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A peculiar case of aqueous misdirection from a pseudophakic secluded pupil in a patient with chronic angle closure glaucoma

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ABSTRACT

Purpose: To explore the course of a pseudophakic and pseudoiridic 61-year-old man with a history of open angle glaucoma in his right eye who developed a sub-totally secluded pupil then later presented with angle closure, a significant pressure spike, and a marked myopic refractive shift, consistent with aqueous misdirection.
Observations: Goniosynechialysis, surgical removal of much of the native peripheral iris, and zonulohyaloidectomy led to a return to his prior refraction and improve intraocular pressure (IOP) control.
Conclusions and Importance: This case demonstrates that a diagnosis of aqueous misdirection should not be disregarded in the presence of a prior vitrectomy and that aqueous misdirection should be strongly considered in cases of elevated IOP with a patent peripheral iridotomy, myopic shift and angle narrowing.

1. Introduction

Both secluded pupil and aqueous misdirection are rare complications of chronic inflammation.[1] Posterior synechiae, when circumferential, can cause a seclusion of the pupil, in which aqueous cannot pass unimpeded from the posterior chamber to the trabecular meshwork. The relative increase in posterior chamber pressure creates an anterior bowing of the peripheral iris stroma (i.e. iris bombé) which can lead to obstruction of the trabecular meshwork with impairment of aqueous outflow.[2,3] Iris bombé can lead to the development of acute or chronic angle closure glaucoma. Iris bombé can be treated with laser peripheral iridotomy, iridectomy, or surgical removal of posterior synechiae - all of which are typically curative if they remain patent.[2] The possibility of iris bombé is precluded by the presence of a patent iridotomy.

Aqueous misdirection is a less well understood entity. It is thought to be due to a misdirection of aqueous fluid within the posterior segment resulting from the anatomic interrelationship of the ciliary body, lens/bag equator and anterior hyaloid face. In a pseudophakic eye the wider diameter of the flattened IOL-bag complex can come in contact with the ciliary processes.[4] Accordingly, some fluid made by the ciliary processes is secreted into the vitreous cavity behind the capsular bag. If this fluid becomes trapped within the vitreous cavity, behind an intact anterior hyaloid, this results in shallowing of the anterior chamber, despite patent peripheral iridotomy(ies). The wider horizontal diameter of a pseudophakic bag is one explanation of why aqueous misdirection is more commonly seen in pseudophakes. Non-surgical management can include cycloplegia, however, when medical management is unsuccessful, one must create a unicameral eye.

2. Case report

A 61 year old pseudophakic and pseudoiridic man presented for routine follow up of previously well controlled open angle glaucoma in his right eye and was found to have a markedly elevated intraocular pressure (IOP) of 34 mmHg, new peripheral anterior synechiae (PAS) with frank iridocorneal adhesions, a sub-totally secluded pupil, and a marked myopic shift. His complex ocular history includes laser assisted in situ keratomileusis (LASIK) bilaterally in the distant past, a retinal detachment 7 years ago requiring multiple retinal surgical interventions at an outside institution which included silicone oil placement with subsequent removal, and cataract surgery. His clinical course left him with chronic cyclitis, a mydriatic pupil with subtotal posterior synechiae resulting in undesirable glare and photophobia.

At our institution, secondary in-the-bag custom, flexible iris prosthesis placement was performed in order to alleviate his photic symptoms (Fig. 1). He had a stable post-operative refraction of −2.25 sphere and he remained stable for several years until his index visit with the elevated IOP to 34 mmHg and a refractive shift to −5.25 + 1.25 × 089

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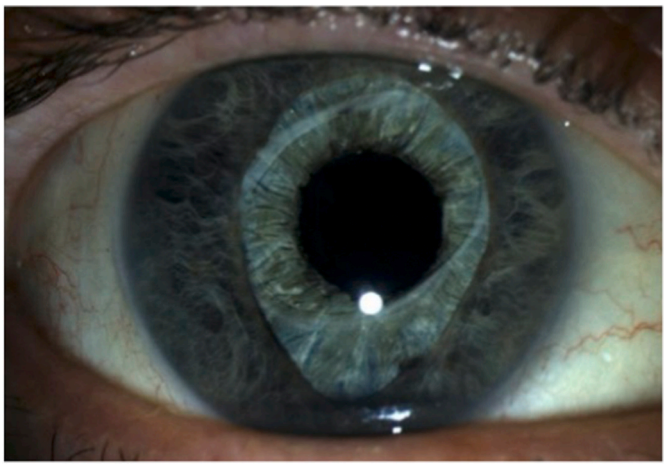

