2 Traumatic Cyclodialysis

Yujie Yan and Zhijun Wang

Abstract

Traumatic cyclodialysis is a condition in which the longitudinal fibers of the ciliary muscle are disinserted from the scleral spur, creating an abnormal communication between the anterior chamber and the suprachoroidal space by different kinds of trauma. This chapter specifically focuses on its definition, epidemiology, pathogenesis, clinical manifestations, investigations, and managements. This chapter also provides clinical cases of complicated traumatic cyclodialysis.

Keywords

Traumatic cyclodialysis · Clinical manifestation · Management

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2.1 Introduction

Cyclodialysis is a condition in which the longitudinal fibers of the ciliary muscle are disinserted from the scleral spur, creating an abnormal communication between the anterior chamber and the suprachoroidal space, which leads to chronic ocular hypotony, corneal edema, shallowing of the anterior chamber, cataract, choroidal effusion, optic nerve edema, retinal and choroidal folds, hypotonus maculopathy, retinal pigment epithelium (RPE) atrophy and loss of vision [1]. It usually occurs due to ocular trauma or as complications following ophthalmic procedures, which involves iris manipulation such as extracapsular cataract surgery, phacoemulsification, intraocular lens insertion, after phakic IOL removal and displacement of an angle supported anterior chamber IOL etc [2]. Classically, Gonioscopy remains the gold standard for the identification of cyclodialysis clefts; However, ultrasound biomicroscopy [UBM], anterior segment optical coherence tomography [OCT], magnetic resonance imaging [MRI] have proven to be effective in diagnosing as well. Although medical treatment can help to close small clefts, laser treatment or surgery is usually needed to seal the fistula.

This chapter will specifically focus on traumatic cyclodialysis, including its definition, epidemiology, pathogenesis, clinical manifestations, investigations, and management.

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2.2 Definition and Epidemiology

Traumatic Cyclodialysis is defined as longitudinal fibers of the ciliary muscle disinserted from the scleral spur, as a result of ocular trauma. It can be accompanied by traumatic hyphema, lens dislocation, traumatic mydriasis, iridocyclitis, and with severe vitreous or chorioretinal pathology [3]. Although cyclodialysis has been described after penetrating ocular trauma [4], most of the cases are followed by blunt ocular trauma, with the reported rates ranging between 1 and 11% [5]. It is more frequent in men, who are more prone to suffer trauma. A variety of agents like balls, stones, punches, airbags, firecrackers and elastic cords have been reported to cause cyclodialysis [1].

2.3 Pathogenesis

Cyclodialysis results from momentary axial compression and rapid equatorial expansion that stretches the ocular tissue, leading to the separation of the meridional ciliary muscle fibers from their attachment in the scleral spur [6]. The detachment of the ciliary body from the scleral spur seems to be the most common mechanism for persistent ocular hypotension after blunt trauma. There does not seem to be a preferential location for cyclodialysis, superior and inferior locations have all been reported.

The direct communication between the anterior chamber and the ciliochoroidal space allows an unrestricted flow from the anterior chamber to the Suprachoroidal space. The choroidal detachment thus produced would decrease the production of aqueous humor in the ciliary epithelium. All these mechanisms contribute to hypotony. However, the intraocular pressure drop is not proportional to the cleft size, which indicates that factors such as decreased aqueous production might also influence the outcome [7].

2.4 Clinical Manifestations

The ocular hypotony syndrome is considered the most important and devastating clinical feature of traumatic cyclodialysis. Ocular hypotony is defined as an IOP of 5 mmHg or lower. Clinical manifestations of chronic hypotony include corneal edema, shallowing of the anterior chamber, cataract, choroidal effusion or detachment, retinal and choroidal folds, optic disk swelling, venous tortuosity, and maculopathy. All these conditions may lead to visual loss, which may become permanent if the hypotony is not resolved promptly. Angular recession is accompanied by traumatic cyclodialysis in most patients. However, secondary open-angle glaucoma is not frequent. A series even found that the presence of a cyclodialysis was a protective factor against the development of glaucoma [8].

