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Evaluation of the effects of cataract phacoemulsification with implantation of one-piece foldable intraocular lenses into the furrow of the ciliary body

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HIGHLIGHTS

In the absence of an IOL dedicated to fixation in the ciliary sulcus, the choice of an easily accessible single-piece foldable lens seems to be an alternative worth considering that will allow for effective cataract surgery without the need for another procedure.

ABSTRACT

Objectives: To evaluate the results of treatment in a group of patients undergoing cataract phacoemulsification with sulcus implantation of single-piece foldable intraocular lenses.

Material and methods: A total of 24 eyes of 24 patients, who underwent cataract phacoemulsification in the Department of Ophthalmology at the Central Clinical Hospital of the Ministry of Interior and Administration in Warsaw in 2008–2015 was included. As a result of intraoperative rupture of the posterior lens capsule, single-piece foldable intraocular lens was implanted into the ciliary sulcus. Visual acuity, intraocular pressure, anterior and posterior segment of the eyes were assessed before the surgery, on days 1 and 7 after the surgery and in the period of 6 to 84 months after the surgery.

Results: During the follow-up period from 6 months to 7 years, an improvement in BCVA was shown by an average of 0.2 on the Snellen chart. Complication included: pigment dispersion (42%), increased intraocular pressure or the need to modify antiglaucoma treatment (25%), iris transillumination defect (17%).

Conclusions: In the case of cataract phacoemulsification complicated by rupture of the posterior lens capsule, sulcus implantation of a single-piece foldable intraocular lens improves visual acuity, but poses a risk of developing secondary glaucoma. If we choose such a solution, we should provide patients with the possibility of regular checkups. Due to relatively frequent complications, in cases of cataract surgery with posterior capsule rupture, the authors recommend choosing other fixation methods.

Key words: cataract surgery, ciliary sulcus, posterior capsule rapture, single-piece intraocular lens, secondary glaucoma

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INTRODUCTION

Posterior lens capsule rapture is a relatively common complication of cataract phacoemulsification. The type of cataract and the experience of the surgeon have the greatest influence on the frequency of this complication. According to various sources, it accounts for 1.7% to 13.3% [1–3] of all procedures. Unfortunately, in most cases, the degree of damage to the posterior lens capsule prevents intracapsular implantation. Here we face the problem of choosing the right method of lens fixation. There are many methods that can be used. Some of them allow the implant to be placed in the posterior chamber, such methods as: transscleral fixation, iris fixation (McCannel sutures [4], retro-pupillar iris-claw lenses), fixation in capsulorhexis (optic-capture), implantation into the ciliary sulcus without additional fixation. Methods for placing the implant in the anterior chamber include: iris fixation (iris-claw lenses) and PMMA lenses with angle support. In our study, we analyzed the complications of lens implantation into the sulcus of the ciliary body.

MATERIAL AND METHODS

Cataract surgery performed at the Department of Ophthalmology of the Central Clinical Hospital of the Ministry of the Interior in Warsaw was analyzed. In the period from 2008 to 2015, 5,513 cataract phacoemulsification procedures were performed. Posterior lens capsule rupture occurred in 103 operated patients (1.87%). The study included 24 patients (24 eyes), the rest did not report for the follow-up examination. The mean age of the analyzed group was 75 (age range 51–88). The gender distribution is 14 women and 10 men. Patients were followed from 6 months to 7 years, the mean follow-up was 46 ± 26.5 months. BVCA, IOP, the position of the lens implant, the condition of the anterior and posterior segment were assessed – before the procedure, on the 1st and 7th day after the procedure and in the period from 6 to 84 months after the procedure. The procedures were performed by four experienced surgeons, patients had intraoperative rupture of the posterior lens capsule, resulting in implantation of a foldable single-piece lens into the ciliary sulcus.

