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Vitreoretinal interface changes after uncomplicated phacoemulsification

Промене на нивоу витреоретиналне додирне површине након
некомпликоване факоемулзификације

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Vitreoretinal interface changes after uncomplicated phacoemulsification

Промене на нивоу витреоретиналне додирне површине након некомплицоване факоемулзификације

SUMMARY

Introduction/Objective The aim of this work was to examine the incidence of posterior vitreous detachment (PVD) after uncomplicated phacoemulsification, as well as the importance of optical coherence tomography (OCT) in detecting early changes on vitreoretinal interface.

Methods PVD was evaluated in 120 eyes of 120 patients by the combination of OCT and ultrasonography immediately prior and 1, 6, and 12 month after the phacoemulsification cataract surgery with intraocular lens implantation.

Results The mean age was 57.0 ± 8.8 years in female and 58.6 ± 8.8 years in male subjects. The progress statuses of were compared after cataract surgery at three time points: after 1, 6, and 12 months. Significant progression of PVD in time was confirmed ($\chi^2=78.32$, $p<0.001$). The Wilcoxon test determined that after 6 months ($p<0.001$) and 12 months ($p<0.001$) the disease progression was statistically significant in comparison to measurements after 1 month. Also, after 12 months, in relation to progression status established after 6 months, there was significant progression of the disease ($p<0.001$).

Conclusion Vitreous body detachment after phacoemulsification surgery is common, and OCT plays a very important role in detecting initial changes on vitreoretinal interface.

Keywords: posterior vitreous detachment; phacoemulsification; optical coherence tomography

САЖЕТАК

Увод/Циљ Циљ рада је био испитати учесталост задње аблације стакластог тела (ЗАСТ) после некомплицоване операције катакркте методом факоемулзификације, као и важност оптичке кохерентне томографије (ОКТ) у детекцији раних промена на витреоретиналној површини.

Метод ЗАСТ је евалуирана код 120 очију од 120 болесника комбинацијом ОКТ и ултрасонографије непосредно и после 1, 6 и 12 месеци од операције катакркте методом факоемулзификације са имплантацијом интраокуларних сочива.

Резултати Средња старост је била 57.0 ± 8.8 код женских и 58.6 ± 8.8 година код мушких испитаника. Стање прогресије је поређено након операције катакркте у три временска периода: после 1, 6 и 12 месеци. Уочена је висока статистичка значајност у напредовању ЗАСТ током времена ($\chi^2=78.32$, $p<0.001$). Вилкоксонов тест је показао високо статистички значајне разлике у детектованим променама после 6 месеци ($p<0.001$) и после 12 месеци ($p<0.001$) у односу на налаз после 1 месеца. Такође и после 12 месеци у односу на налаз после 6 месеци ($p<0.001$).

Закључак ЗАСТ после операције катакркте методом факоемулзификације је честа појава и ОКТ има важну улогу у откривању иницијалних промена на нивоу витреоретиналне површине.

Кључне речи: задња аблација стакластог тела; факоемулзификација; оптичка кохерентна томографија

INTRODUCTION

The vitreous body is the clear gel that comprises more than $\frac{3}{4}$ of the eye. It is a reservoir for lens nutrients. Human vitreous body is composed mainly of water (99%), meshwork of collagen fibrils with proteoglycans and glycosaminoglycans, among which hyaluronic acid is the most important for metabolism. These components at such a concentration form a gel-like structure of the vitreous body, maintain viscosity and provide transparency necessary for achieving maximum visual acuity [1]. In the middle of the last century the role of the vitreous body was minimally recognized, but it is well known nowadays that in vitreous body, as well as in many other human tissues, intensive chemical processes occur and cause the changes of its structure. Its structure is just seemingly simple, but the tissue of the same structure has not been synthesized yet.

Hydrated molecules of hyaluronic acid are the primary location for accumulation of bonded water in the vitreous body. Bonded water is converted into free water by aging process, resulting in

reduced viscosity of hyaluronic acid, followed by reduced viscosity of the vitreous body. It is believed that the process of liquefaction is more pronounced in individuals with nuclear cataract.

The outermost layer of the vitreous body is called the posterior vitreous cortex (PVC) and completely adheres to internal limiting membrane (ILM) of the retina. Posterior vitreous detachment (PVD) is defined as the detachment of posterior vitreous cortex from inner limiting membrane of the retina and it is one of the most characteristic signs of the aging process of the eye [2]. PVD is a slow progressive process induced by liquefaction of the vitreous gel in front of the macula [3]. It begins in perifoveal macula, with posterior vitreous cortex separation from the retinal ILM, thus forming lacunae spaces that coalesce and enlarge. Then, aqueous vitreous through hyaloid, Cloquet's canal causes hydrodissection of the posterior vitreous cortex from internal limiting membrane and forms retrohyaloid space [4].

At this phase the vitreous cortex is still attached in the foveal region and is defined as Foveal adhesion. Foveal adhesion has clinical relevance for the conditions such as vitreomacular traction, diabetic macular edema, macular holes, and exudative age-related macular degeneration, since they have an impact on visual acuity and direct correlation with the pathogenesis of the pathological process in the posterior pole of the eye [5].