2.5 Investigations

Locating the cleft is essential for treatment. Gonioscopy has been considered the gold standard for the diagnosis of cyclodialysis. However, it may not be an optimal choice when there are corneal folds, hazy media, or a shallow anterior chamber. Moreover, microclefts and oblique channels may be particularly difficult to detect using gonioscopy. It is reported that gonioscopy will open the cleft and cause a transient flow of aqueous into the suprachoroidal space, resulting in post gonioscopy hypotony and inducing a significant reduction of IOP and the appearance of visible folds in Bowman's membrane [9].

UBM is considered more useful and sensitive in localizing, measuring, and monitoring cyclodialysis compared with gonioscopy. It allows a cross-sectional image of the cleft (Fig. 2.1) and

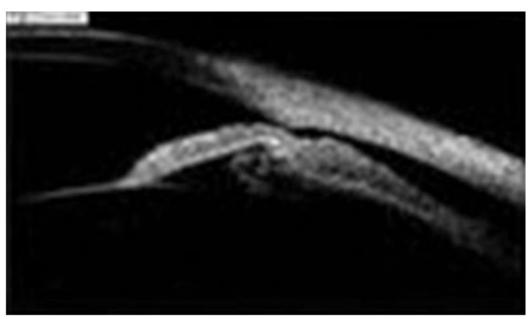

Fig. 2.1 A cross-sectional UBM image of traumatic cyclodialysis, showing ciliary muscle disinserted from the scleral spur, and communication between the anterior chamber and the suprachoroidal space

has the ability to detect when there are corneal folds, hyphema, a shallow anterior chamber or iris bowing. It also has the ability to detect tractional ciliary body detachment, ciliary body atrophy, suprachoroidal effusion, which is an essential tool in the differential diagnosis of ocular hypotony.

OCT is a noninvasive, painless, noncontact technique that provides reproducible images of the anterior segment and can be used in the diagnosis of cyclodialysis as well. It is performed in an upright position (while UBM is usually performed in a supine position), so the findings may more likely reflect gonioscopic and slit-lamp biomicroscopic clinical findings. However, the structure posterior to the iris is not visible with OCT, and traditionally its sensitivity has been considered inferior to UBM. Other ancillary techniques such as transillumination [10], magnetic resonance imaging [11] have also been reported but not widely used in clinical settings.

2.6 Management

Treatment of traumatic cyclodialysis should be started if hypotony is associated with morphological and functional complications. Several options have been used for treating this condition but should concerning about the numbers and the extent of the cleft to choose the optimal treatment.

Medical treatment should be employed first because some cyclodialysis resolves spontaneously, and a slight delay in IOP restoration does not change the visual prognosis. Medical treatment includes administrating atropine and steroids(topical and systemic) for several weeks and quick tapering of steroids. Steroids should not be used for extended periods, for it is believed that they can hinder the healing process that closes the fistula. For a small cleft, if ocular hypotony maculopathy persists after 2 months of stopping steroids, then Invasive or semi-invasive methods should be considered. However, for medium or large clefts, it is recommended to take the invasive methods with no delay.

If the cleft is a small cleft (<3 clock-hours), a laser should be tried. Argon laser is always useful when the cleft is easy to locate. The laser should be applied on both sides of the cleft, and bubble formation is considered a sign of good tissue response. Zeiss four-mirror gonioscopy is recommended in order to deepen the angle. Pilocarpine and viscoelastic are considered able to open the cleft and make Argon laser photocoagulation easier. Swelling of the choroid following laser treatment closes the cleft. Nd-YAG laser and laser endo-photocoagulator have also been used. If the cleft cannot be located, transscleral methods (such as transscleral diode laser) allow treating a wider area. Diathermy is not recommended because it could damage the lens and induce scleral ectasia [12]. Cryotherapy has shown only modest results, and it induces severe inflammation, so it should only be used when the laser is not available or preferably used combined with a gas injection or vitrectomy. If medical and laser treatment have failed in small clefts, direct cyclopexia should be performed(illustrated in the coming paragraph).

