Pseudoexfoliation and cataract surgery: Dangers in the eye

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ABSTRACT

Pseudoexfoliation syndrome is characterized by the accumulation of extracellular matrix materials in ocular tissues that predisposes individuals to the development of glaucoma and cataracts, complicating the process of cataract surgery. This pathophysiological condition not only exacerbates the complexity of cataract surgery but also demands a refined surgical acumen for its management. The objective of this review is to identify and evaluate management strategies that hold the potential to mitigate risks and enhance surgical outcomes, particularly for this patient.

Keywords: Cataract, complications, glaucoma, phacoemulsification, pseudoexfoliation.

INTRODUCTION

Pseudoexfoliation syndrome (PEX-S) represents a pathological state which predisposes individuals to develop glaucoma and cataracts, marked by an accumulation of a grey-white extracellular matrix within ocular structures. This condition emerges from genetic and environmental determinants contributing to its pathogenesis. This accumulation may affect other organs in the body, as well as ocular structures such as the cornea, anterior and posterior capsule, iris, zonules, and trabecular meshwork.[1] This condition, which may be observed unilaterally or bilaterally, is commonly seen in elderly. PEX-S is considered as the most prevalent identifiable cause of open-angle glaucoma, globally. It is expected that, nearly half of the individuals diagnosed with PEX will eventually develop glaucoma.[2] There might be a series of challenges due to zonular instability, poor dilation of the pupil, and increased fragility of the anterior capsule for the cataract surgery in the presence of PEX. Postoperative complications such as susceptibility to macular edema, glaucoma, intraocular lens (IOL) tilt and decentration, capsular phimosis, prolonged inflammation, and endothelial decompensation can be observed.[3-7]

PRE-OPERATIVE EVALUATION

At first glance during an examination with a biomicroscope, pseudoexfoliation material can be observed especially at the edge of the pupil and on the anterior capsule (Figure 1). Using transillumination, defects resembling moth-

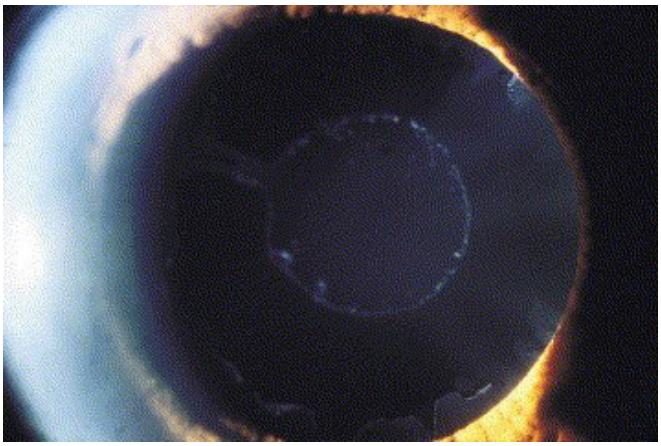

Figure 1: *In an eye with PEX, the classic appearance of the lens involves a relatively homogeneous central disc and peripheral zone, separated by a clear zone resulting from the exfoliation scraped off by the iris. The central disc is typically slightly smaller than the size of the pupil in its physiologically constricted state.*[11]

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eaten areas can be seen in the iris. All patients decided upon for cataract surgery must undergo an examination with pupil dilation, and the degree of pupil dilation should be considered. Studies conducted on eyes with PEX have shown that exfoliation material accumulates around blood vessels in the iris tissue. Histopathological examination has revealed degenerative changes and fibrosis in both the sphincter and dilator muscles.[8,9] Additionally, the adhesion of exfoliation material to the iris pigment epithelium and anterior capsule can mechanically restrict pupil movements. It has been suggested that starting topical non-steroidal anti-inflammatory drops before surgery may help prevent intraoperative miosis.[10]

A shallow anterior chamber indicates weakened zonular support, pushing the cataract and iris forward. Other clinical signs suggesting zonular weakness include lens subluxation, phacodonesis, a narrow iridocorneal angle, and anterior chamber asymmetry.[12] A comparison with the other eye is essential. Küchle et al.[13] have demonstrated that in patients with PEX having a central anterior chamber depth of less than 2.5 millimeters, the risk of intraoperative complications such as zonular dialysis and vitreous loss is increased fourfold. Preoperative Ultrasonic Biomicroscopy (UBM) or gonioscopy can reveal the accumulation of exfoliation material on the zonules and zonular fragmentation.[14]

Increases in preoperative and postoperative intraocular pressure (IOP) that can cause glaucomatous damage may be observed. Pseudoexfoliation glaucoma typically presents unilaterally, with IOP that tends to rise more rapidly compared to patients with primary open-angle glaucoma (POAG). In PEX glaucoma, the observed high IOP can lead to more rapid optic nerve damage and loss of visual field. When symptoms are present in one eye, since PEX glaucoma will develop in the other eye in more than 40% of these patients, the contralateral eye should be carefully examined and monitored.[15] Eye pressure must be measured, and examinations of the optic nerve and retina should be conducted. In another meta-analysis, the optical nerve head vessel density in patients with PEX was evaluated using Optical Coherence Tomography Angiography (OCTA). It was reported that in the eyes of patients with PEX-S and those with pseudoexfoliation glaucoma, there was a decrease in the optic nerve head vessel density, accompanied by a reduction in the thickness of the peripapillary retinal nerve fiber layer.[16]

In patients with PEX, it is essential to ensure that a 3-piece intraocular lens is prepared in the operating room, and that iris expansion hooks are readily available. The possibility of requiring an anterior vitrectomy should not be forgotten. It should be conveyed to the patient that surgery due to PEX carries a higher risk, without discouraging them from the surgery.

