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Analysis of the Causes and Management of Choroidal Detachment after Glaucoma Surgery

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Abstract: *Purpose*: To summarize and analyze the clinical features and management of postoperative choroidal detachment in glaucoma. *Methods*: Ten cases of choroidal detachment that occurred after glaucoma surgery were collected from March 2023 to February 2024 in the hospital. Their clinical characteristics and treatment effects were observed and their causes were analyzed. *Results*: After the operations, the eyes with choroidal detachment after glaucoma surgery had 2 cases of true microphthalmos, 6 cases of advanced glaucoma, and 2 cases of glaucoma secondary to vitreoretinal surgery. The postoperative manifestations were persistent shallow anterior chamber, the formation of anterior chamber, and then suddenly became shallow or disappeared. Meanwhile, the intraocular pressure was lower than 6 mmHg. Ultrasound and funduscopic examination showed that the choroid and retina were partially elevated, and the choroidal detachment recovered after treatment. *Conclusion*: Choroidal detachment is one of the common postoperative complications in glaucoma, especially in some special types of refractory glaucoma. Adequate perioperative management before surgery, cautious and delicate operation during surgery, and close observation and treatment after surgery can obviously decrease the occurrence and damage.

Keywords: Glaucoma; Filtration surgery; Choroidal detachment; Ciliary body detachment

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1. Introduction

Glaucoma external filtration surgery is a traditional and important treatment for glaucoma patients to control intraocular pressure, and choroidal detachment is one of the common complications after this surgery. Prolonged or severe choroidal detachment may cause a series of complications, such as shallow anterior chamber, cataracts, corneal endothelial malnutrition, non-formation of filtering bubbles, low intraocular pressure macular edema,

etc., leading to structural and functional abnormalities of intraocular tissues, seriously affecting visual function. Therefore, preventing and treating choroidal detachment is an important aspect of successful glaucoma filtration surgery. Based on the clinical data of our hospital in the past year, the clinical characteristics, cause analysis, and treatment of 10 cases of choroidal detachment of 10 eyes after glaucoma external filtration surgery were summarized and analyzed.

2. Clinical information

2.1. General information

Ten patients with choroidal detachment (confirmed by fundus and ultrasound) after anti-glaucoma surgery in our hospital from March 2023 to February 2024 were collected in 10 cases (6 males and 4 females) and 10 eyes (left eyes and 5 right eyes). The youngest was 41 years old and the oldest was 76 years old with an average age of 61.4 years old. Among the patients, there were 2 eyes with true microphthalmos, 6 eyes with advanced glaucoma, and 2 eyes with glaucoma secondary to vitreoretinal surgery. There were 2 cases of high myopia, 1 case of hypertension, 2 cases of diabetes, and 1 case of ciliary body detachment. Ocular examinations showed that visual function was poor in all eyes on admission, with visual acuity ≥ 0.3 in 5 eyes, between 0.1 and 0.3 in 3 eyes, and < 0.1 in 2 eyes. Preoperative intraocular pressure (IOP) ranged from 21 to 30 mmHg in 2 eyes, from 31 to 40 mmHg in 2 eyes, and above 40 mmHg in 6 eyes. After hypotensive and anti-inflammatory treatment, the affected eyes continued to have different degrees of ciliary body congestion or mixed congestion and different degrees of posterior iris adhesion. All patients underwent glaucoma surgery as usual, including conventional Trabeculectomy (TVT)in 5 eyes, Ex-Press implantation (Alcon Laboratories) in 2 eyes, and Amed glaucoma valve implantation (New World Medical Inc., Rancho Cucamonga, CA, USA) in 3 eyes. The demographic characteristics of patients with choroidal detachment is presented in **Table 1**.