If medical treatment is not effective in medium-size clefts (3–6 clock-hours), direct cyclopexia should be considered. This procedure starts with a dissection of limbal based sclera lamella, with the thickness of 1/2–2/3 of the total sclera thickness and 3–3.5 mm behind the limbus (Fig. 2.2); then penetrate the sclera 1.5 mm behind the limbus (Fig. 2.3)and finally, suturing the insertion of the ciliary muscle to the scleral spur with 10/0 nylon. Locate the cleft and determine its extension before surgery is crucial in this procedure. However, "real time" locating the cleft during surgery and check the effect after suturing using a gonioscopy or a Goldmann

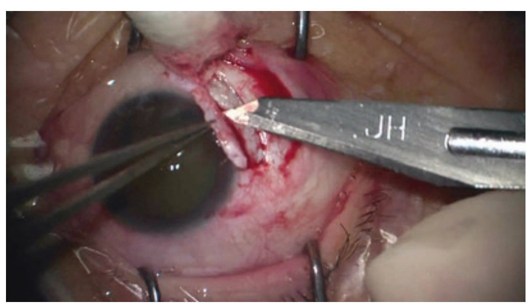

Fig. 2.2 Dissection of limbal based sclera lamella, with the thickness of 1/2–2/3 of the total sclera thickness, and 3–3.5 mm behind the limbus

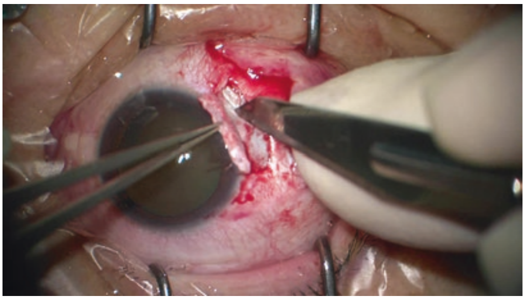

Fig. 2.3 Penetrating the sclera 1.5 mm behind the limbus

three-mirror contact lens is even more important. To locate 1–2 mm beyond the area of cyclodialysis is suggested. It can be challenging to suture a hypotonic eye. Using an anterior chamber viscoelastic or posterior infusion cannula to restore ocular pressure can sometimes be useful. Potential complications include intraocular hemorrhage, endophthalmitis, cataract, vitreous loss, retinal detachment, wound dehiscence, and secondary glaucoma due to peripheral anterior synechiae. For multiple or very extensive clefts, direct cyclopexy is not recommended because dissection of an extensive scleral lamella could affect the anterior segment. Closure of the cleft is followed by an IOP spike. It is considered to be the result of the restoration of aqueous humor production by the ciliary body with incomplete recovery of trabecular meshwork function. IOP returns to normal after a few hours, and this spike occurs in more than half the patients [13]. This spike can be controlled with topical medication except for miotics for they could lead to reopening of the cleft.

Vitrectomy with gas tamponade or silicone oil seems to be the safest option in clefts with a bigger size of (>6 clock-hours), or multiple medium-size clefts, or clefts with various retinal or choroid damage that need vitrectomy as well. Vitrectomy may also be necessary if direct cyclopexy is not successful in small or medium-size clefts. Cryotherapy can be accompanied by vitrectomy to facilitate the closure rate. Endoscopic-guided suture of the ciliary body detachment can also be performed though it is difficult to separate the effects of gas and the suture, as gas tamponade by itself is an effective method to treat cyclodialysis.

