Computer NLS-Graphy
And Magnetic Resonance Imaging
In Evaluation of Surgical Intervention Extent for Brain Tumors Treatment

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Brain tumor eradication extent, especially of malignant one, is the main prognostic issue, affecting lifetime of patients. Detection of primary tumor of brain, its metastases and response degree for following chemo- and radiotherapy is impossible without modern methods of neurovisualization, such as computer NLS-graphy and magnetic resonance imaging (MRI). Diagnostics of early post-operative period (first two days) complications (haematoma, pneumocephalus, ischemic nidus, edema and displacement) and evaluation of carried out surgical intervention extent is also important. However potentials of NLS-research and MRI in evaluation of carried out surgical intervention extent at early post-operative period were not studied before. At the same time attempts to increase lifetime of patients at post-operative period are related to use of new chemotherapeutic and immune preparations, and also various types of radiotherapy. But to use them efficiently, therapists require accurate information about oncotomy extent which today can be acquired only by application of NLS-research and/or MRI at early post-operative period. Taking into account all abovementioned information, the present study, targeted at increasing of NLS-research and MRI application efficiency for patients suffering from brain tumors at early post-operative period, seems to be quite urgent.

By application of these modern methods of diagnostics during first two days after surgical intervention into brain, we tried to evaluate extent of carried out resection and thereupon to choose the most rational tactics of patient treatment during post-operative period or to make a decision if there is need in repeated intervention in order to remove remaining tumor masses.

Material and Methods
We examined 101 neurosurgical patients. In 56 cases we carried out NLS-research and MRI both before operation (not later than in 2 weeks) and during first two days after surgical intervention; in the rest 45 cases we carried out only NLS-research during post-operative period. Also we carried out further repeated examinations if the situation required it.

NLS-research was fulfilled with «Metatron»-4025 system (the Institute of Practical Psychophysics) with generator frequency of 4.9 GHz and unit of continuous spiral scanning; the system has installed «Metapathia GR Clinical» computer software with three-dimensional visualization of organs feature.

MRI was carried out with «Opart» device (Toshiba) with magnetic field intensity of 0.35 T before and after contrast enhancement by paramagnetic in amount of 0.2 ml per 1 kg of patient’s body weight.

Age of patients ranged from 31 to 70. They were administered for brain tumor surgical removal. 35 patients suffered from malignant tumors (glioblastoma — in 16 patients, anaplastic astrocytoma — in 10 and metastases — in 9) and 21 — from benign ones (meningioma — in 12, astrocytoma — in 5, oligodendroglioma — in 2,
teratoblastoma— in 1 and hemangioblastoma — in 1 patient).
26 tumors were localized in left cerebral hemisphere, 30 —
in right cerebral hemisphere. Frontal region of head was
affected in 12 patients, temporal region — in 20, parietal
region — in 8, occipital region — in 4, parietotemporal
region — in 4, occipitoparietal region — in 4 and cerebellar
hemispheres — in 4 patients.

RESULTS
In this study we intentionally did not cover potentials
and comparative analysis on NLS-research and MRI in
detection of such complication of early post-operative
period as haematoma, hygroma and haemorrhage. We
concentrated on their potentials to detect presence
and identify size of residual tumor depending on post-
operative changes of removed tumor bed.

According to surgical intervention, total oncotomy
was carried out in 32 patients, — subtotal — in 18, partial —
in 6 patients; according to neurovisualization methods
data — in 30, 16 and 10 patients correspondingly.

Generally, in 42 (75%) of 56 patients, data acquired
by NLS-research and MRI at early post-operative period
matched completely. At the same time in 26 (46%) cases
both methods confirmed surgical extent of operative
intervention and in 16 (29%) cases by means of these
methods we visualized remaining tumor masses distinctly.

In 4 (15%) of 26 patients NLS-research detected
remaining tumor masses with the background
of hemorrhage in the area of operative intervention,
but at the same time MRI of these patients before and
after intravenous contrast enhancement did not gave
us trustful data confirming presence of post-operative
hemorrhage. In 6 (11%) patients NLS-research detected
massive edema in area surrounding tumor bed at early
post-operative period, it caused suspicion for presence of
remaining tumor masses which was confirmed by further
carrying out of spectral-entropy analysis (SEA) of this
area, and in 4 (7%) patients, even with the background
of lesser post-operative edema, such results were not registered.

At MRI of these patients’ operative area with the background of post-operative edema, in 4 cases we registered increasing of MR-signal at T1-weighted scans (WS) after intravenous contrast enhancement, which evidenced presence of remaining tumor masses, in other 4 cases we did not register such data, although in 2 of them tumor was removed subtotally. In 12 (21%) of 56 patients we detected mismatch between intra-operational evaluation of surgical intervention extent and data acquired by NLS-research and MRI. Combined evaluation of data acquired with three-dimensional visualization methods proven that data due to forming methemoglobin.

In our study, according to surgical intervention data, total removing of tumor was carried out in 32 patients, subtotal – in 18, partial – in 6 and according to three-dimensional visualization methods data – in 30, 16 and 10 patients correspondingly. According to results of NLS-research and MRI in 6 (11%) of 56 patients we managed to update extent of carried out surgical intervention in comparison with intra-operational data; in 2 patients (suffering from melanoma and anaplastic astrocytoma) tumor masses after their subtotal removing were not diagnosed by three-dimensional visualization methods.

On the basis of our study results we may assume that extent of carried out resection should be evaluated according to MRI data, because at edema and ischemia, with the background of surgical wound, remaining tumor masses are visualized more accurately. In our research in 12 (21%) of 56 patients results of NLS-research were questionable – in 6 of them in area surrounding tumor bed we detected massive edema, which is the sign of remaining tumor masses presence. In 4 patients, even with the background of lesser post-operative edema, we did not register such data. In another 2 cases tumor masses were not detected by NLS-research against the background of hemorrhage.

At MRI of these patients, with the background of post-operative edema, in 8 of them we detected increasing of MR-signal after intravenous contrast enhancement at T1WS (including 4 patients with no information concerning remaining tumor masses, acquired with NLS-research), which evidenced presence of remaining tumor masses, and in 4 patients we did not get such data. On the other hand, using of NLS-research with SEA for detection of remaining tumor masses with the background of post-operative haematoma is more preferable. So in 4 of our patients NLS-research with SEA detected remaining tumor masses with the background of hemorrhage in the area of operative intervention, at the same time MRI of these patients before and after contrast enhancement did not give us reliable data regarding its presence with the background of post-operative hemorrhage. Thereby extent of carried out surgical intervention was updated in 26 (93%) of 28 patients by NLS-research. Combined application of these methods allowed us to make more accurate diagnosis in 27 (96%) of 28 cases.
CONCLUSION

1. At edema and ischemia of perifocal brain tissue extent of carried out resection should be evaluated according to MRI data, because remaining tumor masses are diagnosed more precisely.

2. To detect remaining tumor masses with the background of post-operative hemorrhage it is preferable to use NLS-research with SEA.

3. According to results of NLS-researches and MRI in 11% of patients extent of carried out surgical intervention may be updated in comparison with intra-operative data.

4. Accuracy of NLS-research with SEA in evaluation of surgical intervention extent is 93%, accuracy of MRI – 86%. Combined application of these methods allowed us to make more accurate diagnosis in 96% of cases.