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MODERN ASPECTS OF DIAGNOSING GLIAL TUMORS OF THE BRAIN (LITERATURE REVIEW)

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Abstract. A broad review of literature data on the issue of diagnostics of glial tumors of the brain is presented. Information on the epidemiology of neurooncological diseases is provided, and modern concepts of their etiopathogenesis are outlined. Comparative characteristics of new neuroimaging technologies and the possibilities of their intraoperative use in order to optimize the provision of neurosurgical care are described.

Key words: glial tumors, neuroimaging, neurosurgical treatment, molecular virological direction.

Intracerebral glial tumors are neoplasms of the central nervous system (CNS) originating from neuroglia, characterized by infiltrative growth, varying levels of proliferative activity, and a tendency to recur.

Classification

In the International Classification of Diseases, 10th revision (ICD-10), primary malignant brain tumors are defined by code C71.0-9 [1, 2]. The current classification of CNS tumors, published by the World Health Organization (WHO) in 2016, is fundamentally different from the previously adopted one and is based on the molecular genetic aspect. Scientific research in the field of neurooncology over the past few years has confirmed the leading role of changes in the genetic code in the origin of neoplasms. As a result, the updated 5th edition of the WHO classification significantly changes the usual diagnostic principles formulated in 2007 and based exclusively on histological criteria [3, 4]. It should be noted that the changes made allow filling some diagnostic niches. The combination of phenotypic and genotypic features makes the approach to classification more objective and also allows identifying prognostic factors in the treatment of patients.

The classification of CNS tumors of the 5th revision does not include previously accepted concepts such as gliomatosis of the brain, protoplasmic astrocytoma, fibrillary astrocytoma, primitive neuroectodermal tumor (PNET), ependymoblastoma, and cellular variant of ependymoma [5, 6]. At the same time, new terminology has appeared (Fig. 1).

The TNM classification, widely used in oncology, is not applied to primary brain tumors due to the absence of their metastasis to other organs, although perineural spread is typical for some of them [2]. The approaches to treating patients with primary CNS tumors are

based on determining the degree of their malignancy (Grade), the criteria for determining which, in turn, are based on histological, molecular-genetic features, as well as a retrospective analysis of the clinical course of the disease. G1 tumors are characterized, as a rule, by expansive growth, low proliferative activity, and, depending on the localization, can be successfully cured by surgery. G2 formations also have low proliferative potential, but are characterized by infiltrative growth, are prone to recurrence and have a tendency to transform into more malignant types. A combination of surgical treatment and radiation therapy in some cases gives positive results. G3 tumors are characterized by pronounced mitotic activity of cells and atypia of their nuclei. Complex treatment is necessary in the treatment of such neoplasms. G4 neoplasms have an extremely unfavorable prognosis, are characterized by a high level of mitotic activity, the presence of focal necrosis and vascular (endothelial) proliferation. Thus, G1-2 tumors belong to low grade tumors, and G3-4 to high grade tumors [7, 8, 9].

Epidemiology

According to various literary sources, the incidence rates of primary CNS tumors vary from 5 to 14 cases per 100 thousand population [10]. In Russia in 2014, it was 5.55 cases per 100 thousand population [11]. In developed industrial countries, this figure ranges from 8.4 to 11.8 in men and from 5.8 to 9.3 in women [12]. According to the American Central Brain Tumor Registry (CBTRUS), in 2004-2008 in the United States, the incidence of benign and malignant CNS neoplasms was 16.1 and 19.2 per 100 thousand male and female population, respectively; from 2005 to 2013, the number of new cases of the disease increased by 1.4 times [13, 14]. In the Republic of Belarus, the number of patients with malignant neoplasms is also growing. For 2007-2016, the hospital incidence of intracranial tumors, calculated for the initial visits of patients to neurosurgical departments, was 20.6, and

In the regions of the republic, it varies from 12.1 to 31.5 cases per 100 thousand population. The proportion of glial tumors among all intracranial neoplasms is 30-60%, with 80% of malignant brain tumors being gliomas [15]. Although intracranial gliomas account for less than 2% of solid tumors in adults, they rank third in the structure of cancer mortality among men, fourth among women aged 15 to 35 years, and are also in third place in terms of the growth rate of incidence among all cancer neoplasms [16, 17]. There is a tendency for the incidence of CNS tumors to increase by 0.6-0.9% annually. The socio-economic aspect of the problem is that there are a large number of working-age people among patients [18, 19].

