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Research Article

Efficiency of Laser Treatment of Optic Disc Pit Maculopathy in Children

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Abstract

Purpose: To analyze the anatomical and functional results of laser treatment of ODP-M in children.

Material and Methods: The object of the study was 17 children aged 5-16 years with an ODP-M. All children underwent barrier retinal laser coagulation (1-3 sessions): coagulants with a diameter of 200 microns of the 2nd degree were applied without gaps in 2-3 rows in the area of oedema and retinal detachment along the temporal edge of the optic disk from and to the adjacent retina. In addition to the standard ophthalmological examination, all children underwent optical coherence tomography (OCT) of the macula before and during the follow-up period ranged from 2 to 13 months.

Results: After barrier retinal laser coagulation, 10 children had a decrease in the elevation of the retina in the macular zone from 32 to 602 microns. According to OCT data, the "starting" value of the maximum elevation of the retina in the macula in this group averaged 525 ± 140 microns. Complete resorption of subretinal fluid was observed in 3 children for a period of 5 months to 1 year 3 months after the first laser coagulation. Best corrected visual acuity (BCVA) remained stable in 5 children, increased by 0.04-0.6 in 4 children, decreased by 0.1 in 1 child. There was no positive dynamics of resorption of subretinal and intraretinal fluid after barrier retinal laser coagulation in 7 children, and they underwent pars planum vitrectomy with gas tamponade. The "starting" value of the maximum elevation of the retina in the macula in this group averaged 811 ± 43 microns ($p < 0.01$).

Conclusion: The high efficiency of laser treatment of ODP-M in children with its certain quantitative parameters (maximum elevation of the retina in the macula is ≤525 microns) before treatment has been demonstrated.

Keywords: Optic Disc Pit; Macular Retinal Detachment; Retinal Barrier Laser Coagulation

Abbreviations

BCVA: Best Corrected Visual Acuity; OCT: Optical Coherence Tomography; ODP: Optic Disc Pit; ODP-M: Optic Disc Pit Maculopathy

Introduction

The optic disc pit (ODP) is a rare congenital anomaly (an estimated incidence of 1 in 11,000 people), clinically representing an oval notch of gray–white color, most often located in the temporal or lower temporal segment of the disc, less often in the center or along the nasal border [1,2]. In 85% of cases, the pathology is unilateral. Uncomplicated ODP usually proceeds asymptomatically and is often an accidental finding during routine ophthalmological examination. The development of serous macular detachment (ODP-M), which is a sign of a complicated course, is accompanied by a decrease in visual acuity [2]. The frequency of this complication, according to various researchers, ranges from 25 to 75% and most often falls on the 2nd-4th decade of life [1,3,4]. The persistence of macular detachment leads to the development of cystic changes, lamellar or full-layered macular holes, atrophy of the pigment epithelium [5,6].

The origin of the subretinal and intraretinal fluid, as well as the mechanism of ODP-M are still unclear [7-9]. According to theories, the source may be the vitreous, choroid, as well as the vessels of the ODP, however, most scientists believe that the liquid is a liquor coming subretinally and intraretinally from the subarachnoid space through the defect of optic disk. It was shown using optical coherence tomography (OCT), that there is a direct connection between the subarachnoid space and the subretinal space [10]. Another proof confirming this concept is the fact of gas bubbles seeping under the optic nerve membranes after vitrectomy with gas tamponade [11] and intracranial migration of silicone oil after vitreoretinal interventions in patients with ODP-M [12].

What is the trigger for the development of macular complications in the ODP? This question also remains open [13]. As mentioned earlier, the "complication" of the ODP develops in the 2nd-4th decade of life (more often in the 3rd-4th), which coincides with the time of the onset of progressive destruction of the vitreous. Thus, it has been suggested that vitreal traction is the basis for the development of macular complications of the ODP. Moreover, spontaneous resolution of macular edema after complete posterior vitreous detachment has been described [14]. However, the facts that cast doubt on this theory are the development of complications of the ODP in children before the onset of any changes in the vitreous, as well as relapses of macular edema and macular detachment after microinvasive vitrectomy. In addition, several OCT studies have been conducted that have not demonstrated any evidence of vitreous traction in ODP-M [15]. Another theory is that the migration of fluid into the subretinal space is caused by a pressure gradient inside the eye. Normally, the eye is a closed system with no significant differences in pressure between departments. There may be a pressure gradient in an eye with ODP, since intracranial pressure is "transmitted" to the ODP through the cerebrospinal fluid. Thus, when the intracranial pressure is low vitreous fluid is drawn into the ODP, and when it rises the fluid is pushed back into the eye, and can dissect under or within the retina [15].

There is no generally accepted differentiated approach to treatment of ODP-M due to the lack of clear ideas about the its pathogenesis. The question of correlation of anatomical and functional results of various treatment methods remains open, as well as the analysis of factors influencing the success of the intervention.

The purpose to analyze the anatomical and functional results of the laser treatment of ODP-M in children.

Material and Methods

The object of the study was 17 children (8 boys and 9 girls, ages 5-16 years) with ODP-M who were treated in the department of eye pathology of children «Helmholtz National Medical Research Center of Eye Diseases» from 2009 to 2022.

The ODP was unilateral in 14 children (82,3%) - in 6 children on the right eye, in 8 children on the left eye. The pathological process was bilateral in 3 children, while the complications were bilateral in 1 child.

