

Ultrasound Biomicroscopy-Guided Surgical Intervention for Cyclodialysis Clefts

UBM is a key diagnostic and management tool for ocular hypotony of unclear etiology.

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In this issue of Retina Today, Mehran Taban, MD; Christine Sonnie, RN; Brandy C. Hayden, BS; and Jonathan E. Sears, MD, provide surgical pearls for using ultrasound biomicroscopy for the diagnosis and surgical management of cyclodialysis clefts in a series of patients with hypotony treated with external cycloplexy with radial sutures.



We extend an invitation to readers to submit pearls for publication in Retina Today. Please send submissions for consideration to Dean Elliott, MD (dean_elliott@meei.harvard.edu); or Ingrid U. Scott, MD, MPH (iscott@psu.edu). We look forward to hearing from you.

—Ingrid U. Scott, MD, MPH; and Dean Elliott, MD

Ocular hypotony is associated with significant visual dysfunction depending on its severity and duration. One etiology of hypotony is cyclodialysis cleft (CDC), a disinsertion of the longitudinal ciliary muscle fibers from the scleral spur. Originally described as a planned surgical treatment for intractable glaucoma, CDC may be observed following trauma or as an inadvertent surgical event from a variety of procedures involving iris or angle manipulation such as goniotomy, trabeculectomy, phacoemulsification, intra- or extra-capsular cataract extraction, iridectomy, and sclerotomy. It can also be present in cases of anterior proliferative vitreoretinopathy (PVR) with traction on the ciliary body causing an occult CDC.¹

DIAGNOSIS

The diagnosis of CDC requires clinical suspicion, as its signs are often limited; these can include a combination of a shallow anterior chamber, a peaking of the pupil, partial mydriasis, or just hypotony. Gonioscopy can identify a

CDC, but it is often limited, especially for smaller clefts, in cases with factors precluding an adequate view, such as hyphema, corneal edema, and shallow anterior chamber. Immersion B-scan has been used with limited success.² Magnetic resonance imaging (MRI) has also been attempted; however, its high cost, limited accessibility, and relative poor resolution make it an unacceptable choice.³ Even scleral transillumination has been described.⁴

Ultrasound biomicroscopy (UBM) can provide high-resolution (37 μ m) images of angle structures, compared with a resolution of approximately 190 μ m for standard B-scan ultrasound. UBM has been used to diagnose CDCs,⁵⁻⁸ although there are limited reports of its use in diagnosing and guiding the management of CDC in a large series. We are unaware of the use of external direct cycloplexy in previously reported series. The purpose of this study, therefore, is to evaluate UBM in guiding the diagnosis and surgical management of CDCs in a small series of patients with hypotony. The surgical technique employed to close the CDCs was external cycloplexy with radial sutures.

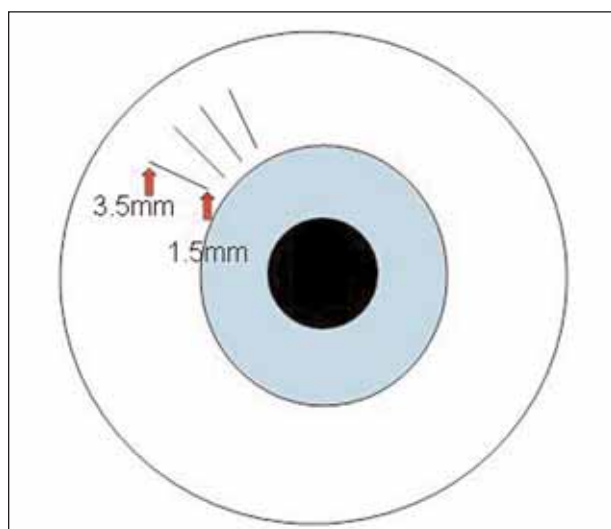


Figure 1. Schematic of external cycloplexy with radial sutures.

METHODS

After receiving approval from the Cleveland Clinic institutional review board, we performed a retrospective analysis of patients with hypotony (intraocular pressure [IOP] <6 mm Hg) of unclear etiology at the Cole Eye Institute between 2002 and 2008. Patients with known causes of hypotony such as a glaucoma shunt, filtering procedure, or chronic retinal detachment were excluded. Patients had imaging with UBM to evaluate for the presence of CDC. Patients who were determined to have a CDC as the potential cause of hypotony underwent surgical repair to close the clefts. Following surgery, UBM was repeated to evaluate the state of the CDC.