INTRA-OPERATIVE EVALUATION

After viscoelastic injection, observing an increase in the depth of the anterior chamber compared to the preoperative examination necessitates considering the possibility of the patient having zonulopathy.

If pupil dilation is insufficient, the pupil is mechanically dilated using two instruments such as the Kuglen hook. The surgeon introduces one Kuglen iris hook through the tunnel incision or the paracentesis incision, and the second Kuglen hook through another paracentesis incision. They are maneuvered to reach the inferior and superior edges of the pupil at the 6 o'clock and 12 o'clock positions, respectively, and then stretched in opposite directions. This procedure is repeated for the 3 o'clock and 9 o'clock meridians. Following this maneuver, the anterior chamber is filled with additional viscoelastic substance to facilitate further dilation of the pupil. If the stretching of the iris proves insufficient, radial sphincterotomies of 0.5 mm in length can be performed using Vannas scissors. Additionally, mechanical pupil dilation with iris retractor hooks, OASIS iris expander, Malyugin-ring or B-HEX Pupil dilator can be used.[17] (Figure 2)

Noticing the wrinkling of the anterior capsule at the beginning of capsulorhexis is another sign. In these cases, performing a large capsulorhexis is important in many respects. According to the literature, a capsulorhexis of approximately 5.5-6 mm in average size is considered ideal for routine cases without PEX.[18] In the study conducted by Vanags et al., it was observed that the capsulorhexis area in patients with pseudoexfoliation (PEX) syndrome decreased by 20% compared to patients without PEX (from the initial size to the 5th visit), (13.49 mm2 vs 10.92 mm2, $P<0.001$).[19] In patients with PEX and weak zonular support, the risk of developing capsular phimosis is high. Considering the approximately 20 percent reduction in capsular opening, it is beneficial to make the capsulorhexis size approximately 6.5-7.5 mm in diameter in patients with PEX.

A capsular tension ring (CTR) is implanted in cases where zonular dialysis smaller than 3 hours is present and capsular bag instability is detected.[20] Nowadays, various designs have been developed for average individuals (Morcher®