Fig. 1. Image of the anterior segment before the aqueous misdirection event. Note the darkened native iris stroma, common in eyes with chronic inflammation. The central lighter area is the exposed portion of the custom iris implant, matched to the fellow eye color. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

(20/40 + 1), more than two diopters more myopic than his prior multi-year stable refraction. There were 2 easily identifiable patent laser iridotomies – in inferotemporal and inferonasal locations - and the IOL-artificial iris-capsular bag complex appeared to be anteriorly displaced. Fundus examination was unrevealing and no residual oil bubbles were present. Specifically, there was no ciliochoroidal effusion. Ultrasound biomicroscopy (UBM) revealed an anteriorly bowed nasal and temporal iris leaflet, an IOL-iris prosthesis-capsular bag complex anteriorly displaced relative to the iris plane, and temporal iridocorneal adhesion. No ciliary effusion was present. The ciliary body was not anteriorly rotated (Fig. 2). A diagnosis of aqueous misdirection was made and the patient underwent goniosynechialysis (GSL), sub-total removal of the remaining native iris and zonulo-hyaloidectomy using a vitrector. The vitrector head was mechanically passed through the zonular plane and into the vitreous cavity from anteriorly to ensure a complete connection of the anterior and posterior segment (see Fig. 3).

Refraction improved from −5.50 + 1.25 × 089 (20/40 + 1) to near the prior refraction: 2.75 sphere (20/40) postoperatively. Anterior chamber and angle depth returned to their native positions (Fig. 2). IOP has been medically controlled since.

3. Discussion

This patient presented an interesting diagnostic challenge for the treating sub-specialists. Several pathologies can cause anterior displacement of the IOL-capsular bag complex. Pupillary block is one of the more common of the uncommon entities. Pupillary block, however, cannot be present in the setting of a patent iridotomy as was present for our patient. Choroidal effusion and suprachoroidal hemorrhage are two other explanations for anterior rotation of the ciliary body, however in this case, both examination and UBM excluded these possibilities. Iridocorneal adhesions can often pull the iris diaphragm forward, but rarely does this result in anterior movement of the IOL complex. In our case, the significant posterior synechiae to the capsulorhexis fused these two structures. Additionally, the central portion of the IOL complex appeared more anterior than the location of most of these iridocorneal adhesions and the iris was billowed convexly, both suggesting a "pushing" mechanism (posterior-anterior pressure gradient) rather than a "pulling" mechanism. Aqueous misdirection is considered a diagnosis of exclusion, though having excluded the alternatives, this became our working diagnosis.

Aqueous misdirection is thought to be unlikely in eyes with previous pars plana vitrectomy since vitrectomy is a known treatment modality for aqueous misdirection, however, such cases have previously been described. One case, presented by Balaggan et al.,[5] reports aqueous misdirection in a vitrectomized eye without a history of angle-closure glaucoma or narrow angles. We have seen this in other cases clinically as well. It is not as counterintuitive as it may seem. A pars plana vitrectomy performed for other reasons, even with extensive dissection of the vitreous base, eschews the anterior hyaloid as it is rarely involved in vitreoretinal pathology and since most vitreoretinal surgeons are hesitant to disturb either the intact crystalline lens or the pseudophakic

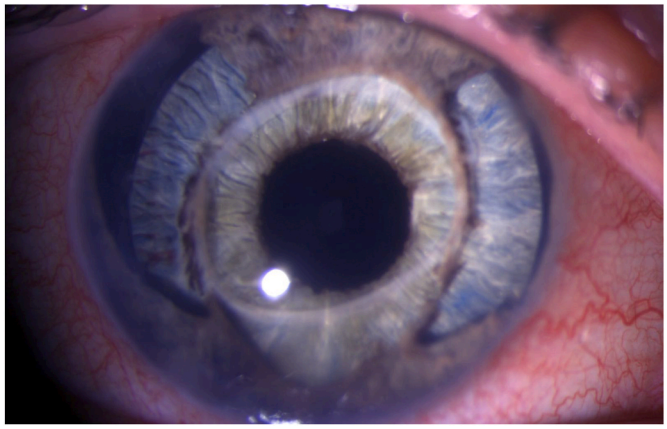

Fig. 3. Photograph showing the resulting anterior segment following the procedure.