In youth, collagen fibers are firmly attached to internal limiting membrane by macromolecules such as laminin, fibronectin, and chondroitin, thus enabling a tight connection between the vitreous body and the retina.

Besides increasing age, PVD may result from myopia, infections and inflammations, intraocular drug application, laser treatment, eye trauma, and cataract surgery as well [6].

B-scan ultrasonography has long been considered a superior method for defining PVD, especially in patients with blurred optical media. In patients with vitreous cortex with less distance than 2mm from the retina, the resolution of standard devices of this kind does not grant the visualization of the process and may be unrecognized at early stages. Today, the introduction of optical coherence tomography method (OCT) not only enables more precisely the diagnosis of PVD, but also determination of early, previously unrecognized vitreous body detachment, and determination of the stages of the process occurring at PVC-ILM interface as well [7,8]. Hoehn reported in his study that OCT showed early detachment stage in 27.7% of the eyes, although B-scan US showed normal results.

There are 5 distinct stages of PVD ^[9]: stage 0 -characterized by no PVD, stage 1-focal perifoveal posterior vitreous detachment involving 1-3 quadrants over the fovea, stage 2 - perifoveal posterior vitreous detachment in all 4 quadrants over the fovea, stage 3 -complete detachment of the posterior vitreous cortex from the fovea, with persistent attachment to the optic nerve head (ONH) and midperipheral retina and stage 4 - vitreous is completely detached from the fovea, as well as from ONH and fundus mideperiphery.

The aim of this work was to examine the incidence of PVD after uncomplicated phacoemulsification, as well as the importance of OCT in detecting early changes on vitreoretinal interface.

METHODS

All participants underwent complete ophthalmological examination from June 2014 to June 2016 at the Ophthalmology Eye Hospital-Clinic Maja, Nis, Serbia. This study was approved by the Institutional Ethics Committee, following the tenets of the Declaration of Helsinki with informed consent obtained from all the participants. The study comprised 120 eyes of 120 patients aged between 50 and 70 years. Before the operation all the patients signed the written informed consent on using their parametric values in the study and on potential intraoperative complications.

Preoperatively, all the patients underwent the same, routine procedure involving determination of the best corrected visual acuity, measurement of intraocular pressure by applanation tonometry, examination of anterior and posterior eye segment using biomicroscopy with indirect ophthalmoscopy. All the patients also underwent high resolution optical coherence tomography (Cirrus; Carl Zeiss Meditec) and ultrasound by using 10MHz probe (SONOMED E-Z).

Inclusion criteria were the presence of age-related cataract in patients over 50 years of age, visual acuity greater than 0.1, axial length of the eye from 22mm to 25mm, absence of PVD, or the presence of the initial stage of PVD. The patients excluded from the study had already present a) macular pathologies, such as epiretinal membrane, macular holes, or age-related macular degeneration, b) vascular occlusion of retinal blood vessels or retinal dystrophy, c) confirmed presence of glaucoma or uveitis, d) amblyopic eyes, e) previous intraocular surgeries or laser interventions, f) local or systemic therapy with corticosteroids or diuretics that can affect vitreoretinal surface and macular thickness, g) diabetes and other systemic diseases that affect vision, h) patients in whom the quality of the OCT scan was inadequate for interpretation, i) intraoperative complications and j) incomplete follow-up.

On the ultrasound, detached posterior cortex is presented as low reflective membrane that floats into vitreous cavity. When interpreting OCT scan findings, discrete linear signal adjacent to inner retina is defined as detachment of posterior vitreous cortex.

All the patients were operated by the same, experienced surgeon. Ultrasonography and OCT examinations were performed by another surgeon in order to obtain objective findings.

One day prior to surgery, ofloxacin drops (Uniflox, Unimed Pharma) were applied to all the patients. The surgery was performed under topical anaesthesia using tetracain 0.5% (Tetracaine Hydrochloride 0.5% drops by Bausch & Lomb) after the patients received tropicamide 1% drops (Mydracyl 1%, Alcon) every 10 minutes for four times. The surgical method was stop and chop phacoemulsification with OZIL probe on Infiniti Vision System apparatus (Alcon Inc), along with flexible lens implantation into the capsular bag. Patients with any intraoperative complications, such

as posterior capsule rupture, vitreous loss or prolapse, were not included in the results of the study. The patients were scheduled for check-ups at days 1 and 7 after the intervention, then at 1, 6 and 12 months.

Biomicroscopy, optical coherence tomography and ultrasonography were performed immediately prior the intervention, then according to the protocol at 1, 6 and 12 months after the intervention.

Statistical analysis

Statistical data processing was performed in statistical software package SPSS 22 for Windows. Primarily obtained results were analyzed using descriptive statistics methods and hypothesis tests method. Descriptive statistical methods used included measures of central tendency, measures of variability and structure indicators expressed in percentage. For determination of normal distribution, coefficient of variation CV, values of scunis (“skewness”) and kurtosis (“peakedness/flatness”), the Kolmogorov-Smirnov and the Shapiro-Wilk test were used. The Wilcoxon rank test was used to analyze differences in the disease status at two time points. The Friedman test compared PVD progression status after cataract surgery at three time points.