Table 1. Clinical Characteristics of patients with choroidal detachment after glaucoma external filtration surgery

No.	Gender	Age	Surgical Eye	Preoperative BCVA	Preoperative IOP(mmHg)
1	M	46	OD	0.02	56.4
2	F	41	OS	0.4	28.7
3	M	66	OS	0.3	33.8
4	F	62	OD	0.12	42.3
5	M	70	OD	0.3	31.8
6	M	67	OS	0.1	45.7
7	F	65	OD	0.3	42.2
8	M	51	OD	0.05	51.4
9	M	70	OS	0.3	29.3
10	F	76	OS	0.2	43.6

Table 1 (Continued)

No.	Preoperative complication	Surgical approach	Occurrence time Of postoperative choroidal detachment (d)	Occurrence site of postoperative choroidal detachment	Postoperative IOP (mmHg)
1	**True microphthalmos,** Advanced glaucoma, Ciliary body detachment	Amed glaucoma valve implantation	3	Multiple quadrants on the nasal and temporal sides	5.8
2	High myopia	Conventional Trabeculectomy	3	Multiple quadrants on the nasal and temporal sides	5.5
3	Diabetes	Ex-Press implantation	2	Subnasally	5.1
4	Glaucoma secondary to vitreoretinal surgery.	Conventional Trabeculectomy	5	Multiple quadrants on the nasal and temporal sides	4.5
5	Diabetes, Advanced glaucoma	Amed glaucoma valve implantation	3	Temporally	4.7
6	Glaucoma secondary to vitreoretinal surgery.	Conventional Trabeculectomy	3	Multiple quadrants on the nasal and temporal sides	4.1
7	Advanced glaucoma, Hypertension	Conventional Trabeculectomy	2	Temporally	4.2
8	True microphthalmos, Advanced glaucoma	Amed glaucoma valve implantation	3	Multiple quadrants on the nasal and temporal sides	5.6
9	High myopia, Advanced glaucoma	Ex-Press implantation	3	Subnasally	5.9
10	Advanced glaucoma	Conventional Trabeculectomy	6	Temporally	4.5

M, male; F, female; BCVA, best corrected visual acuity; OD, right eye; OS, left eye

2.2. Clinical features and management of choroidal detachment

All the patients underwent glaucoma filtration without anterior chamber hemorrhage or other complications. Most of the choroidal detachments occurred around 3 days postoperatively, as confirmed by ultrasound and funduscopic examination, with 2 eyes occurring 2 days postoperatively, 6 eyes appearing 3 days postoperatively, and 2 eyes appearing 5 or more days postoperatively. Most of the patients complained of a black shadow in front of their eyes blocking part of the visual field, decreased visual acuity, and distorted vision in 2–5 days after the operation, while the rest of the patients did not have any special self-conscious symptoms. Ocular examination showed a persistent postoperative shallow anterior chamber in 6 eyes before the onset of choroidal detachment. In 3 eyes, the anterior chamber suddenly disappeared or became shallow after its formation.

According to Spaeth's shallow anterior chamber grading criteria, irises with only peripheral contact with the corneal endothelium is class I, irises with total contact with the corneal endothelium is class II, and class II plus no gap in the pupillary area is class III. The postoperative anterior chamber depths of the 10 eyes in this paper were grade I in 3 eyes, grade II in 7 eyes, and grade III in 1 eye. The sites of choroidal detachment were all located at the anterior equatorial peripheral part of the fundus. Two eyes were located subnasally, three were located temporally, and five eyes had two or more hemispherical choroidal detachments simultaneously on the nose side (**Figure 1**

and **Figure 2**). IOP was lower than 6 mmHg. With the persistence of a shallow anterior chamber and low IOP, the cornea showed different degrees of edema, decreased transparency, and wrinkling of the Descemet's membrane. Immediately after the patient was diagnosed with 10 eyes, cotrimoxazole was given, and the pupils were dilated every 10 minutes for 4 to 6 times. If the pupils were not dilated and the anterior chamber did not deepen, a pupil-dilating combination of subconjunctival injection (epinephrine injection 1mg + atropine injection 2mg + lidocaine injection 2mg), eye pads cover, hormonal eye drops, periocular injection of dexamethasone injection 2.5mg + lidocaine injection 2.5mg, atropine and hormonal ophthalmic ointment were applied at bedtime.