Other options have been reported. One of them is Internal tamponade using a capsular tension ring (CTR) or an intraocular lens (IOL) when cataract surgery is necessary. An IOL is inserted in the sulcus and carefully oriented until one of the haptics faces the site of the cyclodialysis. If the cleft is the extent, placing a CTR in the sulcus would be a better option. The scarring process induced by postoperative inflammation and a moderate internal compression by the haptic or the CTR, results in closure of the fistula. However, long-term outcomes are still uncertain. Potential risks include ciliary body damage, erosion, hemorrhage, and pain from the compressive effects of the haptics or the CTR [14]. Scleral buckling and pneumocyclopexy have also been reported, with the efficiency of which is under debate.

2.7 Specific Challenges and Personal Experience

Treating traumatic cyclodialysis in blunt trauma to large extent and with severe retinal and choroid involvement can be challenging. Vitrectomy and silicone oil tamponade are needed in most cases. A posterior infusion cannula to restore ocular pressure should always be made first, however, sometimes it is hard to position it into the right place in the vitreous cavity, whether because of the low IOP, choroidal detachment or hemorrhage, or the large extent of cyclodialysis. Anterior chamber infusion can then be an alternative way to restore IOP. In cases with large traumatic cyclodialysis at the position of trocar insertion, the cannula cannot penetrate the detached ciliary body. It is better to drainage the suprachoroidal fluid or hemorrhage and then suture the cleft first (see Case 1). Further steps can then be done to manage the retinal or choroidal damage. For an extremely detached ciliary body with a wide extent, an iris hooker can be used to maintain the ciliary body in position temporarily and make the suturing easier (Fig. 2.4).

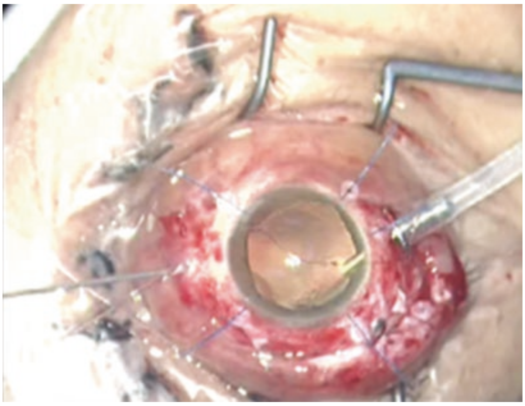

Fig. 2.4 Iris hooker can be used to maintain the ciliary body in position and make the suturing easier

If the posterior cannula can easily be placed in position, then suturing is not always necessary. Cryotherapy along the extent of the cleft can be made to facilitate the closure of the cleft (see Case 2). Perfluoro-N-octane (PFO) assisted total gas-fluid exchange to squeeze the suprachoroidal fluid is always vital before silicone tamponade. A face-down position is recommended after surgery. Silicone oil can be removed depending on how well the retina recover, but for most cases with such severe trauma, silicone oil retention would probably be the result.

2.8 Case 1

Patient with blunt trauma of the right eye causing vitreous hemorrhage, traumatic cataract, lens dislocation and traumatic cyclodialysis was present. Anterior chamber infusion was used to retain the IOP, cataract, and vitreous hemorrhage were removed successfully. PFO was used to retain the retina. Cyclodialysis was right at the position of trocar insertion; thus the cannula cannot penetrate the detached ciliary body. After drainage of the suprachoroidal fluid, the ciliary body was sutured using the bimanual suturing technique. The total gas-fluid exchange was then made, and silicone oil was tamponade (Video 2.1). Six months after surgery, silicone oil was removed, and retinal was in position. The anterior chamber

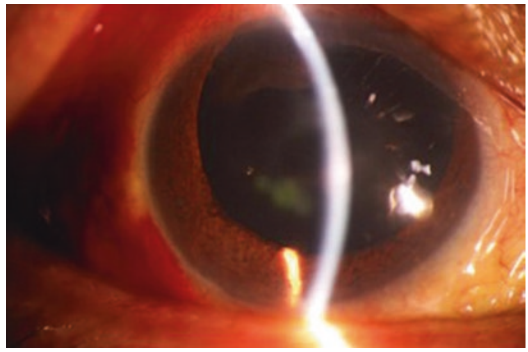

Fig. 2.5 Slip lamp photo showing anterior chamber was deep, and pupil was almost round