THE TECHNIQUE OF THE PROCEDURE

All cataract phacoemulsification procedures were performed with the Alcon Infinity device. Local anesthesia was used (drip anesthesia – Alcaine [proxymetacaine]), 1% Xylocaine [lidocaine] into the anterior chamber). Two 2.2 mm lateral paracentesis and circular capsulorhexis were performed. Rupture of the capsule occurred in 90% during phacoemulsification of the lens nucleus, and in 10% during polishing of the posterior lens capsule. In cases with the loss of vitreous anterior vitrectomy was performed, while in patients without vitreous prolapse, tamponade with viscoelastic was used. After assessing whether the anterior capsule would provide sufficient support for the implant, it was decided to implant the lens into the ciliary sulcus. The primary foldable lens was placed in the anterior chamber, then, using the manipulator haptics were moved between the iris and the anterior capsule. In order to stabilize the position of the implant at the end of the procedure, carbachol 0.1 mg/ml (Miostat, Alcon) was administered to the anterior chamber. In the analyzed years, due to the lack of availability of lenses dedicated to fixation in the ciliary sulcus, we had to use single-piece foldable lenses. There were three types of lenses, 17 people received Alcon SN60WF lens, six people Softec I, one person Quatrix.

RESULTS

The mean BCVA on Snellen charts in the preoperative period was 0.4 ± 0.175, while the control performed for the study showed the mean BCVA of 0.6 ± 0.252. Best corrected visual acuity (BVCA) improved in 16 (76%) patients, remained unchanged in five (21%) patients, and worsened in three (12%) patients. The observed deterioration of vision was related to diseases of the posterior segment of the eyeball such as AMD (two patients) and advanced glaucomatous neuropathy (one patient).

In the studied group of patients, the most frequently observed complication was iris pigment dispersion [5] (42%) and the related secondary increase in intraocular pressure over 21 mmHg [6] (25%). Other complications include: iridocyclitis (4%), translocation of the implant without need to reposition (4%). Other complications described in the literature, not observed in our group of patients, include: anterior chamber haemorrhage, vitreous hemorrhage [7], retinal detachment. The above data show that the most important postoperative problem was the increase in intraocular pressure. In the study group of patients in the preoperative period, the mean intraocular pressure was 14 mmHg (10–18 mmHg). During I postoperative control 16 mmHg (10–45 mmHg). A final check for the study showed a mean IOP of 18 mmHg (11–43 mmHg). It was found that secondary glaucoma developed in 25% of subjects with a ciliary sulcus implant. These patients had not previously received treatment for glaucoma. On the other hand, 50% of patients treated for glaucoma before surgery required intensification of anti-glaucoma treatment after implantation of the lens into the ciliary sulcus.

DISCUSSION

The choice of IOL fixation technique in the eyes with posterior lens capsule rapture depends on the availability of

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different types of lenses, the surgeon's preferences and the anatomical conditions in the operated eye. First, consider whether the condition of the anterior capsule allows the implant to be safely inserted into the sulcus of the ciliary body. The integrity of the anterior capsule, the condition and the size of the anterior capsulorhexis should be assessed. Large capsulorhexis poses a high risk of implant translocation. If we find that the front bag will be a safe support for the artificial lens, we can use several solutions. One of them is the implantation of a widely available single-piece foldable lens. We analyzed this method in our study. As it results from our work and the cited literature, single-piece foldable IOLs are not the optimal solution for fixation into the ciliary sulcus [8]. These lenses have thick haptics and a sharply cut optic edge, which under normal conditions reduces cell migration and affects the frequency of lens capsule opacification. On the other hand, in the case of implantation of this type of lens into the sulcus of the ciliary body, its construction causes increased contact with the posterior iris surface and leads to its mechanical abrasion.

The iris pigment released in this way obstruct the aqueous humor outflow through the trabecular meshwork, which in some patients leads to a secondary increase in intraocular pressure [6, 7].

Other complications described in the literature, not observed in our group of patients, include: anterior chamber haemorrhage, vitreous hemorrhage [8], retinal detachment. In the case of fixation in the ciliary sulcus without the use of sutures, the optimal choice is a 3-piece foldable lens [9]. Thin haptics with an appropriate curvature and a smooth, rounded front surface of the optics minimize abrasion of the posterior surface of the iris. However, direct availability is a problem as these lenses are no longer routinely used for cataract phacoemulsification procedures. Problems of this type occurred in the period analyzed by us. We currently have 3-piece lenses with different powers in stock. In the event of complications, it allows for effective cataract surgery with implantation of the correct lens during the first procedure. In some cases, a second surgery should be considered after ordering the appropriate model and power of the implant.