Afterwards, the eye was bandaged with pressure, and the patient was instructed to rest in bed. Systemic hormonal medication was administered as necessary until complete recovery from choroidal detachment. After conservative treatment, choroidal detachment recovered completely within 1 to 2 weeks in 9 eyes. One eye underwent phacoemulsification cataract surgery combined with IOL implantation and anterior chamber plasty due to loss of the anterior chamber and severe corneal haze and lens opacity.

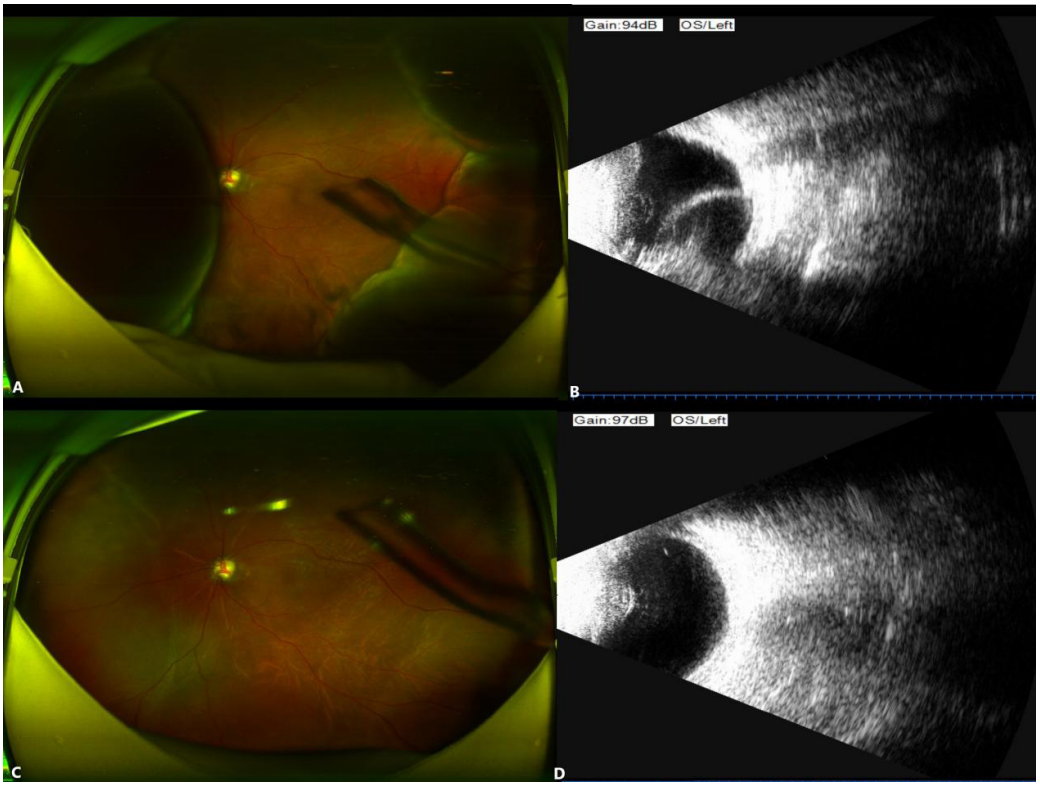

Figure 1. Resolution of postoperative choroidal detachment documented by fundus photography and ultrasonography; (A) Panoramic fundus photography on day 5 after combined surgery showed multiple quadrant hemispherical elevated foci; (B) Ultrasound on day 5 after surgery showed choroidal detachment; (C) Fundus panoramic photograph 2 weeks after medication showing flat retinal volvulus; (D) Ultrasound 2 weeks after medication showing retina in place and choroidal detachment recovered.

