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Influence of the vitreolenticular interface in pediatric cataract surgery

Jan Van Looveren, MD, FEBO, Arnout Vael, MD, Nick Ideler, MD, Hedwig Sillen, MD, Danny Mathysen, PhD, Marie-José Tassignon, MD, PhD, FEBO

Purpose: To report the status of Berger space in pediatric cataract cases and the influence of anterior vitreolenticular interface dysgenesis during primary posterior continuous curvilinear capsulorhexis (PCCC).

Setting: Department of Ophthalmology, Antwerp University Hospital, Edegem, Belgium.

Design: Prospective case series.

Methods: The study comprised consecutive pediatric cataract cases planned for bag-in-the-lens intraocular lens (BIL IOL) implantation. A video-based analysis of the surgical interventions included the type of crystalline lens opacification, presence of a posterior capsule plaque (PCP), presence of anterior vitreolenticular interface dysgenesis, complications during primary PCCC, integrity of the anterior hyaloid membrane, need for anterior vitrectomy, and feasibility of BIL IOL implantation.

Results: Abnormalities in Berger space were observed in 35 of the 64 pediatric cataract cases. Anterior vitreolenticular interface dysgenesis was most often found in cases with persistent fetal vasculature (PFV) and those with posterior cataract. Anterior vitreolenticular interface dysgenesis was diagnosed significantly more often in eyes with unilateral cataract and those with PCP. In pediatric cataract cases presenting with PCP and anterior vitreolenticular interface dysgenesis, the primary PCCC procedure was surgically more demanding, often resulting in detectable breaks in the anterior hyaloid membrane (58.6%) and sometimes necessitating an unplanned anterior vitrectomy (13.8%). Bag-in-the-lens IOL implantation was feasible in all except 1 eye with PFV, which was left aphakic.

Conclusions: Primary vitreolenticular interface abnormalities are often encountered during pediatric cataract surgeries, especially when confronted with PCP in a unilateral cataract. The presence of anterior vitreolenticular interface dysgenesis may complicate a primary PCCC procedure, resulting in an unplanned anterior vitrectomy in some cases.

J Cataract Refract Surg 2018; ■:■–■

The presence of a retrolenticular space between the posterior crystalline lens capsule and the anterior hyaloid membrane was first described by the anatomist Emil Berger in 1887 in a postmortem specimen.[1] In 1985, Weidle[2] showed the presence of this Berger space in the living human eye by filling it with an ophthalmic viscosurgical device (OVD). Recently Berger space was visualized intraoperatively during adult cataract surgery using real-time optical coherence tomography (OCT).[3] In normal developing eyes, Berger space is fully formed by the ninth month of gestation.[4] Although there is improving knowledge on the anatomy and biometric parameters in pediatric cataract eyes,[5] there is little information on the vitreolenticular interface in these cases.

In such eyes, persistent fetal vasculature (PFV) membrane–like structures between the posterior lens capsule and the retrolenticular fibrovascular plaque have been described in literature.[6] Müllner-Eidenböck et al.[7] hypothesized all congenital unilateral cataract presenting with posterior capsule plaque (PCP) to be a consequence of a localized developmental anomaly with insufficient regression of the fetal vasculature. If that is the case, one might expect to be confronted with a high rate of anterior vitreolenticular interface dysgenesis.

During the primary posterior continuous curvilinear capsulorhexis (PCCC) procedure, Berger space can be injected with an OVD to facilitate posterior capsule excision and to protect the anterior hyaloid membrane from injury.[2] The anterior vitreous membrane is kept intact if possible

Submitted: February 4, 2018 | Final revision submitted: June 15, 2018 | Accepted: June 28, 2018

From the Department of Ophthalmology (Van Looveren, Vael, Mathysen, Tassignon), Antwerp University Hospital, Edegem; and the Faculty of Medicine and Health Sciences (Van Looveren, Vael, Ideler, Sillen, Mathysen, Tassignon), University of Antwerp, Antwerp, Belgium.

Drs. Van Looveren, Vael, and Ideler contributed equally to this work.

Corresponding author: Jan Van Looveren, MD, FEBO, Department of Ophthalmology, Antwerp University Hospital, Wilrijkstraat 10, B-2650 Edegem, Belgium. Email: jvanlooveren@hotmail.com.

0886-3350/$ - see frontmatter
https://doi.org/10.1016/j.jcrs.2018.06.052

because it acts as a major barrier between the anterior segment and posterior segment of the eye.[8] Large series of cataract surgeries including primary PCCC in adult eyes[9–11] reported no peculiarities in the vitreolenticular interface and a low rate of surgical complications when filling Berger space with an OVD.

In pediatric cataract surgery, primary posterior capsulorhexis is routinely performed to decrease the risk for reopacification of the visual axis. Additional anterior vitrectomy is advocated in infants.[12] Both manual primary PCCC and vitrectorhexis are used to remove the central posterior crystalline lens capsule.[12,13] A recent metaanalysis of primary posterior capsulorhexis with optic capture in pediatric cataract surgery concluded that this procedure significantly reduces visual axis reopacification and geometric decentration after surgery in a safe manner.[14] Little is known about the vitreolenticular interface and its anomalies in pediatric cataract cases, making manual primary PCCC in children more unpredictable than in adults. Unfortunately, vitrectorhexis (simultaneously removing posterior lens capsule and anterior vitreous) inhibits the possibility of exploring the vitreolenticular interface in these children and, in certain cases, the possibility of maintaining the anterior vitreous barrier.