UBM AND SURGICAL PROCEDURE

Patients underwent imaging with UBM 1840 (Humphrey Instruments Inc., San Leandro, CA), 50 MHz with a resolution of 37 μ m, penetration depth of 5 mm, and scan width of 5 mm. The UBM was used to scan for CDC across 360° of the ciliary body region. All scans were performed by an experienced certified ultrasonographer trained in UBM.

External cycloplexy by radial sutures was employed to close the CDCs (Figure 1). Written informed consent was obtained from each patient before surgery. All patients underwent surgery under retrobulbar anesthesia using bupivacaine 0.75%. Following localized conjunctival dissection and cauterization to obtain hemostasis, the extent of the CDC was marked. Next, using a 9-0 Prolene (Ethicon, Inc., Somerville, NJ) suture, full-thickness bites were taken that spanned from 4.0 to 1.5 mm (radially) from the limbus through the ciliary body. Enough inter-

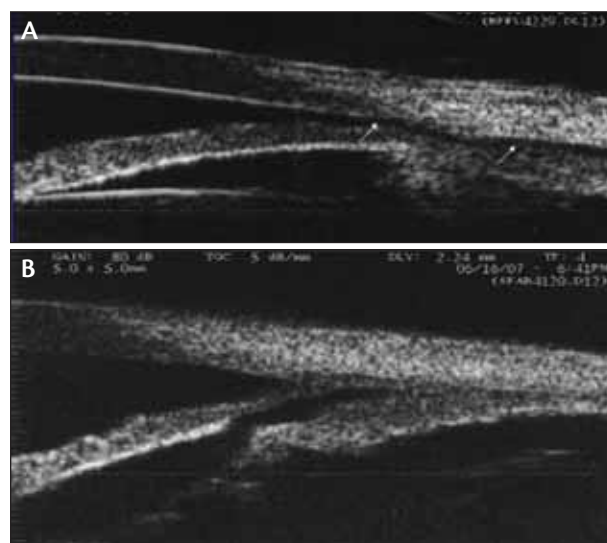


Figure 2. Examples of patients with CDCs demonstrating closure of the cleft following external cycloplexy. (A) Case 1 before surgery, (B) case 1 after surgery

rupted bites were placed, separated by approximately 0.5 mm to cover the cleft extension. Suture knots were then buried through the sclera, and the conjunctiva was closed with a 6-0 plain gut suture.

RESULTS

Twenty patients (20 eyes) were found to have hypotony of unclear etiology; UBM identified a potential (possible or definite) CDC in 10 cases (50%; Table 1). Four patients had a history of infectious uveitis, two patients a history of vitrectomy surgery for epiretinal membrane, two patients had a history of blunt trauma, one patient a history of retinal detachment and aphakia, and one patient had a history of anterior chamber IOL explant and sutured posterior chamber IOL in preparation for corneal transplant.

Ten eyes underwent external cycloplexy with radial sutures and had a median follow-up of 13.5 months (range, 5-36 months) following surgery. Median duration of hypotony among patients with CDC undergoing surgery was 3 months (range, 1-24 months), with median IOP of 1 mm Hg (range, 0-4 mm Hg). Following external cycloplexy, the median IOP was 8 mm Hg (range, 0-28 mm Hg), representing a median increase of 5 mm Hg (range, 0-28 mm Hg). However, among those with definite CDC (n=5 eyes: cases 1-4, 10), the median IOP following external cycloplexy was 21 mm Hg (range, 14-28 mm Hg), representing a median increase of 18 mm Hg (range, 10-28 mm Hg). On the other hand, among those with possible CDC (5 eyes: cases 5-9), the median IOP following external cycloplexy was 4 mm Hg

TABLE 1. DETAILS OF PATIENTS UNDERGOING EXTERNAL CYCLOPEXY.