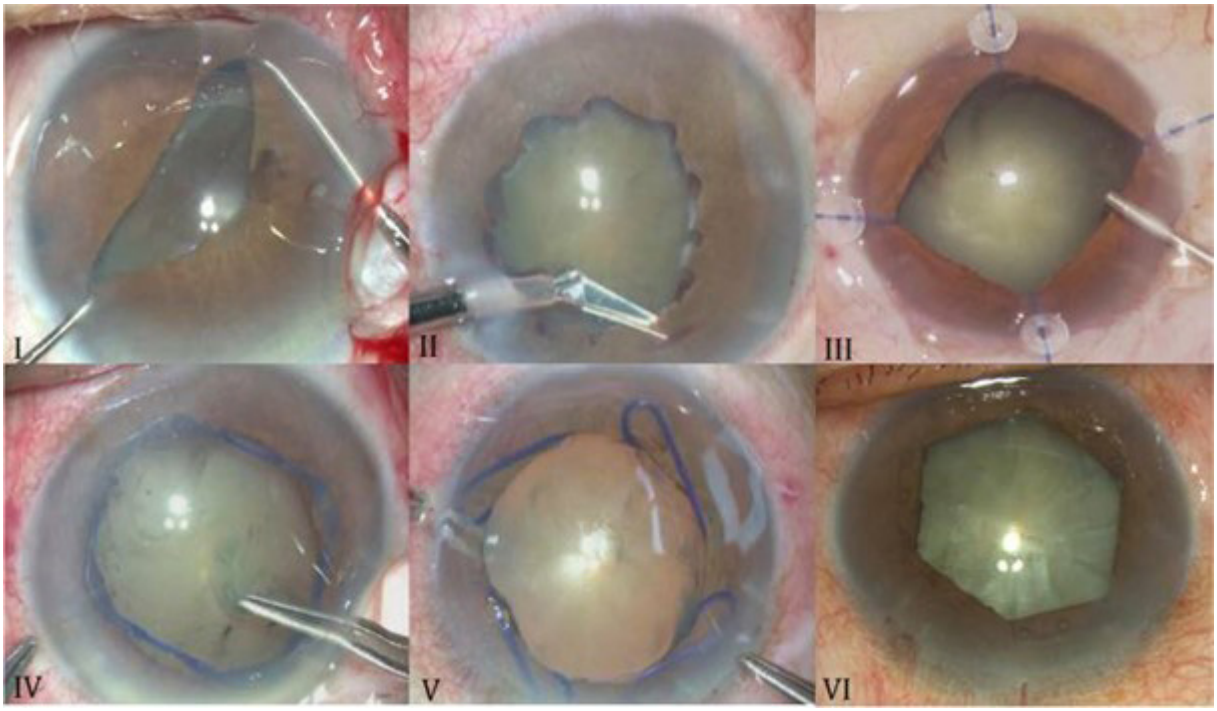

Figure 2: *The six pupil dilation methods are shown. Group I: Manual stretch. Group II: Iris radial cut open. Group III: Iris hooks. Group IV: OASIS iris expander. Group V: Malyugin ring. Group VI: B-HEX pupil expander.*[17]

type 14, 10.0 mm closed diameter), highly myopic patients (Morcher® type 14A, 12.0 mm), and for children (Morcher® type 1C, 9.00 mm).[21] In addition special CTRs were designed for cases with severe zonular dehiscence and an additional fixation hook for scleral fixation.[22-24]

Adequate hydrodissection enhances lens mobility and can help reduce stress on the zonules. Additionally, viscodissection with a 1% cohesive substance can be used to separate the cortex from the capsule.[14] It is also important to avoid overfilling the anterior chamber during hydrodissection.[10] Due to zonular loss, there is a higher risk of increased IOP due to the passage of irrigation fluid from the zonules to the vitreous via intraoperative fluid misdirection syndrome. This condition typically manifests as progressive shallowing of the anterior chamber, increased IOP, and abnormal pain in the patient during surgery. Administering viscoelastic towards the capsule equator, using a capsular tension ring, and reducing the bottle height/irrigation flow can prevent this occurrence. If necessary, a pars plana vitrectomy (vitreous tap) can be performed to achieve normal fluid dynamics and allow the continuation of the surgical case.[18] An osmotic agent (mannitol) can be used to reduce vitreous volume, deepen the anterior chamber, and potentially increase vitreous permeability.[25] If advanced hypermetropia is observed during the preoperative examination of patients with PEX, it is beneficial to be extra cautious.

Another issue is the constriction of the pupil during surgery. Starting preoperative topical nonsteroidal anti-inflammatory drugs (NSAIDs) and topical mydriatic agents can reduce intraoperative miosis.[26]

It is believed that, especially when operating within the confines of a small pupil, the vertical chop technique poses a lower risk of complications and yields better surgical outcomes compared to the horizontal chop and divide & conquer techniques.[27]

Vasavada et al.[28] described POPS (positioning, occlusion, posterior displacement, and swiping), a step-by-step technique for cortical aspiration during cataract surgery. Firstly, the aspiration probe is positioned under the bulk of cortical fibers beyond the capsulorhexis margin. Subsequently, the aspiration port is occluded with minimal vacuum, and the occluded port is displaced posteriorly to detach the cortical fibers off the anterior capsule. Now, tangential, arc-like swiping movements are performed while gradually increasing vacuum at the same time. The fibers are brought to the center and finally aspirated. The POPS technique is thought to be advantageous over the traditional radial traction technique. Careful removal of the cortex and cleaning (polishing) of the anterior capsule after surgery will reduce the incidence of capsular contracture and phimosis, thereby limiting the incidence of secondary cataract.[29]

Increases in intraocular pressure in the early postoperative period are more common in eyes with PEX than in eyes without PEX.[30] During surgery, meticulously removing all viscoelastic will reduce the risk of a sudden increase in IOP.

EARLY POSTOPERATIVE EVOLUATION

Patients with pseudoexfoliation should be carefully monitored in the postoperative period. One should be prepared for a possible postoperative increase in pressure. In a study conducted to evaluate whether oral acetazolamide can prevent an increase in IOP in eyes with PEX-S after cataract surgery, it was observed that oral acetazolamide administered 1 hour before surgery reduced the increase in IOP over a 24-hour follow-up; acetazolamide given 3 hours after surgery was seen to reduce the elevation in IOP 5 hours post-surgery.[31] In a study comparing the effects of topical antiglaucoma drops to prevent an increase in IOP after cataract surgery in eyes with glaucoma, brinzolamide more effectively reduced short-term increases in IOP after cataract surgery compared to travoprost or timolol.[32] The use of oral acetazolamide or topical glaucoma medications immediately in the early postoperative period helps mitigate the acute increase in IOP.[33]

CONCLUSION

Ultimately, performing cataract surgery on patients diagnosed with PEX-S can present a landscape full of unpredictability. A comprehensive preoperative evaluation is mandatory for effective management of potential intraoperative complications. Furthermore, the implementation of preoperative medical treatments for patients with PEX-S can significantly contribute to minimizing the risk of complications. This paper highlights the need for careful patient management to overcome the complexities associated with PEX-S during cataract procedures.

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