Etiopathogenesis and clinical picture

The immediate causes of neuro-oncological diseases are currently not fully understood. About 5-10% of cases may be due to heredity, the rest probably arise as a result of the

impact of external environmental factors (chemical, physical and biological) on the genetic material in cells. Many studies are conducted in support of the viral-genetic theory of tumor occurrence, as well as the connection with the pathology of the immune system [20, 21, 22]. There is evidence that CNS tumors are formed as a result of clonal proliferation with mutations in growth regulator genes: oncogenes that induce cell growth, suppressor genes that suppress cell division processes, apoptosis genes and ensure the reparation of deoxyribonucleic acid (DNA). Damage to these genes underlies the pathological changes that provoke tumor growth [23].

Clinical manifestations of neuro-oncological diseases are very diverse and depend on the localization and prevalence of the pathological process, which determines one or another general cerebral and focal symptomatology. Patients usually present non-specific complaints of headache, general weakness, memory impairment and concentration. Epileptic seizures are a frequent manifestation of the presence of a tumor process in the brain. Focal neurological deficit can be represented by a wide range of sensitivity and coordination disorders, motor, speech and mental disorders, as well as a combination of various sensory and motor disorders, depending on which pathways and nuclei of the cranial nerves are affected.

Diagnostics

The assessment of the neurological status and instrumental methods of examination are important. Modern neuroimaging capabilities allow us to formulate a presumptive diagnosis, determine the tactics of further treatment, the feasibility of surgical intervention, and plan the course of the operation.

The method of computed tomography (CT) of the brain, the diagnostic capabilities of which are based on the different degrees of absorption of X-ray radiation by tissues, is basic and screening in neurosurgery. When studying areas of increased and decreased density of visualized structures of the brain, it is possible to obtain information on the presence of a volumetric process in the cranial cavity, the prevalence of perifocal edema and the degree of dislocation of normal structures. Additional information on the nature of the neoplasm is provided by CT using contrast enhancement, as well as CT perfusion and computed angiography [24]. Diagnostic capabilities have expanded significantly with the advent of such technologies as spiral and multilayer ("multislice") CT, CT with two radiation sources, which allows differentiating closely located objects of different densities in the image, which is especially important when contrasting vessels and formations located near bones or metal structures. CT with contrast is also widely used in planning radiation therapy and in neuronavigation.

According to the existing algorithms for diagnostics and treatment of neoplasms of the nervous system, the standard of neuroimaging is magnetic resonance imaging (MRI)

performed in three projections (transverse, sagittal and coronal) and in three modes (free fluid attenuated inversion recovery (FLAIR), T1, T2) [25]. This method allows to detect the presence of a volumetric formation, determine its boundaries and the degree of perifocal edema, assess the features of the blood supply and the relationship with normal brain structures. Additional diagnostic capabilities are provided by MRI with contrast, proton magnetic resonance spectroscopy (MRS), functional MRI (fMRI), diffusion tensor tractography (DTTG), MR perfusion (study of cerebral blood flow) [26, 27, 28].

MRS (single- and multivoxel) allows, based on the assessment of the level of metabolism in the tumor tissue, to assume the degree of its malignancy, as well as to conduct differential diagnostics between continued tumor growth, radiation necrosis and non-neoplastic diseases of the central nervous system (Fig. 2). The main organic substances taken into account in MRS are N-acetylaspartate (NAA), choline (Cho) and creatine (Cr), lactate (Lac), lipids (lip), myo-inositol (ml), glutamine and glutamate (Glx), alanine. Spectroscopy involves quantitative assessment (measurement of the amplitude of peaks and the integral) of metabolites and comparison of the obtained data with normal values. Thus, the resulting spectrogram is a graph of peaks corresponding to individual metabolites. An increase in the Cho level is noted in G2-3 gliomas, while in glioblastoma, in turn, due to the presence of necrosis, the choline level may be reduced. An increase in the Lac level and a decrease in the NAA and Cr peaks correlate with an increase in the degree of tumor malignancy [29, 30, 31].

New possibilities in diagnostics and studying the activity of the brain were opened by fMRI, which allows determining the relative position of a volumetric formation and functionally significant areas of the brain (motor, speech, visual), which is extremely important when planning surgical intervention, as well as during it to exclude damage to these areas. The method is based on the physiological phenomenon of neurovascular interaction (the relationship between neuronal activity and cerebral blood flow). The information obtained during the study is superimposed on anatomical data and can be presented in the form of color maps [32, 33, 34].

MR or diffusion tensor tractography is a modern neuroimaging technique that allows tracing the course of functionally significant pathways of the brain and the location of the tumor process relative to them. In neurosurgical practice, this method has significantly expanded the possibilities for determining the optimal volume of surgical intervention while minimizing the risks of developing severe neurological deficit in the postoperative period [35, 36].

