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CASE REPORT

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Surgical lens extraction with vitrectomy in patients with angle-closure glaucoma

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ABSTRACT

Closed angle glaucoma is a neurodegenerative disease, resulting from anatomical predisposition, which without appropriate treatment results in irreversible blindness. During intraocular operations in this group of patients, more often than in the general population, severe complications that endanger vision occur. This article presents a surgical technique that combines phacoemulsification of the cataract with partial vitrectomy through the flat part of the ciliary body. In some patients it may act as an glaucoma treatment, eliminating the factors conducive to closing the filtration angle. Its application allows for safe lens replacement under conditions of increased intraocular pressure in patients with very shallow anterior chamber.

KEY WORDS: glaucoma, cataract, phacoemulsification, vitrectomy.

INTRODUCTION

Glaucoma is one of the most common causes of vision loss worldwide. It is a group of eye conditions underpinned by different mechanisms and leading to damage to the optic nerve [1, 2]. Open-angle glaucoma is more prevalent in the European and African populations. Primary angle-closure glaucoma, if not properly treated, is more likely to result in irreversible blindness [2, 3].

Depending on the presence or absence of concomitant ophthalmic or general factors, closure of the filtration angle may have primary or secondary etiology [2]. Primary closure of the filtration angle may arise from different mechanisms, but in 75% of cases it is caused by pupillary block (associated with lens position and thickness) [4]. A flat iris configuration and a mixed mechanism are less commonly involved.

Secondary angle-closure glaucoma is a group of disorders with a specific cause of filtration angle closure. Treatment is varied and closely dependent on the origin of the condition [5].

The primary type of glaucoma is more prevalent. General risk factors for primary angle-closure glaucoma (PACG) include family history of the disease, age over 60 years, female sex, and Asian or Inuit descent. Closure of the filtration angle typically occurs in anatomically predisposed eyes, i.e. with a shallow anterior chamber (approximately 1 mm shallower than normal), narrow filtration angle, small corneal diameter, large anteroposterior dimension of the lens, and small axial length (hyperopia, microphthalmia). Research conducted in this field has also shown that lenses play a major role in the pathogenesis of the condition as a result of the volume of the lens increasing with age or its anterior displacement [6, 7].

At present, primary angle-closure glaucoma is known to affect approximately 20 million people. According to estimates, 34 million people will be affected by the condition by 2040, of which 3-5 million will become blind. For this reason, early and effective therapeutic interventions are extremely important in this patient group [3].

TREATMENT OF PATIENTS WITH ANGLE-CLOSURE GLAUCOMA

Obstructed drainage of the aqueous humor leads to elevated intraocular pressure (IOP). In patients with primary angle closure, the standard management involves its pharmacological reduction and performing peripheral laser iridotomy. However, if these procedures fail to produce the desired effect, surgical treatment must be undertaken. In patients with coexisting cataract, in view of the age-related increase in lens size which is recognized as the main cause of angle closure, lenticular extraction surgery produces an antiglaucoma effect [3].

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If the lens is clear, but its involvement in the pathogenesis of angle closure is confirmed, lens extraction should be considered as a therapeutic option. The timing of the procedure is of key importance. If the intervention is undertaken too late, it increases the risk that the desired drop in IOP will not be achieved even if phacoemulsification leads to a good anatomical outcome. This may be due to pre-existing peripheral anterior adhesions [7].

Phacoemulsification is not a routine procedure in angle-closure glaucoma. The decision to perform lens extraction surgery as the primary treatment for glaucoma should be taken on a case by case basis [8]. In some patients, the procedure may ensure proper IOP control and eliminate anatomical factors leading to angle closure. Replacing the natural lens with an IOL reduces lenticular thickness and significantly changes the depth of the anterior chamber. The iridolenticular diaphragm shifts posteriorly, the chamber depth increases, the filtration angle widens, and the pupillary block, if present, is eliminated [6]. The proven benefit of the procedure in terms of IOP reduction is an argument in favor of the treatment of some types of glaucoma solely by lens extraction, either as definitive treatment or a step in the treatment plan, after which, if so required, another surgical intervention can be safely performed) [8].