True microphthalmic advanced glaucoma after cataract surgery still persisted with high intraocular pressure (ocular axis: 17.66 mm) and shallow anterior chamber, 5 days after vitrectomy combined with implantation of glau coma drainage valve, complaining of decreased visual acuity, sense of occlusion of vision, and low intraocular pre ssure.

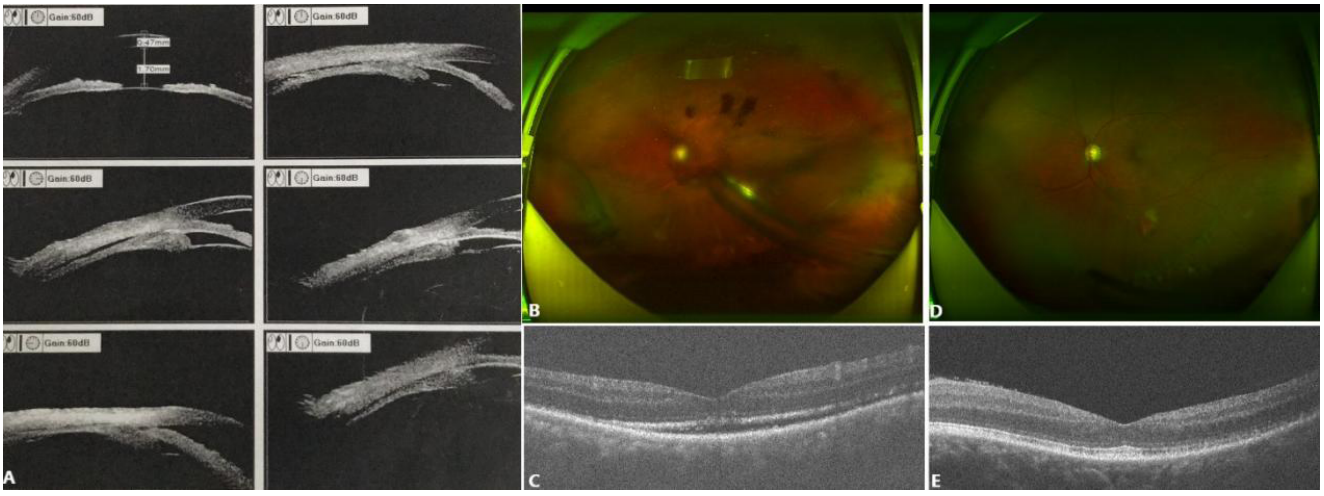

Figure 2. Imaging findings of ciliary body and choroidal detachment after glaucoma drainage device implantation and its resolution after medical treatment; (A) Preoperative UBM showed 360° ciliary body detachment; (B) Glaucoma drainage valve Fundus panoramic photography on day 3 after implantation of glaucoma drainage valve showed hemispherical elevated foci in both subnasal and inferotemporal quadrants; (C) OCT on day 3 after implantation of glaucoma drainage valve showed subretinal effusion; (D) Fundus panoramic photography on day 10 after medication showed flat retinal volvulus; and E: OCT on day 10 after medication showed absorption of subretinal effusion.

True microphthalmos advanced glaucoma persistent high intraocular pressure (ocular axis: 19.74 mm), with shallow anterior chamber. After cataract surgery, the intraocular pressure still could not be controlled, shallow anterior chamber. Vitrectomy combined with implantation of a glaucoma drainage valve was performed again after one month, and on the 3rd day after the operation, he complained of decreased visual acuity, a sense of occlusion of the sight, and low intraocular pressure.