Positron emission tomography combined with computed tomography (PET-CT) is an additional highly effective and modern diagnostic method, widely used throughout the world, allowing to identify the presence of a neoplasm, as well as to differentiate tumor tissue against the background of post-radiation necrosis and postoperative changes, to

exclude the presence of an inflammatory and demyelinating process. High accuracy of PET examination allows to avoid surgical interventions in case of negative and controversial results of CT and MRI (Fig. 3). PET allows to assess the degree of malignancy of a glial tumor by identifying zones of hypo- and hypermetabolism. In neurooncology, the most informative is PET-CT with such radiopharmaceuticals (RP) as 11C-methionine and 18F-fluorocholine, while hyperfixation of the RPP in the zone of the pathological formation is observed [37, 38].

MRI of the brain with contrast suggests a tumor growth site in the right frontal lobe (a), but MR perfusion (b) and PET-CT with 11C-methionine (c) data indicate post-radiation changes.

A decisive role in establishing a diagnosis, determining prognosis and further treatment tactics for patients with glial brain tumors is played by histological examination with the study of preparations stained with hematoxylin and eosin under a light microscope with a magnification of 100, 200 and 400 times. In doubtful cases, to establish the degree of tumor malignancy, it is possible to conduct an immunohistochemical analysis with the determination of the proliferative activity index by the expression of marker No. 67, as well as the study of such specific tumor proteins as GFAP (glial fibrillary acidic protein) and protein S100 for gliomas, epithelial membrane antigen (EMA) for ependymomas [39]. Material for determining morphology can be obtained during surgery to remove the tumor, as well as during stereotactic biopsy, which is used in cases where open surgery is inappropriate due to the localization and prevalence of the pathological focus, as well as in cases of difficult differential diagnosis of tumor, inflammatory and degenerative processes. The ability to perform express biopsy during surgery is of great importance in providing care to neuro-oncological patients. Histological criteria are set out in the WHO classification of CNS tumors, but the modern classification of 2016 is based on molecular genetic principles. Thus, morphological examination must be supplemented with molecular cytogenetic analysis, since some gliomas, despite common histological characteristics, may have significant differences at the genetic level (presence/absence of mutation in the IgG gene, complete deletion of 1p/gD for oligodendrogliomas, etc.) [40, 41, 42].

References:

1. Shakirov B. M. et al. Suicidal burns in Samarkand burn centers and their consequences //Annals of burns and fire disasters. – 2013. – T. 26. – №. 4. – C. 217.
2. Shakirov B. M. et al. SUICIDAL BURNS IN SAMARKAND BURN CENTERS AND THEIR CONSEQUENCES.
3. Хайитов У., Ахмедов Ю., Бегнаева М. Клинико-рентгенологическая картина септической пневмонии у детей //Журнал гепато-гастроэнтерологических исследований. – 2021. – Т. 2. – №. 3.2. – С. 35-36.

4. Яцык П. К. и др. Функциональное состояние фагоцитарной активности нейтрофилов и характер бактериурии у детей с хроническим обструктивным пиелонефритом //Урол. и нефрол. – 1986. – Т. 5. – С. 24.

5. Стреляева, А. В., Сапожников, С. А., Чебышев, Н. В., Эгамбердыев, Б. Н., Садыков, Р. В., & Ахмедов, Ю. М. & Шамсиев, АМ (2014). *Лечение эхинококкоза легких, осложненного пециломикозом, у взрослых больных. Хирургическая практика,(1)*, *4350*.

6. Стреляева, А. В., Сагиева, А. Т., Абдиев, Ф. Т., Садыков, Р. В., Садыков, В. М., Габченко, А. К., ... & Закирова, Ф. И. (2012). Поражение сердца при эхинококкозе печени у взрослых больных. *Медицинская паразитология и паразитарные болезни*, (4), 40-42.

7. Ишкабулов, Д. У., Ахмедов, Ю. М., Ишкабулова, Г., & Эргашев, А. (2008). Хроническая почечная недостаточностью детей: современные методы оценки течения, лечения и прогноза хронических заболеваний почек в стадии почечной недостаточности. *Вестник врача*, *1*, 73-83.

8. Akhmedov I. Y. et al. IS THE MEGAURETER THE PROBLEM OF YESTERDAY, TODAY OR TOMORROW? //European journal of molecular medicine. – 2021. – Т. 1. – №. 1.

9. Мавлянов Ш. Х. и др. Наша тактика в лечении ущемленных паховых грыж у детей //Российский вестник детской хирургии, анестезиологии и реаниматологии. – 2020. – Т. 10. – №. S. – С. 99-99.