OPERATIVE RISK IN PATIENTS WITH ANGLE-CLOSURE GLAUCOMA

A shallow anterior chamber with high IOP due to phacomorphic glaucoma is a widespread phenomenon in countries where access to surgical treatment is limited. In such cases, some of the less experienced surgeons choose to perform extracapsular cataract extraction (ECCE), because phacoemulsification is a very challenging procedure on account of a very shallow anterior chamber and high IOP [9].

During phacoemulsification, a shallow anterior chamber impedes the procedure at nearly every stage [10]. Making an incision in the transparent part of the cornea, in view of its peripheral proximity to the iris, leads to a risk of iris contact with surgical instruments and its prolapse through the ports, which may consequently result in intraoperative pupillary constriction [9, 10]. Surgery performed in a patient with a shallow anterior chamber increases the risk of Descemet's membrane detachment, uncontrolled expansion of capsulorhexis, and rupture of the lens ligaments [10]. In such cases, the risk of endothelial cell loss is higher due to the close proximity of the phacoemulsifier tip to the posterior corneal surface. In addition, suprachoroidal hemorrhages are more common because of large IOP fluctuations during the procedure [9, 11].

In this type of eyes, complications such as malignant glaucoma are known to be more common [10]. The condition presents with elevated IOP, shallow anterior chamber (with a patent peripheral iridotomy), and a build-up of aqueous humor in the vitreous chamber. In the differential diagnosis, hemorrhage into the suprachoroidal space should be excluded [12]. Malignant glaucoma can be acute or chronic. The mechanism of the condition is associated with the posterior flow of aqueous humor. Fluid accumulating in the posterior segment displaces the iridolenticular diaphragm forward, reduces the anterior chamber, and leads to secondary filtration angle closure [13]. The condition may be characterized by a recurrent course. It may fail to respond to conservative or surgical treatment, leading to the development of glaucomatous optic neuropathy and loss of vision [12,14]. If the syndrome occurs intraoperatively, once other causes causing anterior chamber obliteration have been ruled out, aspiration of a small amount of the vitreous body may be performed [10, 11]. The procedure is aimed at restoring normal IOP gradient anteriorly and posteriorly to the iridolenticular diaphragm.

PARTIAL PARS PLANA VITRECTOMY IN LENS EXTRACTION SURGERY IN PATIENTS WITH ANGLE-CLOSURE GLAUCOMA – CASE REPORT

A seventy-year-old female patient was referred to the hospital for the assessment of eligibility for cataract surgery. She had no history of previous ocular treatment. During the assessment for surgery, visual acuity test gave the following results: RE = 5/50 sc; cc-4.0 = 5/16; LE = 5/6 f sc. IOP pressure measurement by Goldman applanation tonometry found the following: RE = 17 mm Hg; LE = 18 mm Hg. Other findings included a significantly shallowed anterior chamber and a bulging opacified lens. Gonioscopy identified a narrow filtration angle in both eyes. Non-pigmented and pigmented trabecular meshwork structures were seen during movements and at the bottom, respectively. A non-dilated depression of the optic disc was observed at the fundus. During pupillary dilation, despite prior administration of acetazolamide, the patient developed an acute angle-closure glaucoma attack in both eyes. The intraocular pressure values were: RE = 73 mmHg, LE = 56 mmHg. After conservative treatment and performing peripheral laser iridotomies, IOP was successfully reduced in both eyes.

A few days later, however, an IOP rise was observed again, and AS-OCT examination revealed slit-like filtration angle in the RE, with closure involving 55% of the circumference, accompanied by pupillary block, and occluded iridotomies. The anterior chamber depth was 1.29 mm (Figure 1). In the LE, the filtration angle closure was estimated at 62% of the circumference, and the patency of the iridotomies was considered uncertain. The anterior chamber depth was 1.31 mm (Figure 2). After extending the iridotomies and initiating topical treatment with dorzolamide and timolol, and pilocarpine, the IOP level was normalized.

The biometric measurements performed in the patient yielded the following results for the RE: axial length (AL) = 22.05 mm, anterior chamber depth (ACD) = 1.83 mm, lenticular thickness (LT) = 4.87 mm; and for the LE: AL = 22.02 mm, ACD = 1.85 mm, LT = 4.8 mm. The width of the filtration angle in the right and left eyes ranged from 9 to 15, and 16 to 23 degrees, respectively.

