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Case Report

The "Ballerina" Sign: Posterior Capsular Rupture during Cataract Surgery

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Abstract

Introduction: In this case study, we present the "Ballerina" sign as a potentially valuable clinical indicator for detecting posterior capsular rupture (PCR) during cataract surgery. The purpose of this study is to highlight the significance of PCR in the context of cataract surgery and introduce this novel sign. ***Case Presentation:*** During the cataract operation on a 70-year-old patient, we observed a spiraling fragment of the nucleus attached to a vitreous string. Subsequently, an anterior vitrectomy was successfully performed without further intraoperative complications, followed by the insertion of a 3-piece lens into the sulcus. Positive visual outcomes were observed during postoperative follow-up appointments at 1 day, 2 weeks, and 3 months. ***Conclusion:*** The documentation of the "Ballerina" sign in the medical literature is innovative, offering ophthalmic surgeons a valuable tool for early PCR detection during cataract surgeries.

Introduction

Cataract surgery is the most commonly performed procedure in the USA [1]. Nonetheless, such procedures are not without their attendant risks, one of which is a posterior capsular rupture (PCR), a major sight-threatening intraoperative complication that needs to be confronted intraoperatively. In conjunction with vitreous prolapse, PCR is associated with increased surgical complexity and is estimated to transpire in 1.4–3.2% of surgeries [2].

Ophthalmic surgeons, even very experienced, may have difficulty recognizing PCR during cataract surgeries [3]. Table 1 presents an extensive compilation of the documented signs of PCR, as described in the literature.

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Table 1. Intraoperative signs of PCR [3–5]

- A sudden increase in the depth of the anterior chamber
- Visible difficulty in rotating a previously movable nucleus
- New difficulty in burying the phaco needle into the nucleus
- Brief dilation of the pupil
- Nucleus tilt that is out of the ordinary
- Punched out a hole in the nucleus
- Unexpected movement of nucleus fragments concerning the phaco tip
- Partial downward displacement of the nucleus into the anterior vitreous space
- Sudden aspiration of vitreous to the phaco tip
- Occlusion of the irrigation and aspiration port without the apparent obstruction of the phaco tip
- Sudden challenges in rotating the nucleus or moving a nuclear fragment
- Vertical rotating vitreous line
- The posterior capsule exhibits a bouncing motion similar to that of a trampoline
- Visual confirmation of capsular puncture following phacoemulsification

Here we demonstrate a "Ballerina" sign that can be detected during cataract surgery and help surgeons react accordingly. The CARE Checklist has been completed by the authors for this case report, attached as online supplementary material (for all online suppl. material, see https://doi.org/10.1159/000538439).

Case Presentation

A 70-year-old male patient was referred by his local ophthalmologist to undergo phacoemulsification due to a cataract in his left eye. His ocular history includes deteriorating visual acuity over several years and pseudophakia in his right eye. Preoperative ocular examination for the left eye showed a deep and clear anterior chamber, wide pupil under pharmacology (6 mm), posterior subcapsular cataract (PSC) +3, nuclear sclerotic +2, intraocular pressure was 10 mm HG, uncorrected distance visual acuity and corrected distance visual acuity (CDVA) 6/20 (Snellen in meters), sphere −3 D, cylinder −0.75 D and axial length of 23.36 mm. The patient had a medical history that included benign prostatic hyperplasia, hyperlipidemia, fatty liver, and a history of undergoing a neurosurgical procedure to treat chronic subdural hematoma following a head injury. The patient's medication regimen involved bisoprolol, atorvastatin, omeprazole, lacosamide, and risperidone. Notably, alpha-blockers were used by the patient in the past due to benign prostatic hyperplasia, but were not included in the current pharmacological treatment of the patient.

The operation was made by temporal access, with two incisions and an incision for a maintainer, as is the practice at the medical center where the surgery was performed [6]. Intraoperative floppy iris syndrome was observed. During the operation, the surgeon noticed a fragment of the nucleus, spiraling, attached to a vitreous string, online suppl. Video 1. After the entire nucleus was aspirated, a PCR was seen and was treated by anterior vitrectomy. A 3-piece intraocular lens was placed in the sulcus without further complications.

One day following the surgical procedure, the patient reported experiencing slight discomfort in the operated eye. Visual acuity assessment showed a measurement of 6/120, while IOP was recorded at 10 mm Hg. Further observation revealed edema present in all corneal layers, with a predominant temporal location in the epithelium. Two weeks

postoperatively, the patient felt a minor ocular irritation, with the uncorrected distance visual acuity measurement of 6/30 and the CDVA measurement of 6/15. The OCT scan of the retina that was done 3 months postoperatively indicated the absence of cystoid macular edema, while revealing the presence of an epiretinal membrane, as shown in Figure 1. Three months after the surgery, the patient expressed high satisfaction; however, he reported experiencing a few floaters. CDVA was determined to be 6/10 with refraction of sphere +0.5 D, and cylinder −2.5D. The patient's other eye that was previously operated, CDVA was 6/12 with sphere +0.25 D, and cylinder −1.25 D.