The age of development of the ODP-M was from 4.5 to 14.5 years (mean 9,3 ± 3 years), and in 10 children (58,8%), the complication was diagnosed in the first decade of life. The estimated duration of the existence of ODP-M before the start of treatment ranged from 3 months to 4 years (the period from diagnosis at the place of residence to consultation at the Helmholtz National Medical Research Center of Eye Diseases). This period was within 1 year in 14 children (82,3%).

All children underwent optical coherence tomography (OCT) of the macular in addition to the standard ophthalmological examination (visometry, autorefractometry, tonometry, biomicroscopy, ophthalmoscopy).

Neuroepithelial detachment was combined with intraretinal a reflective cavities in 16 children. Isolated neuroepithelial detachment was observed in 2 children.

The maximum elevation of the macular before treatment ranged from 346 to 1026 microns. This parameter did not depend on the duration of macular changes.

The best corrected visual acuity (BCVA) was 1.0 in all children before the development of the macular complication. At the time of the appeal, this indicator ranged from 0.01 to 0.8.

All children underwent retinal barrier laser coagulation (1-3 sessions). Laser coagulants with a diameter of 200 microns of the 2nd degree were applied without gaps in 2-3 rows in the area of oedema and retinal detachment along the temporal edge of the optic disk from and to the adjacent retina.

All parameters of the ophthalmological status were evaluated before and during follow-up period (from 2 to 13 months).

Statistical data analysis was carried out in the IBM SPSS Statistics program (version 22) and using the statistical package Microsoft Excel. To determine the statistical significance of the results obtained, the nonparametric Mann-Whitney U-test (U-test) was used. Differences were considered statistically significant at $p < 0.05$. Data are presented as mean ± standard deviation (mean ± SE).

Results

After barrier retinal laser coagulation, 10 children had a decrease in the elevation of the retina in the macular zone from 32 to 602 microns. According to OCT data, the "starting" value of the maximum elevation of the retina in the macula in this group averaged 525 ± 140 microns (from 346 to 882 microns). Complete resorption of subretinal fluid was observed in 3 children for a period of 5 months to 1 year 3 months after the first laser session (Figure 1a, b).

Figure 1a: Optical coherence tomography of the macular zone before treatment. The elevation of the retina is 270 microns.

Figure 1b: Optical coherence tomography of the macular area of the retina 5 months after retinal barrier laser coagulation. Complete resorption of subretinal fluid.

Best corrected visual acuity (BCVA) remained stable in 5 children, increased by 0.04-0.6 in 4 children, decreased by 0.1 in 1 child.

There was no positive dynamics of resorption of subretinal and intraretinal fluid after barrier retinal laser coagulation in 7 children, and they underwent pars planum vitrectomy with gas tamponade. According to OCT data, the "starting" value of the maximum elevation of the retina in the macula in this group averaged 811 ± 43 microns (from 687 to 1026 microns) ($p < 0.01$).

Multifactorial analysis showed that the anatomical outcome of the interventions was determined by the formation of a chorioretinal scar preventing the flow of fluid from the fovea into the subretinal and intraretinal space, and the functional prognosis depended on the degree of preservation of photoreceptors and pigment epithelium in the fovea. At the same time, there was no relationship between the estimated duration of retinal detachment and the elevation of the retina with the dynamics of visual acuity after treatment.

Discussion and Conclusion

The goal of most available approaches to the treatment of ODP-M is to block the flow of fluid from the ODP into the intraretinal and subretinal space of the macular zone or an attempt to create conditions for its continuous drainage. "Barrier" laser coagulation of the retina, vitrectomy with or without inner limiting membrane peeling, isolated gas tamponade of the vitreal cavity, as well as various combinations of the presented methods, removal of glial tissue and tamponade of the ODP with various biological substrates (autologous fibrin, amnion, sclera, etc.) are performed. Alternative methods are macular buckling surgery, internal fenestration of the retina [16]. Conservative treatment, including dehydration therapy and topical use of corticosteroids, as a rule, does not lead to resolution of macular changes [15]. Also, isolated cases of spontaneous resorption of subretinal fluid in the fovea are described [17,18].

In recent years, par planum vitrectomy with the gas tamponade is increasingly considered the "gold standard" for the treatment of ODP-M. However, taking into account the risk of intra- and postoperative complications, as well as ambiguous results (anatomical success of surgical treatment varies from 50% to 95%, while an increase in visual acuity is noted in about 50%) [16], a number of authors prefer barrier laser coagulation as the first intervention. At the same time, there are a number of unresolved issues regarding the criteria for evaluating its effectiveness, as well as the risk of damage to the papillary-macular bundle.

According to the results of our study, we consider it expedient to attempt barrier laser coagulation of the retina at a height of elevation of the retina in the macular zone of no more than 525 microns. We have demonstrated the high efficiency of this approach to the treatment of ODP-M in children. It is important to note that the resorption of subretinal and intraretinal fluid observed occurs for quite a long time (from 3 months to 3 years) after interventions, which requires dynamic monitoring.

Competing Interests

Authors declare to have no competing interest.

Autor Contribution

- Katargina L.A. - concept and design of the study, scientific editing, approval of the final version of the article;
- Denisova E.V. - laser coagulation, scientific editing;
- Demchenko E.N. - examination of patients, laser coagulation, scientific editing;
- Osipova N.A. - examination of patients, laser coagulation, writing of text, design of bibliography, responsibility for the integrity of all parts of the article, performed the statistical analysis.

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