Case	Age	Ocular History	Duration of Hypotony	UBM	Surgical Procedure	Preop IOP (mm Hg), VA	Postop IOP (mm Hg), VA	F/U (mo)
JH	47	s/p PPV for ERM	2 mo	Definite CDC	Cyclohexy, PPV, MP, phaco/PC-IOL	4, 20/400	14, 20/70	24
CC	40	Blunt trauma, s/p phaco/PC-IOL	1 mo	Definite CDC	Cyclohexy, anterior PPV	3, 20/100	27, 20/60	6
ZP	12	Blunt trauma s/p SB/PPV	2 mo	CB detachment, definite CDC?	Cyclohexy	0, ?	28, 20/80	36
RR	65	s/p PPV for ERM	3 mo	Definite CDC	Cyclohexy	3, 20/70	15, 20/20	12
MJ	52	ARN, RRD, s/p PPV	5 mo	CB detachment, possible CDC	Cyclohexy, phaco/PC-IOL	0, HM	0, CF	6.5
GM	80	ARN, RRD, s/p PPV/SO, now PVR	24 mo	CB detachment, possible CDC	Cyclohexy	1, HM	6, HM	13.5
HO	67	Acute endophthalmitis / RRD, s/p PPV	3 mo	CB detachment, possible CDC	PPV, SO, epiciliary tissue peel, cyclohexy	4, 20/400	8, CF	19
ED	77	s/p PPV x 3 for RRD/PVR, OIS	2 mo	CB detachment, possible CDC	cyclohexy	0, 20/80	4, 20/70	5
TM	36	CMV, RRD, s/p CE/SB/PPV/SO	12 mo	CB detachment, questionable to no CDC	PPV, SO, epiciliary tissue peel, cyclohexy	0, CF	0, HM	21
GC	72	ACIOL explantation, sutured PCL	3 mo	Definite cleft	Radial cyclohexy	0, 20/400	22, 20/40	20

UBM=ultrasound biomicroscopy, Cyclohexy=external cyclohexy with radial sutures, s/p=status post, ARN=acute retinal necrosis, PPV=pars plana vitrectomy, CMV=cytomegalovirus, RRD=rhegmatogenous retinal detachment, CE=cataract extraction, MP=membrane peel, SO=silicone oil, Phaco=phacoemulsification, IOL=intraocular lens, SB=scleral buckle, PDR=proliferative diabetic retinopathy, PVR=proliferative vitreoretinopathy, OIS=ocular ischemic syndrome, CB=ciliary body, CDC=cyclodialysis cleft, IOP=intraocular pressure, N/A=not applicable, mo=month, yr=year, VA=visual acuity, CF=count finger, HM=hand motion

(range, 0-8 mm Hg), representing a median increase of 4 mm Hg (range, 0-5 mm Hg).

Characteristics of successful outcomes included definite identification of cleft and hypotony duration of 3 months or less. Patients with a history of infectious uveitis had an unfavorable outcome with to no partial elevation of their IOP.

Examples of UBM for definite CDC are illustrated in Figure 2. Sample pre- and postoperative UBMs are shown.

DISCUSSION

Hypotony can be a devastating ocular condition, and, if untreated, can lead to visual loss and phthisis. The etiologies of hypotony include retinal detachment, PVR, trauma, wound leakage, uveitis, retrolenticular membranes with ciliary body detachment, intraocular foreign body, and CDC.⁹ CDC can often be difficult to diagnose and

treat. UBM can guide the surgical management of CDC by accurately directing the placement of radial sutures around the cleft region using external cyclohexy. However, in our study, only cases with a definite CDC as identified by UBM met surgical success (elevation of IOP) in the current series. Cases of questionable or possible CDC did not benefit significantly from undergoing surgery.

Furthermore, patients with a history of infectious uveitis and/or hypotony for longer than 3 months had an unfavorable outcome, with partial to no elevation of IOP.

Hypotony can be associated with only 2 clock hours of ciliary body detachment.⁵ A possible mechanism of hypotony associated with ciliary body detachment is the reversal of flow that occurs with a hypertonic ciliary body stroma. A decrease in aqueous humor production secondary to the ciliary body detachment⁹⁻¹¹ and increased aqueous humor outflow via the suprachoroidal space¹²⁻¹³

have been proposed as potential mechanisms of hypotony in cases of CDC.

Management of CDC ranges from medical therapy (cycloplegia) and laser photocoagulation to a variety of surgical procedures such as direct cyclopexy, indirect cyclopexy, iris-based inclusion cyclopexy, anterior scleral buckling, and silicone tube fixation.^{7,11,14-18} The prognosis of CDC-induced hypotony depends on both the degree and duration of the hypotony. A visual acuity of 20/25 is more likely if the hypotony is reversed within 2 months of its occurrence, and the prognosis is worse with an IOP less than 4 mm Hg. Our study also demonstrates that the prognosis is poorer in surgical patients with hypotony for more than 3 months' duration.

It is important to note that anterior PVR can cause traction on the ciliary body, leading to an occult CDC. Lewis et al¹ reported that, in a series of anterior PVR, four of 17 eyes had an occult CDC. These cases require release of the anterior traction to help the closure of clefts.¹⁹ In the absence of a cyclodialysis, hypotony can be caused by atrophy of the ciliary tips from epicyliary proliferation, thermal treatment of the long posterior ciliary arteries, or infectious uveitis.