The patient was considered eligible for phacoemulsification cataract surgery in the RE. Before the procedure, she received an intravenous infusion of 250 ml of 20% mannitol.

Surgery was performed under periocular anesthesia to improve the operator's comfort in the challenging operative

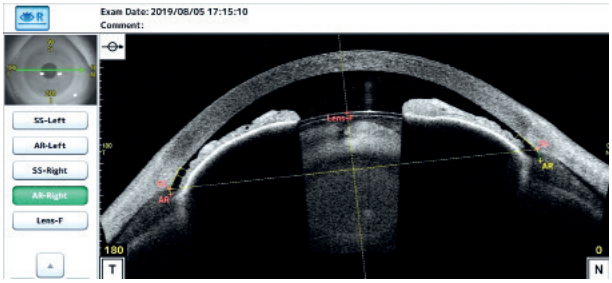

Figure 1. Preoperative AS-OCT examination of the right eye

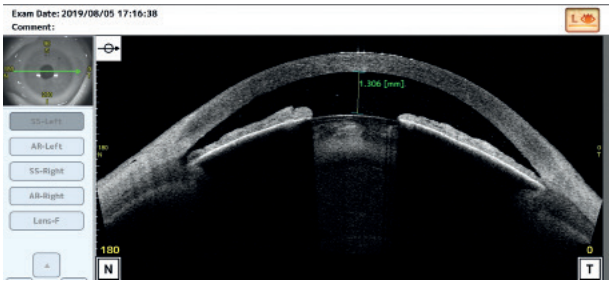

Figure 2. Preoperative AS-OCT examination of the left eye

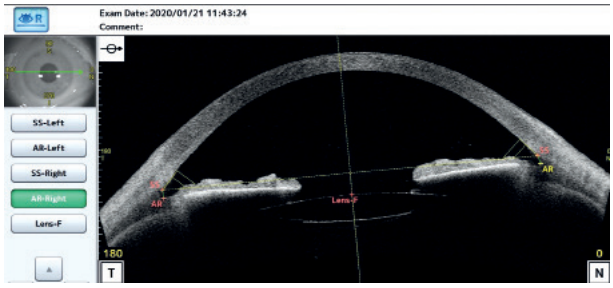

Figure 3. Postoperative AS-OCT examination of the right eye

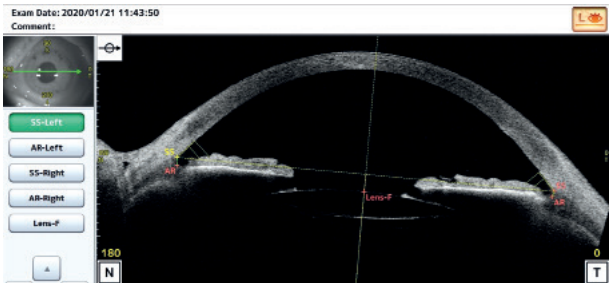

Figure 4. Postoperative AS-OCT examination of the left eye

conditions and create a possibility to expand the scope of the planned procedure, if needed. In view of the patient's history of acute attack of glaucoma during diagnostic pupillary dilation and laser iridotomies of an uncertain patency, pupil dilation was delayed until the patient was on the operating table. However, it was not possible to achieve the full effect using pharmacological agents, which additionally increased the difficulty of the procedure. A significant increase in IOP and iris prolapse through the port were observed after the start of surgery. Therefore, a decision was made to perform 23G partial core vitrectomy (the phacomulsification device used during the procedure was only suitable for 23G vitrectomy; using the 25G or 27G technique would require the patient to be transported to a different operating room with a dedicated vitrectomy console), which led to IOP normalization and enabled continuation of the procedure. Then, a Malyugin ring was inserted to mechanically dilate the pupil and achieve improved control of capsulorhexis. The following stages of the phacoemulsification procedure proceeded uneventfully.

In view of unfavorable anatomical conditions in the left eye, and the complicated course of the procedure in the other eye, it was decided that phacoemulsification should be preceded by posterior vitrectomy. In technical terms, the procedure was slightly simpler because of normal pupillary width, and it proceeded without complications.