10. Стреляева, А. В., Гаспарян, Э. Р., Сагиева, А. Т., Курилов, Д. В., Щеглова, Т. А., Зуев, С. С., ... & Ахмедов, Ю. М. (2011). Гомеопатические препараты в лечении преэклампсии, осложненной пециломикозом. *Традиционная медицина*, (4 (27) 2011), 23-28.

11. Ибрагимов, Э. К., Ахмедов, И. Ю., Мирмадиев, М. Ш., & Ахмедов, Ю. М. (2022). хирургическАя коррекция кист холедохА в детском возрАсте. *FORCIPE*, *5*(S1), 83-83.

12. Ахмедов Ю. М. и др. Особенности патологического протеолиза в развитии ожоговой пневмонии у детей //IVсъезд комбустиологов России: сб. науч. трудов. М. – 2013. – С. 44-45.

13. Шарков, С. М., Яцык, С. П., Фомин, Д. К., & Ахмедов, Ю. М. (2012). Обструкция верхних мочевых путей у детей. Союз педиатров России, Научный центр здоровья детей. *Москва*.

14. Ишкабулов Д. И., Ахмедов Ю. М. Наследственные заболевания почек //Нефро-урология у детей. – 2008. – С. 205-207.

15. Akhmedov Y. M. et al. X-ray planimetric methods for the diagnosis of obstructive uropathy in children //Saratov Journal of Medical Scientific Research. – 2007.

16. Ахмедов Ю. М., Сабиров Б. У., Мамышева Н. О. Местная тканевая реакция со стороны организма-носителя в зависимости от наличия патогенной микрофлоры в эхинококковых кистах //IBN SINO-AVICENNA. – 2005. – №. 1-2. – С. 13.

17. Яцык П. К., Ахметов Ю. М. Микрофлора мочи у детей с хроническим обструктивным пиелонефритом Ю. м. Ахмедов, ЛК Катосова //депонированная рукопись. – 1991. – С. 24.

18. Ахтамов М. А., Рахимов А. У., Ахмедов Ю. М. Применение продигиозана при хроническом гематогенном остеомиелите у детей //Хирургия. – 1985. – №. 7. – С. 92.

19. Ахмедов И. Ю. и др. ХИРУРГИЧЕСКИЕ МЕТОДЫ ЛЕЧЕНИЯ МОЧЕКАМЕННОЙ БОЛЕЗНИ В ПЕДИАТРИЧЕСКОЙ ПРАКТИКЕ (ОБЗОР ЛИТЕРАТУРЫ) //ЖУРНАЛ РЕПРОДУКТИВНОГО ЗДОРОВЬЯ И УРО-НЕФРОЛОГИЧЕСКИХ ИССЛЕДОВАНИЙ. – 2022. – Т. 3. – №. 3.

20. Джуракулов Ж. Д., Ахмедов И. Ю., Мирмадиев М. Ш. ДИАГНОСТИКА И ЛЕЧЕНИЕ ДИАФРАГМАЛЬНЫХ ГРЫЖ В ДЕТСКОМ ВОЗРАСТЕ //FORCIPE. – 2022. – Т. 5. – №. S1. – С. 65.

21. А. М. Ишанкулов, С. А. Аллазов, Ю. М. Ахмедов, Ж. А. Дарханов, О. А. Ишанкулов Удачный случай свободной реплантации суицидально ампутированного полового члена // Вестник экстренной медицины. 2013. №1.

22. Хаджибаев АМ А. Ю. М., Карабаев Х. К. др. Выбор лечебно-диагностической тактики при закрытой сочетанной абдоминальной травме //В сб.«Современная военно-полевая хирургия повреждений». Санкт-Петербург. – 2011. – С. 175.

23. Б. М. Шакиров, Ю. М. Ахмедов, К. Р. Тагаев, Х. К. Карабаев, Э. А. Хакимов Раннее хирургическое лечение глубоких ожогов тыльной поверхности стопы // Вестник экстренной медицины. 2011. №2.

24. Яцык П. К. и др. Функциональное состояние фагоцитарной активности нейтрофилов и характер бактериурии у детей с хроническим обструктивным пиелонефритом //Урол. и нефрол. – 1986. – Т. 5. – С. 24.

25. Ишкабулов Д. У. и др. Хроническая почечная недостаточностью детей: современные методы оценки течения, лечения и прогноза хронических заболеваний почек в стадии почечной недостаточности //Вестник врача. – 2008. – Т. 1. – С. 73-83.

