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Causes of failures in the treatment of malignant glaucoma after cataract removal based on an analysis of several case studies

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Abstract

The study analyses the causes of ineffective malignant glaucoma treatment applied in 4 patients (6 eyes). Glaucoma symptoms appeared immediately after cataract removal. The common feature of the applied therapies was the desire to lower eye pressure using various methods. The most important element of treatment, i.e. restoring the correct anatomical relations in the eye, was left out during treatment. The prolonged time in the implementation of effective therapy results in progressive visual impairment and appearance of irreversible lesions in the anterior segment of the eye. In addition, it puts the patient at risk of experiencing constant eye pain, even if the intraocular pressure is normalized. The key to therapeutic success is restoration of the physiological distribution of the aqueous humour. Nonsurgical methods of treating malignant glaucoma, if ineffective, should be replaced by surgery within several days. The procedure of choice is excision of the vitreous from the area of the lens and the ciliary body with its anterior capsule, performed from the posterior approach. This method seems to be the most effective in pseudophakic eyes, and the time of its implementation has a decisive impact on obtaining a beneficial effect of the procedure and reducing the risk of postoperative complications.

Keywords: Malignant glaucoma; Trabeculectomy; Cyclophotocoagulation; Cataract; Pseudophakia

1. Introduction

Malignant glaucoma is one of the more serious complications of eye surgery that can lead to loss of vision. According to Pons, it is most often observed after trabeculectomy (filtration surgery) performed in patients with narrow angle glaucoma or angle-closure glaucoma [1]. The incidence of malignant glaucoma after this procedure is 0.6-4% [2]. This complication is even less common in the case of cataract removal. It is observed in 2 out of 9 thousand eyes, which is 0.02% of all cases [2]. Malignant glaucoma is based on a change in the physiological direction of the aqueous humour flow. Instead of draining out through the pupil into the anterior chamber, the fluid accumulates behind the lens and in the vitreous chamber. According to Kaplowitz et al., the cause of such a condition is complex and it most likely results from the anterior rotation of the ciliary body and disturbances in the anterior vitreous [3]. The abnormal aqueous humour flow leads to a significant increase in pressure in the posterior pole of the eye, causing a number of consequences. There are anatomical changes in the anterior segment of the eye typical for an acute attack of angle-closure glaucoma. Increasing pressure in the posterior segment of the eye moves the iris-lens diaphragm towards the cornea, leading to the development of 4 main symptoms of malignant glaucoma: 1. significant shallowing or complete loss of the anterior chamber 2. progressive increase in intraocular pressure 3. progressive deterioration of vision, among others, due to the appearance of a visual defect - myopia, 4. constant pain in the eyeball caused not only by an increase in eye pressure, but also by constant stretching of the suspensory ligaments (author's note). Patients with preoperative hyperopia are at the highest risk. Low intraocular pressure accompanying the symptoms of malignant glaucoma was exceptionally observed in patients after trabeculectomy [5-6].

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Treatment. It aims at reversing symptoms of malignant glaucoma. Taking into account the effectiveness of the applied therapies, the implementation of effective treatment becomes a challenge for every physician [2].

The cause of malignant glaucoma and the implementation time of effective therapy have an impact on the final treatment effect [1-8]. Pharmacological treatment is applied first. These are topical drugs that lower eye pressure and drugs such as mydriatic-cycloplegic agents. The purpose of the latter is to relax the ciliary muscle, which should result in the reversal of anterior rotation of the ciliary processes, and thus the reversal of the symptoms of glaucoma. In the absence of their effectiveness, general treatment lowering eye pressure, including acetazolamide and hyposmotic agents, e.g. Mannitol, is introduced. The ineffectiveness of pharmacological treatment results in the implementation of interventional therapies. Posterior capsulotomy with an anterior hyaloidotomy, performed with the use of the Nd-Yag laser, is a proposed, but moderately effective treatment option [8]. Lois proposed zonulo-hyaloid-vitreotomy (ZHV) as another method of treating glaucoma in patients with pseudoaphakia. This method, used in several patients, proved to be 100% effective [10]. However, Magdula et al. in a long-term follow-up assessed the effectiveness of this therapy at 40% [11]. If the above methods fail, experts suggest performing partial posterior vitrectomy. During the surgery vitreous is removed from behind the lens and ciliary body area along with the anterior capsule. The therapy was introduced many years ago due to its proven effectiveness and low risk of complications [12]-[13].