Discussion

PCR is a major complication of cataract surgical treatment with several risk factors. These factors include extraocular factors such as deep-set eyes or a prominent brow, intraocular factors such as small pupils or high myopia, surgeon-related factors such as an inexperienced operator, intraoperative factors such as capsulorhexis block, and technical factors such as machine malfunction [3, 7, 8]. In the event of detecting PCR, surgeons should take a few crucial steps. First, they should avoid rapid movements of the phaco tip to prevent the anterior chamber collapse. Second, they should fill the anterior chamber with an ophthalmic viscosurgical device to stabilize nuclear fragments and block vitreous prolapse. After implementing these steps, the surgeon should consider whether to continue a phaco operation or switch to a safer, non-phaco technique based on various clinical considerations.

There are several signs that surgeons observe during cataract surgery to identify the occurrence of PCR. In a review conducted by Chakrabarti et al., early indicators of PCR were explored, including signs like a sudden deepening of the anterior chamber and a perceived inability to rotate a previously mobile nucleus. It's crucial to note that these signs might be transient, and the rupture itself may go unnoticed due to the nucleus overlay [3]. In an article by Crandall et al. [4] additional indicators are highlighted, including the nucleus moving away from, rather than toward, the phaco, and the aspiration of vitreous into the phaco tip (Table 1).

The article by Crandall et al. suggests various measures to prevent posterior capsule rupture (PCR), such as ensuring thorough hydrodissection and hydrodelineation, mobilizing the nucleus, opting for 0° and 15° phaco tips, utilizing machines with surge protection software to prevent trampolining and posterior capsule capture, and either employing bimanual irrigation and aspiration or conducting irrigation and aspiration after intraocular lens insertion to secure the posterior capsule [4]. Among different intraoperative signs which help to detect PCR during cataract surgery, the "Ballerina" sign, a spiraling fragment of the nucleus attached to a vitreous string, could assist surgeons in the early detection of a PCR.

PCR can result in various negative outcomes. Research by Wilczynski et al. [9] indicates that patients who experience PCR significantly decrease their CDVA following surgery compared to patients who undergo uncomplicated cataract surgery. Moreover, there is a substantial risk linked to the implementation of an additional procedure, such as anterior vitrectomy. In a study conducted by Ang and White, it was discovered that this procedure was required in over 60% of patients [10] and carries an elevated risk of experiencing floaters [3]. The current case also involved the performance of such procedures and the subsequent occurrence of floaters. The need for an extra procedure poses a threat to the visual outcomes of the patients, and further investigation is required to determine the link between additional procedures following PCR during phacoemulsification and decreased visual outcomes. One of

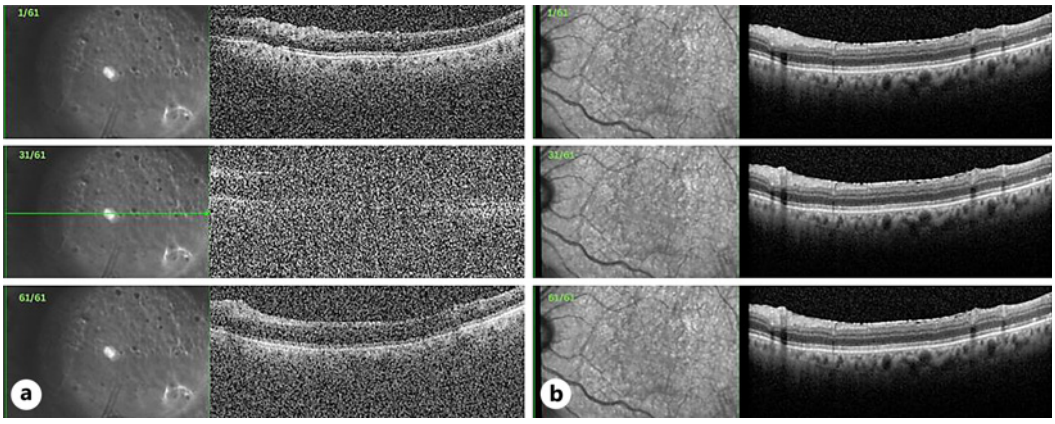

Fig. 1. Pre- and postoperative (3 months) OCT scan of the operated eye **a**. Preoperative OCT scan of the operated eye – no epiretinal membrane (ERM). **b** Postoperative OCT scan of the operated eye – no cystoid macular edema (CME), while revealing the presence of an ERM.

the clinical implications of PCR is the extra cost incurred by the patient, the medical center, and insurer. In accordance with Ryburn et al. [11], the overall expense of performing a singular PCR surpasses 1,100 USD, primarily attributed to extended operation room durations, supplementary postoperative consultations, interventions, and diagnostic imaging assessments. This is exemplified in our case, where the patient necessitated a return to the clinic for follow-up ophthalmologic and imaging examinations.

To conclude, this case study intraoperative sign of PCR, termed the "Ballerina" sign, a spiraling nucleus fragment attached to a vitreous string. We believe that this sign can potentially assist cataract surgeons worldwide in improving the detection and treatment of PCR.

Statement of Ethics

Ethical approval is not required for this study in accordance with local or national guidelines. Written informed consent was obtained from the patient for publication of the details of their medical case and any accompanying images.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Dan Ramon and Asaf Achiron performed the surgery and edited the article. Nadav Shemesh wrote the article and edited the figures and the movie.

Data Availability Statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

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