3. Discussion

The pathogenesis of choroidal detachment is complex and may be related to the following factors. First, preoperative intraoperative and postoperative intraocular pressure are the main factors. Preoperatively, high intraocular pressure will lead to choroidal vascular congestion, tissue edema, and increased permeability, resulting in plasma and fibrous exudation of the pigmented membrane. A sudden decrease in intraoperative intraocular pressure will lead to a certain negative pressure in the suprachoroidal cavity, disappearance of the anterior chamber, anterior shift of the crystalline lens, increase in the permeability of the choroidal capillaries, and leakage of plasma fluid into the suprachoroidal cavity of the ciliary body. A persistent postoperative state of low IOP promotes more fluid accumulation and detachment of the ciliary body choroid. Scheffer noted that any internal eye surgery to open the anterior chamber is characterized by a sudden drop in IOP. In addition, fluid accumulation and choroidal detachment only occurs with persistent low IOP. Therefore, it is very important to decrease IOP sufficiently preoperatively, to puncture the anterior chamber intraoperatively to allow slow outflow of aqueous humor, and closely observe IOP changes in the operated eye postoperatively. In particular, the choice of anesthesia and surgical approach is also very important in the 10 patients with special types of glaucoma reported in this article.

Intraoperative general anesthesia can significantly decrease the fluctuation of intraocular pressure. The

implantation of glaucoma drainage device (GDD) is better than traditional trabeculectomy to prevent an intraoperative sudden drop in intraocular pressure in patients with glaucoma secondary to vitreoretinal surgery, thus lowering the risk of choroidal detachment [1]. For such patients, intraoperative injection of viscoelastic agents into the anterior chamber can be conducted to avoid the risk of secondary choroidal detachment caused by a sudden drop in intraocular pressure during and after surgery. Preoperative state of ciliary body detachment refers to the second factor. Ciliary body detachment causes the small arteries supplying the ciliary body to be stretched and blood supply to be reduced, exacerbating ischemia and hypoxia, leading to a decrease in aqueous humor secretion and a drop in intraocular pressure; leakage fluid collects in the supraciliary cavity and causes choroidal detachment; and increased outflow from the uveoscleral pathway disrupts the blood-aqueous barrier, leading to a drop in IOP [2, 3]. Therefore, glaucoma patients should routinely undergo preoperative UBM. Besides, those with ciliary body detachment should be treated promptly, thereby reducing the risk of postoperative choroidal detachment.

As reported in this study, one of the cases had choroidal detachment after glaucoma filtration surgery with preoperative ciliary detachment. Notably, in some patients, ciliary choroidal detachment is a stage in the development of malignant glaucoma. Ciliary choroidal detachment can cause anterior displacement of the vitreous and lens, ciliary body edema, and secondary closure of the chamber angle, leading to retrograde movement of aqueous humor and inducing malignant glaucoma [4, 5]. At this time, although high intraocular pressure of malignant glaucoma can relieve choroidal detachment, but malignant glaucoma has already occurred and the anterior chamber becomes shallow. However, the intraocular pressure is relatively normal or low, it is easy to be misdiagnosed or underdiagnosed. Thirdly, preoperative vitreous cavity status. Epstein found that shallow anterior chamber occurred less in children or young people than in older people. This stems from the more normal vitreous structure of young people, which resists compression caused by choroidal detachment. In contrast, the elasticity of the vitreous body decreases in patients with elderly or myopia, and the supporting effect on the eyeball wall is weakened. This makes it less resistant to the leakage of choroidal intravascular fluid, weakened, and the risk of choroidal detachment after surgery increases. In addition, a large number of studies have reported that secondary high intraocular pressure after vitreoretinal surgery is common and may lead to progressive glaucoma damage [6].

Under poor drug control, anti-glaucoma surgical treatment should be considered. Because the vitreous cavity of these patients contains water, choroidal detachment or even explosive suprachoroidal hemorrhage is prone to occur during external filtration surgery. Hence, the choice of surgical approach is very important. In the current study, the two patients with secondary glaucoma after vitrectomy experienced choroidal detachment after traditional trabeculectomy. The main reason was that the vitreous cavity was unable to support the eyeball wall. This was associated with the large fluctuations in intraocular pressure during and after trabeculectomy, and it is worth noting. Fourthly, systemic conditions. The elderly, high myopia, advanced glaucoma, true microphthalmia, and other patients with poor microvascular function, hemodynamic compensatory capacity is weak. At the same time, their ocular vortex venous and vascular damage will cause extravasation of fluid from the uveal membrane, which can easily lead to choroidal detachment if combined with diabetes mellitus, hypertension, hyperlipidemia, and other systemic diseases [7].