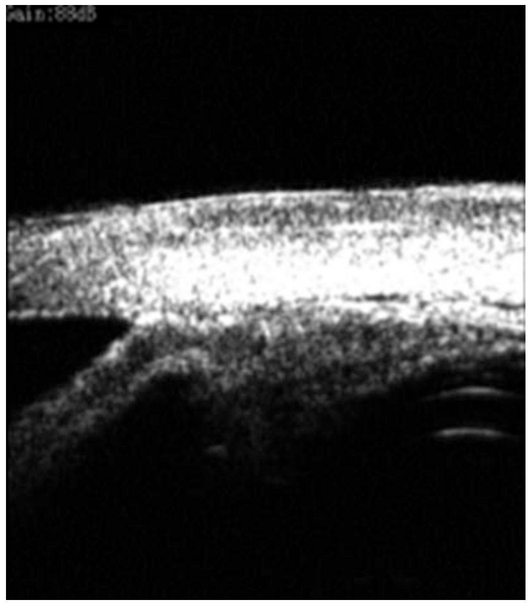

Fig. 2.6 Cross-sectional UBM image showed the ciliary body was reattached

was deep, and the pupil was almost round (Fig. 2.5). UBM showed the ciliary body was reattached (Fig. 2.6), and IOP was maintained in normal status.

2.9 Case 2

Patient with blunt trauma of the left eye causing vitreous hemorrhage, traumatic cataract, and traumatic cyclodialysis was present. After cataract and vitreous hemorrhage were removed, cryotherapy along the extent of the cleft was made to facilitate the closure of the cleft (Video 2.2). Total gas-fluid exchange with PFO was used to stabilize the retina, and total gas-fluid exchange was made. Silicone oil was then tamponade. Six months after surgery, silicone oil was removed, and the retinal was in position. The anterior chamber was deep, and pupil was round (Fig. 2.7). UBM showed the ciliary body was reattached (Fig. 2.8), and IOP was maintained in normal status.

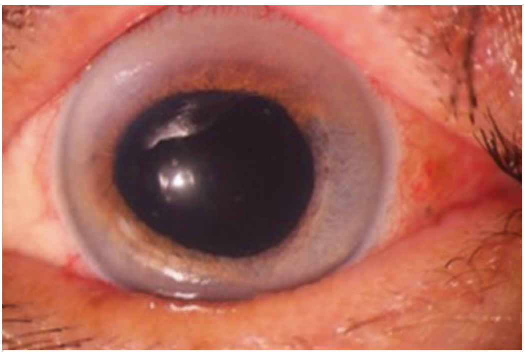

Fig. 2.7 Slip lamp photo showing anterior chamber was deep and pupil was round

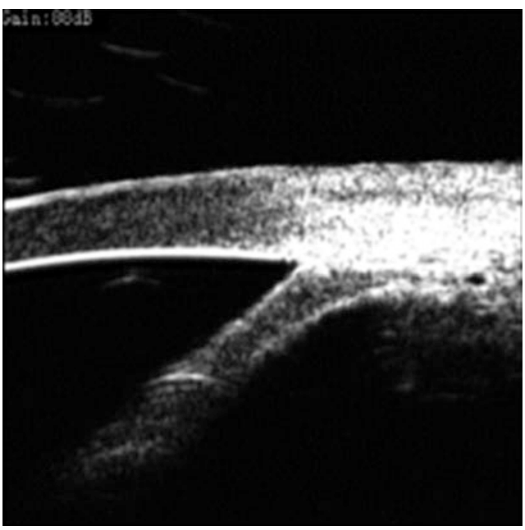

Fig. 2.8 Cross-sectional UBM image showed the ciliary body was reattached

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