RESULTS

The study included 120 patients. Out of them, 45 patients were females and 75 males. Mean age was 59.0 ± 8.8 years (mean age in females was 57.0 ± 8.8 years and in male 58.6 ± 8.8 years).

Prior to surgery, the patients were initially measured for the best corrected visual acuity (BCVA) and axial length (Lax) – data has been presented in table 1.

Table 1. Central tendency measures.

Variables	Mean \pm SD	Med (min–max)
BCVA	0.4 ± 0.2	0.4 (0.1–0.7)
Lax	23.6 ± 1.0	23.5 (22.0–25.6)

BCVA – best corrected visual activity;
Lax – axial length

Initially, 66 (55%) patients had some PVD stage as follows: 40 patients (60.6%) with stage 1, 16 patients (24.2%) with stage 2, 10 patients (15.2%) with stage 3 and in 54 patients (45%) PVD was not registered.

After one month, the disease progression was registered in 48 patients (40%), out of whom a complete PVD was determined in 6 patients (in 3 patients with initial stage 1, in 2 patients with initial stage 2, and in 1 patient with initial stage 3). In 72 patients (60%) the condition remained unchanged. After 6 months, in 7 new patients complete PVD was reported, so there was a total of 13 patients with complete PVD after 6 months (in 2 new patients with initial stage 2, in 2 patients with initial stage 3, and in 3 patients with previously absent complete PVD that is present now). The disease progression was registered in 76 patients (66.7%), and there were no changes in 38 patients (33.3%) (114 of them now without complete PVD). After 12 months, complete PVD was established in 15 more patients (in 4 new patients with initial stage 1, in 2 new patients with initial stage 2, and in 11 patients with complete PVD which was not present previously), which makes a total of 28 patients with complete

PVD. The disease progression was seen in a total of 93 patients (86.9%), and in 14 (13.1%) the condition remained unchanged (out of them, 107 is now without complete PVD) (Table 2).

Table 2. Illustration of PVD progression at 1, 6 and 12 months after cataract surgery

Initial PVD stage before the surgery	Progression after			No progression after			Complete PVD			
	1 month	6 months	12 months	1 month	6 months	12 months	1 month	6 months	12 months	
No PVD	54	17	34	44	37	20	7	0	3	14
Stage 1	40	19	23	33	21	14	4	3	3	7
Stage 2	16	8	10	9	8	4	3	2	4	6
Stage 3	10	4	9	7	6	0	0	1	3	3
Total	120	48	76	93	72	38	14	6	13	28

PVD – Posterior vitreous detachment.

By using the Friedman test of repeated measures, the progress statuses of were compared after cataract surgery at three time points: after 1 month, 6 months, and 12 months. Significant progression of PVD in time was confirmed ($\chi^2=78.32$, $df=2$, $p<0.001$). The Wilcoxon test determined that after 6 months ($p<0.001$) and 12 months ($p<0.001$) the disease progression was statistically significant in comparison to measurements after 1 month. Also, after 12 months, in relation to progression status established after 6 months, there was significant progression of the disease ($p<0.001$).

DISCUSSION

PVD is very common in patients who underwent cataract surgery with phacoemulsification. There are many reasons for it, but the main ones are the potentials of greater fluctuation of the vitreous body and greater anteroposterior traction enabled by less thickness of IOL in comparison to natural lens [10]. Increased vitreous gel liquefaction caused by ultrasonography effects, as well as fluid flow through the zonulae due to the surgery, are also the reasons for higher incidence of PVD after phacoemulsification surgery [11, 12].

Other authors obtained the results similar to ours. Ivastinović et al reported that PVD developed in 71.9% of patients 3 months postoperatively. Higher incidence of PVD in his findings in comparison to our study is explained by the age of their patients, who were older on average than the group of patients we followed [13]. The same author reported in the appendix to his study that 100% of patients develop some stage of PVD one year postoperatively [14]. Unlike the authors of this study, Mirashahi et al also monitored PVD development exclusively by ultrasonography and reported that 58.6% of patients developed some PVD stage after a year [15].

It can be seen that OCT allows detection of early stages of PVD. OCT identifies more cases of posterior vitreous detachment than other available methods. To the best of our knowledge so far, early stages of PVD would have been unrecognized without utilization of OCT [13].

Complications associated with PVD were not common in our study, symptomatic PVD was registered in 4 patient out of 120 (3.33%), which correlates with literature data [16].

We believe that the inclusion of greater number of patients would provide a better insight into potential risk factors, gender differences and age impact, but limitations in finding more patients to be included in a study are preoperative media transparency, as well as preoperative nonexistence of PVD in relatively older population.

CONCLUSION

Vitreous body detachment after phacoemulsification surgery is common, and OCT plays a very important role in detecting initial changes on vitreoretinal interface.

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