 26 (46%) cases, both methods confirmed the radicality of the performed surgical intervention, and in 16 (29%) cases, they made it possible to confidently visualize residual tumor masses based on the presence of foci of intense accumulation of the contrast agent in the form of lumps or nodules, usually located in the deep parts of the removed tumor bed. In 4 (15%) of 26 patients, CT revealed residual tumor masses against the background of hemorrhage in the area of the surgical intervention, while MRI in these patients before and after intravenous contrast enhancement did not provide convincing data confirming their presence against the background of postoperative hemorrhage. In 6 (11%) patients, in the early postoperative period, native CT revealed massive edema in the area surrounding the tumor bed, which caused suspicion of the presence of residual tumor masses, and in 4 (7%), even against the background of slight postoperative edema, such data were not obtained. In 10 patients (18%), no convincing data on the presence of accumulation foci (residual tumor masses) were registered after intravenous contrast enhancement. During MRI of these patients in the surgical area against the background of postoperative edema, 4 patients showed an increase in the MR signal after intravenous contrast enhancement on T1- weighted images (WI), which indicated the presence of residual masses, and 4 patients did not have such data, although the tumor was resected subtotally. In 12 of 56 patients (21%), there were discrepancies between the intraoperative assessment of the degree

of radicality of the performed surgical intervention and the CT or MRI data. During a comprehensive assessment of these neuroimaging methods , the results coincided with the intraoperative data in 6 (11%) of 56 patients, and in 6 (11%) of 56, the CT and/or MRI results made it possible to clarify the extent of the surgical intervention.

Discussion. Evaluation of the radicality of surgical treatment of brain tumors, despite the introduction of highly informative and minimally invasive research methods into clinical practice, continues to be a pressing problem in neurosurgery. The use of CT and MRI has significantly improved not only the recognition of residual masses of brain tumors, but also made it possible to detect them against the background of postoperative edema and / or hemorrhage zones. At the same time, today we are talking not just about diagnostics, but about the earliest possible recognition of non-radically removed brain tumors. Early diagnostics using a set of radiation research methods helps to improve the treatment results of patients with brain tumors. At present, no one has any doubts that if residual masses of a brain tumor are suspected, CT and / or MRI with contrast enhancement should be performed. The data obtained using CT and MRI are usually sufficient to assess the volume of the performed surgical intervention [3]. In 1995, the International Society of Pediatric Oncologists (SIOP) adopted the Central Nervous System Tumors Committee recommendations for examining children with CNS tumors [4]. These recommendations also include criteria for determining the extent of surgical intervention using neuroimaging methods performed in the early postoperative period. It was noted that CT may be insufficient for diagnosing tumors located in the brainstem and posterior cranial fossa. Therefore, in such cases, MRI of the brain in 3 projections is mandatory, including T1 and T2WI without contrast enhancement and T1WI with paramagnetic contrast. During preoperative examination, two tumor sizes should be measured on tomograms , the first of which is selected on the image where the tumor has the maximum size, and the second - perpendicular to the first on the same section. In case of uneven tumor growth, the second diameter can be selected on another section, where it turns out to be larger. It is important to record this for subsequent control studies, otherwise it will be extremely difficult to assess the dynamics of the process. It should be emphasized that diagnostic CT and/or MRI should be performed no more than 10-14 days before surgery, so that the neurosurgeon has reliable information about the tumor process in the central nervous system and can adequately plan the scope of the surgery. Postoperative examination (CT and/or MRI with contrast enhancement) must be performed no later than the 3rd day after surgery. This is explained by the fact that the consequences of disruption of the blood-brain barrier, as well as the barrier between normal brain tissue and the tumor in the form of hemorrhages, edema and other postoperative changes can distort the data of a neuroradiological examination performed more than 3-5 days after surgery and complicate an adequate assessment [7, 8]. Currently, there are isolated studies [9] on the capabilities of MRI in visualizing tumor remnants, as well as those devoted to a comparative assessment of the capabilities of CT and MRI in solving this issue [3]. In MRI performed on the first day after surgery, in 44% of cases the increase in the signal from methemoglobin complicated the interpretation of the obtained data. In 79% of cases it was possible to detect contrast enhancement of residual tumor masses, and in 12% – linear contrast enhancement along the edge of the surgical wound due to postoperative changes [3]. G.E. Trufanov et al . [11] detected linear accumulation of contrast agent associated with postoperative changes in 64% of cases, which complicated the detection of residual tumor masses. In the work [2] it is indicated that CT performed on the first day after surgery revealed tumor remnants in 32% of cases, and MRI – in 84%. In CT, the absence of contrast enhancement was noted in 43%, the results were uninformative in 24% of cases, in MRI – in 11 and 5%, respectively. Cases with blood clots and air pockets located near the edges of the surgical wound presented difficulties for CT, while cases with the presence of linear enhancement areas along the resection edges presented difficulties for MRI. In no case did the developing methemoglobin complicate the interpretation of MRI data. There is an opinion that CT and MRI, even with the use of contrast enhancement, cannot differentiate between early postoperative changes and residual tumor masses. According to A.K. Gnekow , surgical assessment of the scope of the operation should be carried out based on the data of the surgical intervention using the following criteria: S1 – complete resection, no residual tumor; S2 – the volume of the residual tumor on the tomograms is no more than 1.5 cm2 , local invasion is possible; S3 – the volume of the residual tumor