Following the procedure, visual acuity in the RE and LE was 5/8 sc. IOP measured by Goldman applanation tonometry was 17 mmHg (on a combined drug containing timolol and dorzolamide). A significant improvement in anatomical conditions was observed on AS-OCT, including deep anterior chamber, iris retraction, and correct implant positioning (Figures 3 and 4). The width of filtration angle in the right and left eyes ranged from 36 to 40, and 34 to 40 degrees, respectively.

DISCUSSION

Patients at a high risk of angle closure and pupillary block benefit from laser iridotomy performed before their scheduled surgical procedure. Additionally, preoperative use of dehydrating agents reduces intraocular pressure and deepens the anterior chamber [10]. In patients with conditions including phacomorphic glaucoma and other types of angle-closure glaucoma, with high preoperative IOP, it is a common practice to administer mannitol intravenously [11].

In cases where the above procedure is not sufficiently successful, and the patient's shallow or abolished anterior chamber, with iridocorneal contact, render surgery impossible, surgical decompression of the vitreous chamber should be considered. In some patients, the only way to successfully increase the depth of the anterior chamber is to perform a limited vitrectomy, removing a small amount of vitreous humor [10]. This technique is based on 23-25G, single-port, sutureless, pars plana transconjunctival vitrectomy, and facilitates phacoemulsification in the eyes with a shallow anterior chamber and high IOP. The decision to extend the scope of the procedure can also be made intraoperatively, if difficulties arise during the surgery, such as inability to adequately maintain the anterior chamber with viscoelastics, or signs of positive pressure build-up in the vitreous chamber. In this way, the procedure can be continued without complications in some patients with an anatomical predisposition.

The initial step in partial vitrectomy is the placement of a 23 or 25G port posterior to the corneal limbus (3.5 mm). In the next stage, using a vitrector, the retrolenticular part of the vitreous body is removed (approximately 0.2-0.3 ml) until the anterior chamber is deepened and optimum ocular tension is achieved.

The procedure is performed under visual control (in patients with a clear lens) or (if the cataract prevents proper vi-

sualization) while exercising special care so as not to damage the lens ligaments and capsule. Leaving the vitrectomy cannula sealed with a plug is recommended, so that the procedure can be repeated, if necessary.

Controlled excision of the anterior vitreous body leads to posterior displacement of the lens, increases the depth of the anterior chamber, and thereby facilitates surgical manipulations within the chamber. It also lowers the IOP level, decreasing positive vitreous pressure and the risk of posterior capsule rupture, iris prolapse, and suprachoroidal hemorrhage. In this situation, controlled capsulorhexis and phacoemulsification are also possible options, with less likelihood of corneal endothelial damage [9,15].

Vitrectomy contributes to the safe performance of the lens extraction procedure. However, it should be noted that it also involves a small risk of complications associated with posterior eye surgery, such as damage to the lens and its ligaments, retinal tear and detachment, endophthalmitis, and hypotonia. As a result, patients need a close postoperative follow-up [9,16,17].

CONCLUSIONS

Phacovitrectomy can be performed as an antiglaucoma procedure in patients with angle-closure glaucoma and an extremely shallow anterior chamber. By eliminating the anatomical predisposition leading to the closure of the filtration angle, it lowers the intraocular pressure. Additionally, it improves vision in patients with lenticular opacity.

Surgical vitreous decompression can also be performed during phacoemulsification if complications arise during the standard procedure.

Phacovitrectomy can prevent intraoperative complications which are common in this group of patients, and include endothelial cell loss, iris damage, uncontrolled capsulorhexis, suprachoroidal hemorrhage as well as intraoperative malignant glaucoma. Using a small caliber port improves patient comfort and reduces the time of healing, which makes it comparable to phacoemulsification itself.

This relatively simple technique has a potential for wider applications not only by a narrow circle of vitreoretinal surgeons.

The procedures performed to date in our clinical center with the use of this method have provided evidence for its suitability, efficacy, and safety. This applies in particular to patients with a shallow anterior chamber, abnormal intraocular pressure, and acute primary and phacomorphic angle closure. However, widespread application of phacovitrectomy and in-depth assessment of the benefits and potential risks associated with the procedure require further studies and case reviews in a larger group of patients.

DISCLOSURE

The authors declare no conflict of interest.

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