There are potential limitations to our study, which are primarily related to its retrospective nature and the associated potential biases. The study is also based on a small series of cases; however, a randomized investigation of a relatively rare entity (ie, CDC) is clearly challenging. Two patients underwent vitrectomy with silicone oil placement (cases 7 and 9); however, these cases did not have significant elevation of IOP, and therefore surgical success cannot be attributed based on silicone oil placement.

CONCLUSION

This study demonstrates that UBM is a key diagnostic and management tool for ocular hypotony of unclear etiology, especially in cases of poor view of the anterior segment and iridocorneal angle. In our series, about 50% of patients who have undergone previous non-glaucoma ocular surgery had a suspicion of CDC. Of these patients, approximately half benefited from surgery. Patient selection may be improved by operating on patients with definite clefts with hypotony for less than 3 months and not associated with infections. ■

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1. Lewis H, Verdaguer JI. Surgical treatment for chronic hypotony and anterior proliferative vitreoretinopathy. *Am J Ophthalmol*. 1996;122(2):228-235.
2. Kaushik S, Arya SK, Kochhar S. Cyclodialysis cleft diagnosed by conventional ultrasonography. *Ophthalmic Surg Lasers*. 2000;31(4):346-349.
3. Johnson SM, Cheng HM, Pineda R, Netland PA. Magnetic resonance imaging of cyclodialysis clefts. *Graefes Arch Clin Exp Ophthalmol*. 1997;235(7):468-471.
4. Jewelewicz DA, Liebmman JM, Ritch R. The use of scleral transillumination to localized the extent of a cyclodialysis cleft. *Ophthalmic Surg Lasers*. 1999;30:571-574.
5. Coleman DJ, Daly SW, Atencio A, Lloyd HO, Silverman RH. Ultrasonic evaluation of the vitreous and retina. *Semin Ophthalmol*. 1998;13(4):210-218.
6. Karwatowski WS, Weinreb RN. Imaging of cyclodialysis cleft by ultrasound biomicroscope. *Am J Ophthalmol*. 1994;117(4):541-543.
7. Gentile RC, Pavlin CJ, Liebmman JM, et al. Diagnosis of traumatic cyclodialysis by ultrasound biomicroscopy. *Ophthalmic Surg Lasers*. 1996;27(2):97-105.
8. Park M, Kondo T. Ultrasound biomicroscopic findings in a case of cyclodialysis. *Ophthalmologica*. 1998;212(3):194-197.
9. Chandler PA, Maumenee AE. A major cause of hypotony. *Am J Ophthalmol*. 1961;52:609-618.
10. Maumenee AE, Stark WJ. Management of persistent hypotony after planned or inadvertent cyclodialysis. *Am J Ophthalmol*. 1971;71:320-327.
11. Joondeph HC. Management of postoperative and post-traumatic cyclodialysis clefts with argon laser photocoagulation. *Ophthalmic Surg*. 1980;11(3):186-188.
12. Shaffer RN, Weiss DI. Concerning cyclodialysis and hypotony. *Arch Ophthalmol*. 1962;68:25-31.
13. Suguro K, Toris CB, Pederson JE. Uveoscleral outflow following cyclodialysis in the monkey eye using a fluorescent tracer. *Invest Ophthalmol Vis Sci*. 1985;26(6):810-813.
14. Kuchle M, Naumann GOH. Direct cyclopexy for traumatic cyclodialysis with persisting hypotony: report in 29 consecutive patients. *Ophthalmology*. 1995; 102(2):322-333.
15. Jurgens I, Pujol O. Ultrasound biomicroscopic imaging of a surgically reattached cyclodialysis cleft. *Br J Ophthalmol*. 1995;79(10):961.
16. Tate GW Jr, Lynn JR. A new technique for the surgical repair of cyclodialysis induced hypotony. *Ann Ophthalmol*. 1978;10(9):1261-1268.
17. McCannel MA. A retrievable suture idea for anterior uveal problems. *Ophthalmic Surg*. 1976;7(2):98-103.
18. Brown SVL, Mizen T. Transscleral diode laser therapy for traumatic cyclodialysis cleft. *Ophthalmic Surg Lasers*. 1997;28(4):313-317.
19. Brooks AMV, et al. Noninvasive closure of a persistent cyclodialysis cleft. *Ophthalmology*. 1996;103:1943-1945.