1.1. Objective

Retrospective analysis of the results of malignant glaucoma treatment performed in four patients (6 eyes). Complete loss of vision in one eye, continuous pain in the eye and unregulated intraocular pressure in the remaining patients were the reasons for seeking effective therapy. Due to the cause, each of them (4 eyes) underwent partial posterior vitrectomy, the effects of which were analysed.

2. Material and methods

Four patients decided to consult the Silesian Eye Treatment Centre because of complications from cataract removal. The main complaints included continuous pain in the eyeball in three patients (3 eyes) and loss of vision in another. The cause of the above was the appearance of malignant glaucoma symptoms immediately after cataract removal, in two patients binocularly. Information on age, reported pain, intraocular pressure, duration of ineffective therapy, presence of lesions in the anterior chamber, visual acuity on the day of consultation, and the type of treatment used are presented in Table 1.

Table 1 Information concerning sex, age, reported pain, intraocular pressure, duration of ineffective therapy, presence of lesions in the anterior chamber and the type of treatment applied in patients.

Sex/ Age/ eye	Eye pain	IOP (mmHg) At the day of consultation	Duration of treatment (months)	Anterior chamber	Topical eye drops for Glaucoma	Yag iridotomy	Surgical intervention
m/33/right	yes	33	15	Very shallow	yes	yes	ZHV, TSCPC, PPV
f/80/right	yes	18	16	Lack,	yes	yes	TSCPC, trabeculectomy
f/77/right	no	24	17	Shallow peripheral adhesions	yes	yes	trabeculectomy
left	yes	19	3	Very shallow peripheral adhesions		yes	trabeculectomy
m/84/right	yes	60	5	Lack	yes	yes	TSCPC

ZHV -zonulo hyaloid-vitreotomy, PPV- pars plana vitrectomy, TSCPC – transscleral cyclophotocoagulation,

During the consultation, each patient was diagnosed with three symptoms of malignant glaucoma, including significant shallowing of the anterior chamber (4 eyes) and complete loss of the anterior chamber (2 eyes) (Fig. 1).



Figure 1 OCT of the anterior segment of the eye. 84-year-old patient, right eye. Significant shallowing of the anterior chamber and complete closure of the iridocorneal angle - iridocorneal adhesions (arrows) at the range of 360°. IOP 60mmHg. Transscleral cyclophotocoagulation was carried out 4 weeks earlier.

Other symptoms include continuous pain in the eyeball and the presence of myopia caused by the shift of the iris-lens diaphragm towards the cornea. Multiple iridocorneal adhesions in the peripheral segment of the cornea were present in 3 eyes (2 patients). Apart from the aforementioned adhesions, an additional accompanying symptom was the narrowing of the visual field observed in the patient who underwent trabeculectomy in both eyes. The time that elapsed from the onset of malignant glaucoma symptoms to the consultation of 3 patients who came to the Centre due to eye pain was 3, 5 and 18 months. In the case of the patient who underwent trabeculectomy, only a reduction in intraocular pressure was achieved. Significant shallowing of the anterior chamber, numerous iridocorneal adhesions and the aforementioned eye pain were not eliminated (Fig 2a, b).

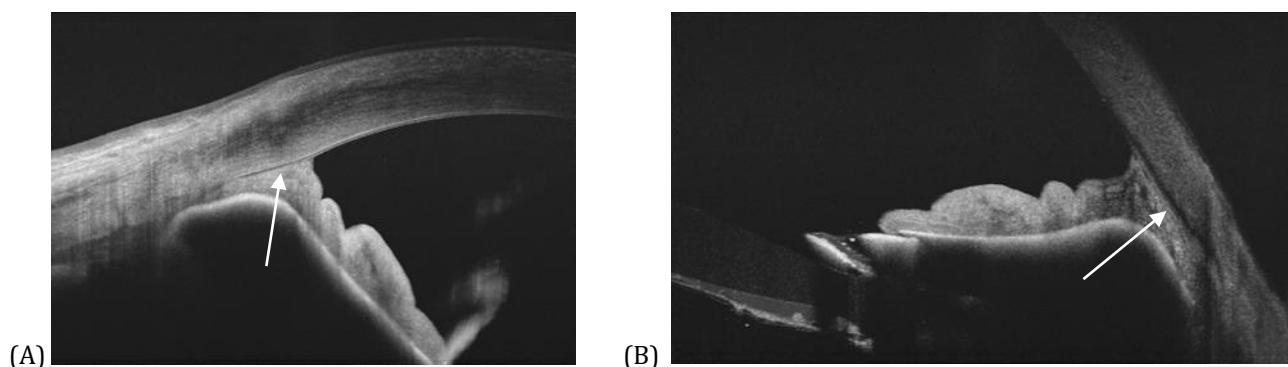


Figure 2a, b. OCT of the anterior segment of the eye. 77-year-old female patient, right eye. 17 months after trabeculectomy. Visible iridocorneal adhesions (arrows), closing the iridocorneal angle. IOP 30mmHg, constant eye pain.

