ARTICLE

Intraocular pressure elevation after cataract surgery and its prevention by oral acetazolamide in eyes with pseudoexfoliation syndrome

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Purpose: To examine whether intraocular pressure (IOP) increases immediately after cataract surgery in eyes with pseudoexfoliation (PXF) syndrome and to assess whether orally administered acetazolamide can prevent the IOP elevation.

Setting: Hayashi Eye Hospital, Fukuoka, Japan.

Design: Prospective case series.

Methods: Patients with PXF syndrome scheduled for phacoemulsification were randomly assigned to 1 of 3 groups: (1) oral acetazolamide administered 1 hour preoperatively (preoperative administration group), (2) administered 3 hours postoperatively (postoperative administration group), and (3) not administered (no administration group). The IOP was measured using a rebound tonometer 1 hour preoperatively, upon completion of surgery, and at 1, 3, 5, 7, and 24 hours postoperatively.

Results: The study comprised 96 patients (96 eyes). The mean IOP increased at 3, 5, and 7 hours postoperatively in all groups. At 1 hour and 3 hours postoperatively, the IOP was significantly lower in the preoperative administration group than in the postoperative group and no administration group ($P \leq .001$). At 5, 7, and 24 hours postoperatively, the IOP was significantly lower in the preoperative group and postoperative administration group than in the no administration group ($P \leq .045$). An IOP spike higher than 25 mm Hg occurred less frequently in the preoperative administration group than in the postoperative administration group and the no administration group ($P = .038$).

Conclusions: Intraocular pressure increased at 3, 5, and 7 hours after cataract surgery in eyes with PXF syndrome. Oral acetazolamide administered 1 hour preoperatively reduced the IOP elevation throughout the 24-hour follow-up; acetazolamide administered 3 hours postoperatively reduced the elevation at 5 hours postoperatively and thereafter.

J Cataract Refract Surg 2018; ■:■–■

Pseudoexfoliation (PXF) syndrome is a hereditary systemic disorder of the extracellular matrix.[1–3] The prevalence of this syndrome increases with age and varies in racial and ethnic populations.[4–6] Pseudoexfoliation causes many ocular complications, such as elevated intraocular pressure (IOP), cataract formation, degeneration of corneal endothelial cells, and dehiscence of the lens zonular fibers.[1–3,7,8] Specifically, progressive accumulation of the fibrillary extracellular matrix in the trabecular meshwork reduces the aqueous outflow and thus increases the IOP.[9,10] When the IOP increases substantially, glaucomatous optic neuropathy develops at a high incidence.

Some studies reported that IOP increases markedly within 24 hours after cataract surgery in eyes with PXF syndrome.[11–13] Levkovitch-Verbin et al.[13] showed that the IOP elevation occurs within several hours after surgery. Furthermore, the short-term IOP elevation might be reduced with topical timolol maleate or bimatoprost.[12,13] These studies provide little information regarding the longitudinal changes in IOP; however, the effectiveness of a topical antihypertensive agent has not been established. Furthermore, the optimal timepoint at which an antihypertensive agent should be administered to effectively prevent the short-term IOP elevation within 24 hours after surgery remains unclear.

The purposes of the present study were to examine the longitudinal changes in IOP after cataract surgery in eyes with PXF syndrome and to assess whether administering oral acetazolamide could effectively reduce the IOP

Submitted: October 17, 2017 | Accepted: November 9, 2017

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0886-3350/$ - see frontmatter
https://doi.org/10.1016/j.jcrs.2017.11.017

elevation. In addition, we examined the appropriate time to administer the oral acetazolamide to prevent IOP elevation after cataract surgery.

PATIENTS AND METHODS

Study Design

This study was a prospective randomized clinical study performed at the Hayashi Eye Hospital, Fukuoka, Japan, between October 2014 and June 2017. The Institutional Review Board/Ethics Committee of the Hayashi Eye Hospital prospectively approved the study protocol and all participants provided written informed consent after a detailed explanation of the nature of the study. This study was registered in the University Hospital Medical Information Network (UMIN000017556).