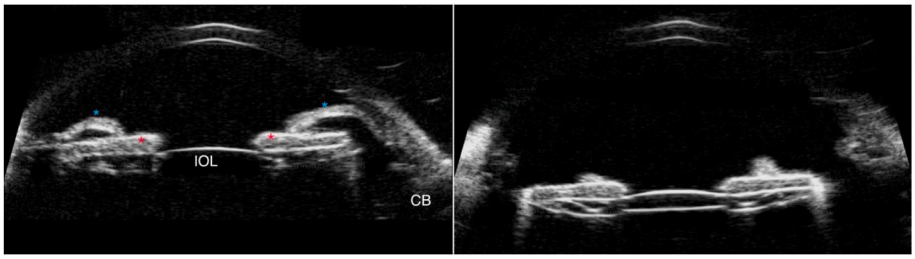

Fig. 2. (LEFT) Note in this pre-intervention UBM image that the capsular bag complex containing both the IOL and the iris prosthesis (red asterisk) is anteriorly displaced relative to the normal zonular plane, notably in front of the pars plicata (CB). Also note the confirmation of the clinically a identified iridocorneal, (right side of image) and that the residual native iris (blue asterisk) is billowed only slightly convexly, neither in bombé, nor taut, suggesting that the native iris diaphragm and the bag-IOL-iris prosthesis complex is being pushed forward, rather than pulled forward. The fellow iris leaflet on the left side of the right image is not bowed forward, which we would expect if this was a simple pupillary block. The entire IOL/bag complex is pushed anterior to the zonular insertion of the ciliary body, resulting from the fluid trapped behind the retained hyaloid face.
(RIGHT) In this post-op UBM, note the significantly deeper anterior chamber and return of the capsular bag-IOL-iris prosthesis complex to the normal zonular/ciliary body plane. Also not the absence of the peripheral native iris tissue. Some stubs of native iris tissue remain, attached to the capsulorhexis margin. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

capsulozonular complex, a thin layer of remaining anterior vitreous gel can remain and can prevent flow of aqueous to (or through) a patent iridotomy. In the presence of a secluded (or mostly secluded) pupil, there is inadequate flow into the anterior chamber and a pressure gradient develops, moving the fused capsule-iris diaphragm forward. When medical management with cycloplegia is unsuccessful, alleviating aqueous misdirection requires the creation of a truly unicameral eye with a generous irido-zonulo-hyaloidotomy.

Since the patient had an artificial iris in situ in the capsular bag already, the native iris was neither functional nor necessary. While goniosynechialysis can reopen the angle, recrudescence is common. This residual iris was also much darker than that of the fellow eye, from which the custom iris prosthesis template photo was taken. Since a generous iridectomy is required as part of the irido-zonulo-hyaloidotomy and we desired to prevent recurrent goniosynechiae, it seemed appropriate to remove much of the residual iris tissue both for resolution of the pathophysiology present and, also, for the happy added bonus of the improved cosmesis achieved by uncovering the iris prosthesis which was a better match to the fellow eye. Some bridges of peripheral iris were left in place superiorly and inferiorly, since there were no iridocorneal adhesions here and the zonular status of this eye with chronic cyclitis was unclear thus we deemed the additional support desirable.

The presence of an iris prosthesis was a coincidental occurrence that we believe played no role in the development of the pathophysiology. The iris prosthesis in this case is contained entirely within the capsular bag. The device was trephinated to fit the measured size of the pseudophakic bag after IOL placement, thus is does not alter the capsular bag diameter. Its flexible and thin profile with a peripheral edge thickness is only 250 μm, thinner than CTRs or IOL haptics. Accordingly, its presence does not affect the bags anteroposterior dimensions either.

4. Conclusions

This case thoroughly demonstrates that a diagnosis of aqueous misdirection should not be disregarded in the presence of a prior vitrectomy. Aqueous misdirection should be strongly considered in cases of elevated IOP with a patent peripheral iridotomy, myopic shift and angle narrowing. Surgical management with irido-zonulo-hyaloidotomy was successful in establishing a unicameral eye and correcting the underlying pathology. With the plan for goniosynechialysis to aid in aqueous outflow, the presence of the iris prosthesis pre-empted photic symptoms which might occur with native iris removal and allowed for a functional and aesthetically beneficial removal of nearly all of the remaining iris.

Patient consent

This report does not contain any personal information that could lead to the identification of this patient.

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