There is little information on how many manual primary PCCC procedures in pediatric cataract cases result in an unplanned anterior vitrectomy resulting from inadvertent or preexisting breaks in the anterior hyaloid membrane. In a series by Dholakia et al.,[15] manual primary PCCC was completed in all eyes after OVD was injected into Berger space; even so, anterior vitreous disturbance was noted in 4.7% of children younger than 2 years.

This study sought to further unravel the status of the vitreolenticular interface in pediatric cataract cases. We also wanted to determine whether we could identify predicting risk factors for the presence of anterior vitreolenticular interface dysgenesis, which might complicate the posterior capsulorhexis procedure.

PATIENTS AND METHODS

This case series comprised all pediatric cataract patients having cataract surgery at Antwerp University Hospital (approval Ethics committee Antwerp University/Belgian registration number: B300201524649). The study adhered to the tenets of the Declaration of Helsinki. All eyes of patients with unilateral cataract were included. For patients presenting with bilateral cataract, 1 eye was randomly selected for inclusion. Patients with traumatic cataract or combined surgeries were excluded.

Patients' data were collected from their medical records. There were no additional studies other than the ones that are part of routine evaluation for cataract surgery in children. Collected parameters included sex, age at time of surgery, medical history, and laterality of lens opacification. Biometric parameters, such as keratometry values and axial length (AL) measurements, were recorded preoperatively, if possible using an optical biometer (Lenstar, Haag-Streit AG), or perioperatively using a handheld autorefractometer-keratometer (Retinomax K3, Righton) and A-scan echography (Ultrasound A by Righton).

All cataract surgeries were performed by the same surgeon (M.-J.T.). In all cases, BIL IOL implantation was planned, requiring a calibrated 5.0 mm anterior capsulorhexis and posterior capsulorhexis.[16] A manual posterior capsulorhexis technique was used. First, the posterior lens capsule was punctured in the center with a 30-gauge needle and sodium hyaluronate 1.0% (Healon) was injected into Berger space to separate the posterior lens capsule and anterior hyaloid membrane. Next, a 5.0 mm primary PCCC was created with a forceps. Stabilization and centration of the BIL IOL optic required additional implantation of bean-shaped ring segments.[17]

Only cases for which there was a full video recording of the surgery were included. Surgical videos were reviewed by 2 ophthalmologists (V.L.J., S.H.), both experienced in pediatric cataract evaluation and blinded to the medical data of the patients. The following criteria of the cataracts were evaluated: type of cataract according to lens opacity location (classification proposed by Lin et al.[5]) and presence of PCP after lens removal and cortical cleanup. The following surgical steps of manual posterior capsulorhexis were evaluated: viscodissection of the posterior lens capsule and anterior hyaloid membrane, excision of the posterior lens capsule (5.0 mm) with a forceps, and need for anterior vitrectomy. The feasibility of subsequent BIL IOL implantation was then evaluated. Videos were evaluated independently; if characteristics or procedures were appreciated differently, the videos were reevaluated simultaneously to allow a consensus to be reached.

All data were imported into an SPSS statistics database (IBM Corp.) for further statistical analysis. Descriptive statistics were performed to determine the distribution of unilateral and bilateral cases, sex, and age at time of surgery. Mann-Whitney *U* tests were performed for age, and independent-sample *t* tests were performed for AL and corneal curvature. Crosstabs with Pearson chi-square tests (*r*) were created for laterality of cataract, sex, and PCP. Finally, binomial logistic regression for the presence of anterior vitreolenticular interface dysgenesis was performed with all parameters that reached statistical significance in the previous tests. Any correlation between the presence of anterior vitreolenticular interface dysgenesis in pediatric cataract cases and surgical difficulties encountered during PCCC procedure was investigated.

RESULTS

One hundred thirty-four pediatric cataract surgeries in 93 children were performed at the Antwerp University Hospital during the study period (November 2010 though April 2016). After exclusion and randomization, the study included 64 eyes of 64 children. Exclusion was mainly because no surgical video recordings were available for review. Table 1 shows the distribution of age at time of surgery, sex, AL, corneal curvature, and presence of PCP in the unilateral subgroup and bilateral subgroup. Table 2 shows the classification of the patients depending on the type of lens opacification.

Vitreolenticular Interface Anomalies

Dysgenesis of the anterior vitreolenticular interface with detectable adhesions in the interface between the posterior lens capsule and anterior hyaloid membrane was observed in 35 patients (54.7%). Eight had limited adhesions (separable by viscodissection), 20 were classified as severe adhesions, and in 7 cases, Berger space seemed absent (no space present between posterior lens capsule and anterior vitreous).

Anterior vitreolenticular interface dysgenesis was found across all categories of lens opacification, except in cases of purely anterior cataract (Table 2). Anterior vitreolenticular interface dysgenesis was most often found in cases presenting with PFV (3 eyes [100%]), posterior cataract (11 eyes