26. Ахмедов Ю. М. и др. Особенности патологического протеолиза в развитии ожоговой пневмонии у детей //IVсъезд комбустиологов России: сб. науч. трудов. М. – 2013. – С. 44-45.

27. Атакулов, Б. М., Габченко, А. К., Садыков, В. М., Абдухалик-Заде, Г. А., & Ахмедов, Ю. М. (2006). Морфолого-экспериментальные исследования пневмонии у детей пециломикозной этиологии. *Проблемы хирургии, фармакологии, фармации и паразитологии*, 13-14.

28. Ахмедов Ю. М., Садыков В. М. Хирургическое лечение осложненного эхинококкоза //Проблемы биологии и медицины. – 2005. – №. 1. – С. 12-15.

29. Ахмедов Ю. М., Ахмеджанов И. А., Мавлянов Ф. Ш. Результаты лечения врожденного гидронефроза у детей //Современные технологии в оценке отдаленных результатов лечения урологической патологии у детей: Тезисы докладов науч.-практ. конф. детских урологов. М. – 2001. – Т. 68.

30. Мамадалиев А.М., Мамадалиева С.А. Значение фронто-темпорально-орбито-зигоматикального доступа для удаления менингиомы кавернозного синуса и крыла основной кости// Матер. Всеросс. НПК «Поленовские чтения». СПб. 2005. с.283-284.

31. Мамадалиев А.М. К гистологическим особенностям опухолей головного мозга//Матер. Всеросс. НПК «Поленовские чтения». СПб. 2010. с.266

32. Norkulov N.U., Mamadaliev A.M., Shodiev A.Sh. The importance of neurological symptoms of mild traumatic brain injury for clinical and forensic assessment of patients. *Vrach-aspirant*. 2012;4.2 (53):245-249. (In Russ.).

33. Норкулов Н.У., Мамадалиев А.М., Шодиев А.Ш. Значение неврологической симптоматики легкой черепно-мозговой травмы для клинической и судебно-медицинской оценки состояния больных. Врач-аспирант. 2012;4.2 (53):245-249.

34. Ravshanov Davron Mavlonovich Some Features of the Clinical Course of Parasagittal Meningiomas of the Brain, *Asian Journal of Case Reports in Medicine and Health*, Page 19-23

35. Abdukholikovich A. M., Mamatkulovich M. A., Abdurakhmonovna M. S. The study of the improved complex neurosurgical treatment in patients with posttraumatic chronic subdural hematomas and hygromas //European science review. – 2016. – №. 1-2. – С. 28-32.

36. Abdukholikovich A. M., Mamatkulovich M. A., Abdurakhmonovna M. S. The study of the results of endolumbal insufflation of ozone and pyracetam in the treatment of posttraumatic epilepsy //European science review. – 2015. – №. 11-12. – С. 29-32.

37. Ravshanov D. M. Optimization of the Results of Surgical Treatment of Parasagittal Meningiomas of the Brain //Texas Journal of Medical Science. – 2022. – Т. 10. – С. 48-51.

38. Ravshanov D. M. Optimization of the Results of Surgical Treatment of Parasagittal Meningiomas of the Brain //Texas Journal of Medical Science. – 2022. – Т. 10. – С. 48-51.

39. Norkulov N. U., Shodiev A. Sh., Ravshanov D. M. Determination of the efficacy of the use of nootropes in the treatment of brain concusion in the acute period https://doi.org/10.17605/OSF.IO/JQF9S

40. Шодиев А. и др. К особенностям клинического течения и лечения нетравматических внутримозговых кровоизлияний у детей //Журнал проблемы биологии и медицины. – 2018. – №. 2.1 (101). – С. 128-131.

41. Шодиев, А. Ш., Ш. И. Абдувалиев, and З. С. Пардаева. "К ВОПРОСУ КЛИНИЧЕСКОГО ТЕЧЕНИЯ И ЛЕЧЕНИЯ НЕТРАВМАТИЧЕСКИХ ВНУТРИМОЗГОВЫХ КРОВОИЗЛИЯНИЙ У ДЕТЕЙ." *XX ДАВИДЕНКОВСКИЕ ЧТЕНИЯ*. 2018.

42. Абдувалиев, Ш. И., А. Ш. Шодиев, and З. С. Пардаева. "НЕКОТОРЫЕ ОСОБЕННОСТИ КЛИНИЧЕСКОГО ПРОЯВЛЕНИЯ НЕТРАВМАТИЧЕСКИХ ВНУТРИМОЗГОВЫХ КРОВОИЗЛИЯНИЙ У ДЕТЕЙ." *XX ДАВИДЕНКОВСКИЕ ЧТЕНИЯ*. 2018.