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# OPTIMIZATION OF CRANIOPHARYNGIOMAS SURGICAL TREATMENT THROUGH INTRAOPERATIVE MONITORING OF VISUAL EVOKED POTENTIALS

**Uygun U. Altybayev [1], Alisher M. Sultanov [2], Jaxongir Z. Yo'ldoshev [3], Gulrux T. Achilova [4]**

***1*** Head of the Neuro-oncology Department of the Republican Specialized Scientific and Practical Medical Center of Neurosurgery, Tashkent, Uzbekistan

***2*** Doctor of neurophysiologist of the Republican Specialized Scientific and Practical Medical Center of Neurosurgery, Tashkent, Uzbekistan

***3*** Postgraduate student of the Republican Specialized Scientific and Practical Medical Center of Neurosurgery, Tashkent, Uzbekistan

***4*** Assistant, department of neurosurgery,
Tashkent Pediatric Medical Institute, Tashkent, Uzbekistan
E-mail: neuroxirurg1983@gmail.com

## ABSTRACT

This study explores the optimization of surgical treatment for craniopharyngiomas through intraoperative monitoring of visual evoked potentials (VEP). The aim was to enhance the safety and effectiveness of tumor removal by providing an objective assessment of the visual system's functional state during surgery, particularly in cases where the tumor is in close proximity to the optic nerves and chiasm. A total of 59 patients were divided into two groups: a control group that underwent standard surgical treatment and a main group in which intraoperative VEP monitoring was additionally applied. Comparative analysis demonstrated that VEP monitoring significantly improved visual acuity and field expansion, reduced postoperative visual impairments, and increased the precision of tumor resection. The findings confirm the effectiveness of intraoperative VEP monitoring in craniopharyngioma surgery, supporting its broader use to minimize neurological complications and improve functional outcomes for patients.

**Key words:** craniopharyngioma, visual evoked potentials, visual acuity, visual fields, intraoperative monitoring.

## INTRODUCTION

Craniopharyngiomas account for 30% of all tumors in the chiasmatic-sellar region [2]. The location of the tumor in the direct nearness to the optic nerves and

chiasm, to formations of the bottom of the third ventricle, as well as to the internal carotid arteries and their main branches causes extraordinary difficulty of surgical treatment of such patients [5]. The degree of radicality of craniopharyngiomas resection is determined to a large extent by physiological allowance of surgical manipulations in the brain structures during the separation of tumor from them. The timely definition of the limits of such interference causes significant influence on the treatment results [4].

At the present time the method of registration of visual evoked potentials (VEP) acquires broad usage in clinical practice as a method allowing to get objective information about the visual system condition without patient's verbal report, which is especially important when a patient is unconscious during an operation [1]. As nowadays there is no common opinion on using intraoperative monitoring of the visual analyzer function during the removal of tumor [6, 8], the decision to conduct the present research was made. In this article we introduce the results of our research that was directed at the study of effectiveness of using intraoperative monitoring of visual evoked potentials in patients with craniopharyngiomas.

**THE PURPOSE OF RESEARCH.**

To optimize the results of surgical treatment of patients with craniopharyngiomas by way of using intraoperative monitoring of visual evoked potentials.

**MATERIAL AND METHODS OF RESEARCH.**

The study is based on the results of observation of 59 patients with craniopharyngiomas, that got treatment in the Republican Scientific Centre of Neurosurgery during the period from 2016 to 2023; the patients were divided into two groups: - in the first group – the control group (30 patients) - the tumors were removed; - in the second group – the main group (29 patients) - in addition to the tumor removal intraoperative monitoring of visual evoked potentials to a flash was used. The investigated groups were comparable in age, social factors and accompanying diseases, besides that, the neuro-ophthalmic symptoms of every patient were analyzed in details. The chiasmatic syndrome (the decrease of visual acuity and/or visual fields defect) was diagnosed in all patients in the both groups. 30 (51,1%) patients had visual disorders as the first sign of craniopharyngioma.

For more clearness, because of the difficulty of visual disorders assessment, we studied visual acuity and visual fields defects for each eye separately (90 eyes in the sum in the both groups of patients). On the basis of the research results during the preoperative and postoperative period comparative analysis of neuro-ophthalmic symptoms dynamics was conducted in the patients of the control group

and in the group where intraoperative monitoring of visual evoked potentials was used.

**RESULTS AND DISCUSSION**

In resolving the problem of visual functions disorders in the surgery of tumors in the chiasmatic-sellar region considerable importance belongs to using modern informative methods of diagnostics, microsurgical technique, principles of neuroanesthesiology and neurological life support. The questions of optimal neurosurgery technique and tactics of preserving anatomical wholeness of the optic nerves and chiasm, unlike their functional preservation, are described in detail in modern literature, although intraoperative monitoring of visual analyzer function allows to reduce the amount of neuro-ophthalmic complications in the postoperative period [8].