The fourth patient, who lost vision in one eye due to complications resulting from malignant glaucoma, decided to have cataract removal performed in the other eye, which was additionally burdened with narrow angle glaucoma. The procedure with the subsequent implantation of a bifocal lens was performed after the previous intravenous administration of Mannitol. Despite the lack of intraoperative complications, the symptoms of malignant glaucoma also appeared in this eye. Glaucoma symptoms did not subside after the use of topical and general eye pressure-lowering drugs, mydriatics and laser iridotomy. Therefore, on the 8th day after cataract removal, partial posterior vitrectomy was performed. The same procedure was performed in the case of the remaining 3 patients (3 eyes).

3. Results and discussion

Posterior vitrectomy involved removal of the anterior part of the vitreous body with its capsule and posterior vitreous detachment. Eye pain subsided in each case immediately after the procedure. The anterior chamber was not permanently reconstructed and the circular iridocorneal adhesions were not eliminated after one procedure. During the subsequent two surgeries a viscoelastic was introduced into the anterior chamber, which prevented another deletion of the anterior chamber, but did not prevent partial recurrence of adhesions in the angle and shallowing of the chamber. Similar lesions were found in the blind eye. Permanent iridocorneal adhesions did not occur in the youngest patient, a 33-year-old male, who underwent, among others, transscleral cyclophotocoagulation and in the patient who underwent posterior vitrectomy 8 days after the onset of malignant glaucoma symptoms [Fig.3a, b].

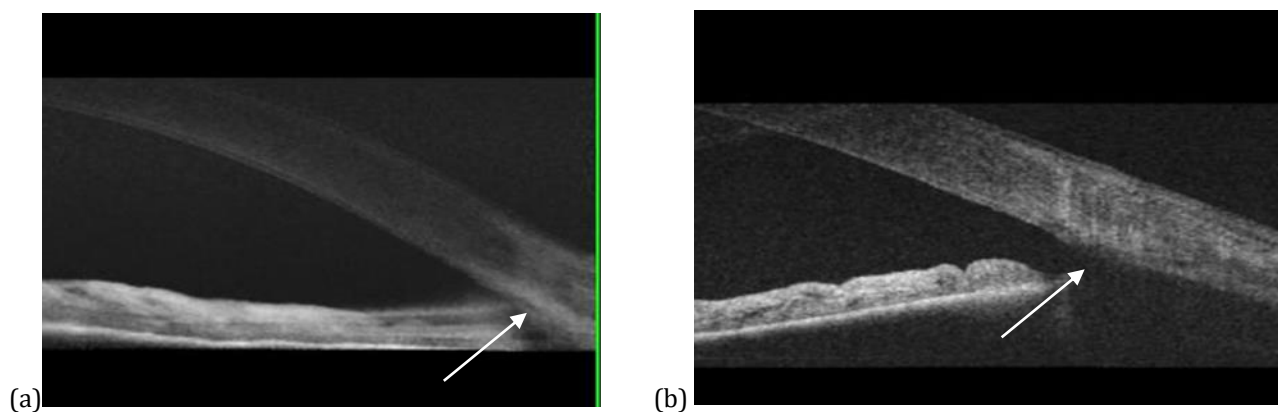


Figure 3 OCT of the irido-corneal angle (arrows), a) before PPV, the angle is closing, b) after PPV, the angle became open. PPV was made 8 days after onset of malignant glaucoma

In these eyes, the intraocular pressure normalized quickly. In the remaining 2 cases, including the eye that had previously undergone trabeculectomy, the narrowing of the field of vision also regressed. Each of these patients required administration of eye drops to lower eye pressure.

Visual acuity. It improved after the procedure, but due to the described complications, stabilization of vision appeared only after 4-6 weeks. In each case, myopia was reduced. The obtained values of visual acuity to best-corrected far and near distances, assessed before and during the period of 5-30 months after the procedure, and the postoperative change in the scope of the visual defect, are presented in Table 2.