The cases reported in this paper included 2 cases of true microphthalmos, 6 cases of advanced glaucoma, 8 cases of elderly patients with 2 cases of high myopia, 1 case of hypertension, and 2 cases of diabetes mellitus. It can be seen that the ocular and systemic conditions of the patients increase the risk of choroidal detachment in the postoperative period [8]. Finally, if the surgical incision is too far back, it is easy to damage the ciliary body and

make its contact with the scleral protuberance loose or detached, leading to the direct entry of aqueous humor into the suprachoroidal cavity. If the surgical incision is too large, the postoperative closure of the conjunctival incision is poor, the outflow of fluid is too much, the filtration is too strong, and the intraocular pressure is lowered, which can easily cause choroidal detachment. Too long surgical time can make the pressure in the suprachoroidal cavity lower than atmospheric pressure, resulting in fluid leakage to the outside. Insufficiently delicate surgical operation, intraoperative fluid release is too fast, and IOP drops suddenly. In this paper, there were 2 cases of posterior surgical incision and 2 cases of rapid intraoperative fluid release.

There is no uniform conclusion about the choice of treatment for choroidal detachment. Most clinicians prefer conservative treatment with drugs, which should not be rushed [7]. Conservative treatment included:

(1) Glucocorticoid: local and systemic glucocorticoid application can decrease the permeability of the capillary wall, inhibit the release of prostaglandins and histamine, repair the blood-aqueous barrier, reduce fluid extravasation, decrease the release of various inflammatory factors, and decrease the ocular inflammatory response.

(2) Ciliary muscle paralytic agent: 1% atropine, compound tropine phthalamide are commonly used to paralyze the ciliary muscle, thus the lens-iris septum is shift backward, the anterior chamber is deepened, the pupillary block is lifted, and the posterior iris adhesion is avoided.

(3) Hemostatic drugs: To prevent the bleeding phenomenon of ciliary body and choroidal blood vessels caused by the sudden drop of intraocular pressure.

(4) Physiotherapy: Bandage both eyes, rest quietly to decrease the outflow of aqueous humor, wound repair [9–11].

Surgery should be considered if choroidal detachment with anterior chamber loss lasts for about a week, crystals adhere to the cornea, the cornea is cloudy and edematous, and ocular irritation worsens. Surgery is usually performed with anterior chamber plasty or suprachoroidal chamber drainage [12]. Of the 10 patients reported herein, 9 eyes with shallow anterior chamber of grade I or II had all detached choroidal reset after conservative treatment for at least 3 days and up to 15 days (all confirmed by ultrasound and ultra-wide-angle fundus imaging). These results further demonstrate the importance of prevention, early diagnosis, and treatment of secondary choroidal detachment after glaucoma surgery. Of course, it must be considered the limitations of the present study. Firstly, the study was retrospective and reported a small number of cases. Second, this study did not analyze the impact of other risk factors, such as preoperative status (acute or chronic), age, gender, genetic factors, etc. on the risk of choroidal detachment after glaucoma filtration surgery. We will further investigate the risk factors of secondary choroidal detachment after glaucoma filtration surgery in subsequent large sample studies.

4. Conclusion

In conclusion, choroidal detachment is one of the common complications after external filtration surgery for glaucoma. Although most of them can be recovered by pharmacologic conservative treatment, its occurrence still needs to be emphasized [7]. For high-risk patients, adequate preoperative examination, evaluation, perioperative preparation and communication, intraoperative selection of appropriate surgical and anesthetic modalities and careful and delicate operation, and postoperative close observation and management can significantly decrease its occurrence and damage.

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Disclosure statement

The authors declare no conflict of interest.

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