The usage of neurophysiological monitoring during neurosurgical operations should be thoroughly studied. Intraoperative neurophysiological monitoring of the optic nerves and chiasm is an important element of the surgery of tumors in the chiasmatic-sellar region, it allows to prevent dangerous manipulations. During tumor removal a neurosurgeon obtains information from neuromonitoring in order to control function of visual analyzer structures. The information obtained from intraoperative monitoring of visual evoked potentials allows to differentiate the intensity of the structure-functional influences on the parts of the visual analyzer close to the tumor [1, 3, 7]. The timely assessment of the degree of intraoperative interference, the changes of transmission in the optic nerves and chiasm, obtained by monitoring, leads to changing of surgical methods for decreasing the cases of irreversible damages of the peripheral neuron of the optic pathway, caused by operative interference [2]. We have assessed the dynamics of visual function (visual acuity, visual fields) in patients with craniopharyngiomas during the early postoperative period. The dynamics of visual acuity and visual fields were investigated separately. In the control group improvement of visual acuity was detected in 32,6% of patients, without dynamics in 45,65% and deterioration in 21,74%. In the basic group: improvement of visual acuity was observed in 63,64% of patients, without dynamics in 36,36%, deterioration of visual acuity was not detected. The result in the group with intraoperative monitoring is 1,95 times better than in the control group. In the first group the average visual acuity in the early postoperative period compared with preoperative level improved to 0,12; in the second group the results are significantly better – improvement of the visual acuity to 0,22. Improvement of the visual acuity (with optic correction) in the early postoperative period as well was more often observed in the second group of patients to 0,1.

The dynamics in visual fields was analyzed in the postoperative period in the two groups of patients. In the control group widening of visual fields limits was observed in 19,56% of patients, without dynamics in 56,52% and deterioration in 23,91%. In the second group: improvement was detected in 75,0% of patients, without dynamics in 25,0%, deterioration was not observed. In the control group the number of patients with normal visual field or partial temporal hemianopsia was increased from 56,52% to 60,87% (A = 4,35%), the number of patients with visual field remnants was reduced from 13,04% to 6,5% (A = -6,54%), in one case amaurosis occurred. In the group with neuromonitoring the amount of eyes with normal visual field or partial temporal hemianopsia also increased from 18,18% to 81,81% (A = 63,64%), in 2 eyes of patients with visual field remnants the visual field widened, complete vision loss after the operation was not detected. All the patients in the group with intraoperative monitoring of visual analyzer's function had visual field widened in postoperative period more than in the control group of patients.

Therefore, the analysis of the data of our investigation shows that using intraoperative monitoring of visual evoked potentials allows to improve the results of craniopharyngiomas treatment by way of decreasing the amount of visual disorders in the postoperative period. In the process of craniopharyngiomas removal the anatomical relevance between the peripheral part of the visual analyzer and the tumor doesn't give way to estimate completely physiological allowance of surgical manipulations, therefore intraoperative neurophysiological monitoring should be conducted. During operation it is necessary to consider the functional condition of the optic nerves and chiasm, so that the degree of radicality of surgical treatment must not exceed the admissible neurophysiological allowance of intraoperative interference in the cerebral structures. In case of changing visual evoked potentials it is necessary to stop the tumor removal and the selection of the visual analyzer structures. If the changes are not stopped, it is recommended to limit the surgical interference. The conducted research shows that registration of visual evoked potentials significantly increases the abilities of clinical analysis of neurophysiological allowance of surgical manipulations, as the changes of the amplitude and latency of the peak P100 broaden the abilities of intraoperative prognosis of the course of the postoperative period and prevent the irreversible changes in the visual analyzer structures from development. It is necessary to spread intraoperative monitoring of visual evoked potentials in the surgery of tumors in the chiasmatic-sellar region not only for earlier diagnostics of visual disorders, but for earlier assessment of surgical treatment effectiveness. The usage of the method of monitoring, providing good results of treatment in such category

of patients, is considered productive in spite of additional financial expenses. In the end of operation, the normalization of amplitude-temporal parameters of the peak P100, together with previous to it decreasing in latency and increasing in amplitude gives a neurosurgeon the information about favorable prognosis in respect of vision. Pathological changes of VEP in the stage of finishing of the operation shows the possibility of unfavorable result of the surgical interference. Sharp decreases in amplitude and normalization in latency of P100 is the sign of ischemia of the optic nerves and chiasm.