Table 2 Values of best corrected visual acuity (BCVA) to far (logMAR) and near (Snellen) distances, obtained before and after posterior vitrectomy procedure.

Age	BCVA to far distances before PPV (logMAR)	BCVA to near distances before PPV (Snellen)	Eye defect before surgery Dsph/Dcyl	Eye defect after surgery Dsph/Dcyl	BCVA to far distances after PPV (logMAR)	BCVA to near distances after PPV (Snellen)
33	0.4	D-0.5	-5.0D	-0.5D	0.3	D-0.5
77	0.1	D-0.5	-2.5D	-0.25D	0.1	D-0.5
80	1.0f	D-3.0	-3.0D/-3.0D	-1.25/-1.5	0.3	D-0.75
84	0.9	D-0.5	-6.0D/-1.0D	-2.0 Dcyl	0.1	D-0.5

Visual acuity to far distances significantly improves after posterior vitrectomy procedure, as did the size of myopia. Visual acuity to near distances stayed unchanged or also improved.

At the beginning of the process of selecting a treatment method, a question should be asked. What is the purpose of treatment? The best therapy is to implement causal treatment. If we do not know the cause, we introduce symptomatic

treatment. To implement causal treatment, the cause must be defined first. In our patients, the cause was well-defined - malignant glaucoma.

In malignant glaucoma, the cause leads to an abnormal accumulation of fluid in the vitreous cavity of the eye with its consequences [1-2]. The iris-lens diaphragm moves towards the cornea leading to the appearance of symptoms typical for angle-closure glaucoma. The sole and proper goal of treating malignant glaucoma is to restore the physiological distribution of aqueous humour in the eye. It is not only lowering the eye pressure with all available methods, because as shown, among others, in this study it is ineffective and is burdened with numerous complications. In the described group, despite the knowledge of the cause of the pathology, only some of the implemented treatment was justified (pharmacological treatment, Yag iridotomy and posterior capsulotomy). Foreman-Larkin believes that 3-5 days is a sufficient time to use non-surgical treatment [8]. After that, surgical treatment should be introduced. In the study group, surgical treatment included TSCPC, zonulo-hyaloid-vitreotomy and trabeculectomy, which only resulted in a temporary reduction in eye pressure. Other symptoms of malignant glaucoma did not subside. Shallowing of the anterior chamber, pain in the eyeball and progressive myopia were not eliminated. Taking into account available literature, the presence of these symptoms should prompt physicians to implement partial posterior vitrectomy. The timing of its implementation is of great importance. Posterior vitrectomy should be performed quickly enough to avoid permanent pathological lesions, mainly iridocorneal planar adhesions leading to permanent blockage of the trabeculum. According to the analysis of this small group of patients, vitrectomy carried out after a few or several months is associated with a number of adverse complications. Iridocorneal adhesions, the need for multiple anterior chamber restoration procedures, the need for additional treatment to lower eye pressure (Figure 3). Did it make sense to perform the above procedures as appropriate treatment for malignant glaucoma? The answer is No. These procedures do not eliminate the cause of glaucoma in any way and are only intended to reduce eye pressure. As for the zonulo-hyaloid-vitreotomy mentioned by Lois as an effective method of treating malignant glaucoma [10], according to the author of this study, the procedure is quite risky and unpredictable in its consequences. When introducing the vitrectomy knife from the side of the anterior chamber, we have no control over its operation. During such therapy, the artificial lens and the Zinn ligaments may be damaged, leading to subsequent subluxation of the lens. Additionally, in the event of damage to the ciliary processes haemorrhage and even retinal detachment may occur. It is also uncertain whether the procedure will break the abnormal path of aqueous humour distribution. As for posterior vitrectomy, the procedure is performed under visual control (endoillumination or corneal illumination in the OFISS system). Thus, the risk of these complications is much lower, and the effectiveness is very high [12-13].

4. Conclusion

Treatment of malignant glaucoma occurring after cataract removal should follow the appropriate principles as regards the selection of treatment methods and the time of their implementation. It should be targeted at treatment to remove the cause, not the symptom, i.e. abnormal high eye pressure. The ineffectiveness of conservative and laser therapy constitutes an indication for partial posterior vitrectomy to remove the causes of malignant glaucoma. This treatment should be introduced a few days after the onset of glaucoma symptoms at the latest. Its implementation at a later time exposes patients to a number of complications, including continuous pain in the eyeball, reduced effectiveness and even loss of vision.

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