on the tomograms is more than 1.5 cm2; S4 – large residual tumor (the scope of the operation is a biopsy). The volume of surgery using early CT and/or MRI should be assessed based on the following criteria: R1 — no signs of tumor on CT/MRI performed with contrast enhancement, the volume of resection is total; R2 — marginal accumulation of contrast agent (only at the site of surgery); R3 — residual tumor is determined, with two sizes indicated; R4 — no changes compared to preoperative studies. The volume of tumor resection should be determined based on the assessment of the surgical results (the surgical protocol with the surgeon's assessment of the volume of tumor removal — position S) and the CT/MRI data performed in the early postoperative period (position R). Depending on the combination of different values of positions S and R, four criteria can be distinguished: S1 and R1 — total tumor resection; S2 and R1–2 — subtotal resection; S1–3 and R3 — partial resection; S4 and R4 — tumor biopsy. I.N. Pronin [2] suggests that in the absence of contrast enhancement, the tumor should be considered completely removed, and the remaining tumor masses should be assessed as a percentage of the primary tumor volume. Residual masses that make up 10–15% of the primary tumor are subtotal removal, more than 15% are partial. We also used these criteria, since they offer an assessment of the radicalism of the surgical intervention performed, taking into account the size of the primary tumor. In our observations, according to surgical intervention data, total tumor removal was performed in 32 patients, subtotal - 18, partial - 6, according to neuroimaging methods - 30, 16, and 10 patients, respectively. According to the results of CT and MRI, in 6 (11%) of 56 patients it was possible to clarify the degree of radicalism of the performed surgical intervention in comparison with intraoperative data, and in 2 patients (with melanoma and anaplastic astrocytoma), tumor masses were not diagnosed by neuroimaging methods during their subtotal removal . Based on the results of our studies, it can be assumed that the volume of the resection performed is better assessed based on MRI data, since residual tumor masses are visualized more clearly in the presence of edema and ischemia against the background of surgical trauma. In our studies, CT results were questionable in 12 (21%) of 56 patients - in 6 of them, massive edema was detected in the area surrounding the tumor bed, which caused suspicion of residual tumor masses. In 4 patients, no such data were obtained even against the background of minor postoperative edema. In another 2 cases, tumor masses were not visualized during CT against the background of hemorrhage. In all 12 cases, after intravenous contrast enhancement, no convincing data were obtained on the presence of accumulation foci (residual tumor masses). When MRI was performed on these patients against the background of postoperative edema, 8 patients showed an increase in the MRI signal after intravenous contrast enhancement on T1WI (including 4 patients with no data on residual tumor masses when performing CT), which indicated the presence of residual tumor masses, while 4 patients did not have such data. On the other hand, when residual tumor masses are detected against the background of postoperative hematoma, the use of CT with intravenous contrast enhancement is even preferable, although there are studies [6] indicating that tumors may be poorly differentiated against the background of hemorrhages when performing CT. Thus, in 4 of our patients, CT revealed residual tumor masses against the background of hemorrhage in the surgical intervention area, while MRI performed on these patients before and after intravenous contrast enhancement did not provide convincing data on their presence against the background of postoperative hemorrhage. Thus, the degree of radicality of the surgical intervention performed was clarified with the help of CT in 22 (79%) of 28 patients. The combined use of these methods allowed us to establish the correct diagnosis in 27 (96%) of 28 cases.

Conclusions:

1. In case of edema and ischemia of perifocal brain tissue, the volume of the performed resection is better assessed based on MRI data, since residual tumor masses are visualized more clearly.
2. To detect residual tumor masses against the background of postoperative hemorrhage, it is preferable to use CT with intravenous contrast enhancement.
3. Based on the results of CT and MRI, in 11% of patients it is possible to clarify the degree of radicality of the surgical intervention performed in comparison with intraoperative data.

4. The accuracy of CT in determining the degree of radicality of the performed surgical intervention is 79%, and MRI – 96%. The combined use of these methods made it possible to establish the correct diagnosis in 96% of cases.

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