## CONCLUSION

The conducted analysis of research dedicated to neurophysiological control of visual function allows us to make a conclusion about the worthwhileness of using intraoperative monitoring of visual evoked potentials in all stages of surgical removal of craniopharyngiomas located near the optic nerves and chiasm. During craniopharyngiomas removal the method of intraoperative monitoring of visual evoked potentials is recommended to be used in everyday practice in neurosurgical clinics.

## REFERENCES

1. Algattas, H., Setty, P., Goldschmidt, E., Wang, E. W., Tyler-Kabara, E. C., Snyderman, C. H., & Gardner, P. A. (2020). Endoscopic endonasal approach for craniopharyngiomas with intraventricular extension: case series, long-term outcomes, and review. *World Neurosurgery*, 144, e447-e459.

2. Alexandrov N.Yu**.** Evoked potentials in diagnostics of the nerve system damages. – 2001.

3. Anikin S.A**.** The effectiveness of intraoperative monitoring of visual evoked potentials in the surgery of tumors in the chiasmatic-sellar region. 2009.

4. Bosnjak, R. Direct epidural electrical stimulation of the optic nerve: a new method for intraoperative assessment of function 2008. consequences of an initial endonasal endoscopic approach for resection of craniopharyngiomas. *Neurosurgical Focus*, 28(4), E8.

5. Bernstein, M. Neuro-oncology / M. Bernstein, M.S. Berger. – New York: Stuttgart, 2005. - 490 p.

6. Campbell, P. G., McGettigan, B., Luginbuhl, A., Yadla, S., Rosen, M., & Evans, J. J. (2010). Endocrinological and ophthalmological Zhu, H., Qiao, N., Yang, X., Li, C., Ma, G., Kang, J., Liu, C., Cao, L., Zhang, Y., & Gui, **S.** (2022). The clinical application of intraoperative visual evoked potential in recurrent craniopharyngiomas resected by extended endoscopic endonasal surgery. *Clinical Neurology and Neurosurgery*, 214, 107149. pubmed.ncbi.nlm.nih.gov

7. Gnezditskiy V.V. Evoked potentials in clinical practice. 2003.

8. Hong, C. S., Gerstl, J. V., Corrales, C. E., Smith, T. R., & Ritzl, E. K. (2024). Monitoring of visual-evoked potentials during fat packing in endoscopic resection of a giant pituitary adenoma. *Surgical Neurology International*, 15, 387.

9. Hasimoto, I. Recent Advances in Human Neurophysiology/ I. Hasimoto, R. Kakigi // Int. Evoked Potential. Symp. Okazaki. - Japan, 1998. - P.234-238.

10. Miyagishima, T., Tosaka, M., Yamaguchi, R., Nagaki, T., Ishii, N., Kojima, T., & Yoshimoto, Y. (2019). Extended endoscopic endonasal resection of craniopharyngioma using intraoperative visual evoked potential monitoring: technical note. *Acta Neurochirurgica*, 161(11), 2277-2284. link.springer.com

11. Kamio, Y., Sakai, N., Sameshima, T., Takahashi, G., Koizumi, S., Sugiyama, K., & Namba, H**.** (2014). Usefulness of intraoperative monitoring of visual evoked potentials in transsphenoidal surgery. *Neurologia Medico-Chirurgica*, 54(8), 606-611.

12. Kinney, G. Intraoperative neurophysiological monitoring technology: recent advances and evolving uses 2007.

13. Oda, Y., Amano, K., Chiba, K., Aihara, Y., & Kawamata, T**.** (2024). Pediatric craniopharyngioma with significantly increased intraoperative visual evoked potential amplitude and postoperative visual acuity improvement: a case report. *Child's Nervous System*, 40(9), 2967-2971.

14. Tao, X., Fan, X., Gui, S., Liu, J., Yang, X., Li, K., Yang, J., Li, C., & Qiao, H. (2023). Efficacy of intraoperative visual evoked potential amplitude reduction in predicting visual outcome after extended endoscopic endonasal resection of craniopharyngiomas. *Journal of Neurosurgery*, 140(5), 1270-1275. pubmed.ncbi.nlm.nih.gov

15. Tosaka, M., Sato, N., Fujimaki, T., & Yoshimoto, Y. (2012). Intraoperative monitoring of visual evoked potentials during transsphenoidal surgery for sellar and suprasellar tumors. *Journal of Neurosurgery*, 117(2), 279-284.

16. Qiao, N., Yang, X., Li, C., Ma, G., Kang, J., Liu, C., Cao, L., Zhang, Y., & Gui, **S.** (2021). The predictive value of intraoperative visual evoked potential for visual outcome after extended endoscopic endonasal surgery for adult craniopharyngioma. *Journal of Neurosurgery*, 135(6), 1714-1724. thejns.org