An alternative solution are single-piece lenses designed for both the intracapsular implantation and the ciliary sulcus. They have thinner haptics that reduce contact with the iris, and additionally, their inclination by five degrees moves the optical part of the implant away from the iris. With their application, there was no evidence of pigment dispersion syndrome or other complications related to the implant into the ciliary sulcus [10]. There are also single-piece lenses dedicated only to the sulcus implantation, but their safety profile requires further research [11]. Their advantage is easy implantation and a smaller corneal incision than in the case of 3-piece lenses. One should also remember about the necessity to correct the optical power of the IOL in relation to the original calculation [12]. Changing the position of the implant requires modifying the fixed nominal lens by about 0.8, which translates into a reduction of the lens power by 0.5 to 1.0 D depending on the axial length of the eyeball [13]. You can also use the available lens power change tables for a given implant power.

Based on our own material, we believe that in cases of rupture of the posterior capsule with the prolapse of the vitreous, thorough anterior vitrectomy provides conditions for proper IOL placement, stabilizes its position and reduces the risk of late complications [14, 15]. The vitreous strand incarcerated into the corneal ports are a common cause of implant dislocation. There are inconsistent reports in the literature regarding the frequency of this complication. Among the group of patients studied by us, the implant decentrated only in one person. Immediately after the procedure, pupillary constriction caused by administration of carbachol (Miostat) to anterior chamber helps to maintain the position of the lens. In the first days after surgery, the use of mydriatics should be avoided. Over time, the adhesion of the implant to the anterior capsule increase and causes its additional stabilization. The total dimension of the Alcon lenses we use is 13.0 mm. Based on anatomical measurements, it is believed that the diameter of the ciliary body sulcus ranges from 11 to 12.5 mm [16, 17]. According to the literature, a lens size above 12.5 mm may ensure a stable position of the implant [18].

Also described is the "optic-capture" technique, which involves placing haptics on the anterior capsule, while the optics remain inside capsule [19, 20]. It stabilizes the position of the implant, limits the movement of the vitreous body to the anterior chamber and reduces the risk of pigment dispersion and secondary glaucoma. However, it requires an appropriately sized, well-centered capsulorhexis, optimally with a diameter of 4.8–5,0 mm.

Sometimes the condition of the anterior capsule does not allow the lens to be safely inserted into the ciliary sulcus. The cause may be too large capsulorhexis, damage to the continuity of the capsule or damage to the zonular fibers that endanger the stability. In these cases, alternative fixation methods can be used. One of them is transscleral fixation. However, it is a difficult procedure and exposes the patient to intraoperative complications (e.g. vitreous hemorrhage) and long-term complications such as retinal detachment [21], IOL dislocation due to suture degradation, etc. [22].

Quite a new and promising method are iris-claw lenses dedicated to iris fixation. Many studies confirm their high safety profile, low number of complications [23] and effective aphakia correction, which in most cases allows to obtain better corrected visual acuity than before the procedure [24]. At present, iris-claw lenses seem to be the best

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method of correcting aphakia in cases where sulcus implantation is impossible [25]. In the event of damage to the posterior lens capsule, which prevents safe intracapsular or ciliary sulcus implant placement, we suggest performing a secondary surgery with an iris fixated lens in a few weeks. In our opinion, such a procedure gives the best results, and the re-calculation of the implant allows for good visual acuity, making the patient independent from optical correction for distance.

CONCLUSION

Our work and literature show that the most common problem in patients with sulcus implantation of single-piece lenses is the development of secondary glaucoma due to pigment dispersion. In our study group, 25% of patients developed this type of complication, which is consistent with the available literature. It is worth adding that in all the studied patients it was possible to achieve good intraocular pressure control only on the basis of topical medications. Despite relatively good results, in order to avoid complications and the need for more frequent eye checks, we recommend choosing other implant techniques described above. However, there are certain situations in which we have limited resources and the question arises whether it is worth exposing the patient to stress and risk related to the next surgery. Bearing in mind that complications will not develop in all patients, the surgeon must approach each case individually. In the absence of an IOL dedicated to fixation in the ciliary sulcus, the choice of an easily accessible single-piece foldable lens seems to be an alternative worth considering that will allow for effective cataract surgery without the need for another procedure.

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