Participants

A clinical research coordinator screened all consecutive patients who were scheduled for admission to the Hayashi Eye Hospital to have cataract surgery. The major inclusion criteria were eyes with PXF syndrome that were to have phacoemulsification surgery with implantation of a single-piece hydrophobic acrylic intraocular lens (IOL) (SN60WF, Alcon Laboratories, Inc.), and eyes that were to have the first surgery by a single surgeon (M.Y.). Ophthalmologists used slitlamp microscopy (T.S., S.M., K.Y.) to determine the presence of PXF in the anterior ocular segment. Exclusion criteria were eyes with a pathology of the cornea, vitreous, or macula, planned extracapsular cataract extraction, eyes with lens luxation, eyes with a possible zonular dehiscence, a history of ocular inflammation or surgery, small pupillary diameter less than 4.0 mm after full mydriasis, patient refusal, and any anticipated difficulties with examination or analysis. Eyes with possible zonular dehiscence were defined as having a shallower anterior chamber depth (>0.2 mm) compared with the fellow eye. Eyes that had complicated surgery or eyes that had pupil enlargement procedures were also excluded. Patient enrollment was continued until 102 eyes of 102 patients were included.

Randomization

The patients were randomly assigned to 1 of 3 groups the day before surgery as follows: (1) eyes that were scheduled to have administration of oral acetazolamide at 1 hour preoperatively (preoperative administration group), (2) eyes that were scheduled to have oral acetazolamide administration at 3 hours postoperatively (postoperative administration group), or (3) eyes that were not to have administration (no administration group). The coordinator generated a randomization code with equal numbers using random number tables and assigned each patient to 1 of the 3 groups. The coordinator informed a nurse who oversaw the oral acetazolamide administration about the group to which each patient had been assigned. The coordinator kept the assignment schedule concealed until all data were collected. The examiners, all staff other than the nurse in charge, surgeon, and data analyst, were unaware of the group to which the patients had been assigned.

Oral Acetazolamide Administration

Systemic or topical antihypertensive medications that had been used were suspended the day before surgery. The nurse in charge administered 500 mg of oral acetazolamide (Diamox) 1 hour before cataract surgery to patients in the preoperative administration group and administered the same dose of oral acetazolamide 3 hours after surgery to patients in the postoperative administration group.

Surgical Procedures

An experienced surgeon (M.Y.) performed all the cataract surgeries. Each eye received a 2 mL sub-Tenon capsule injection of xylocaine 2.0%. A transconjunctival single-plane sclerocorneal incision was made using previously described surgical techniques.[14] First, 2 side ports were made with a 0.6 mm slit knife approximately 45 degrees away from the main incision. Through a side port, a continuous curvilinear capsulorhexis was created using a 23-gauge capsulorhexis forceps. Then, a 2.2 mm single-plane incision was made in the sclera at approximately 1.5 mm posterior to the limbus with a stainless steel keratome. The keratome was moved forward through the sclera and cornea, and entered the anterior chamber at 0.5 mm anterior to the limbus. After hydrodissection, phacoemulsification of the nucleus and aspiration of the residual cortex was performed with the Constellation phacoemulsifier (Alcon Laboratories, Inc.). After the lens capsule was filled with sodium hyaluronate 1.0% (Hyaguard), the single-piece hydrophobic acrylic IOL was inserted into the capsule using a Monarch II injector with a D cartridge (Alcon Laboratories, Inc.). The ophthalmic viscosurgical device was thoroughly removed. Upon completion of the surgery, the side ports were hydrated and the anterior chamber was deepened with a balanced salt solution using a cannula. The IOP was measured using a rebound tonometer (Icare Tiolat, Icare Finland Oy). The IOP was adjusted to range between 15 mm Hg and 30 mm Hg by injecting a balanced salt solution or by removing anterior chamber fluid through a side port.

Outcome Measures

Patients in the 3 groups were evaluated for IOP, wound status and leaking, and flare intensity within 24 hours after surgery. The IOP was measured using the rebound tonometer 1 hour before surgery, at the conclusion of surgery, and at 1, 3, 5, 7, and 24 hours after surgery by experienced ophthalmic technicians. The same technician measured the IOP for each patient. The IOP measurement method using the rebound tonometer was described previously.[15] The IOP measurements were repeated 3 times and the mean value was used for analysis. When any type of error sign was observed or when a discrepancy existed between 1 IOP reading and the other 2 IOP readings, the reading was abandoned and another measurement was obtained. The reliability and reproducibility of IOP measurements using the rebound tonometer have been verified.[16–18]

The wound state of the transconjunctival single-plane sclerocorneal incision was assessed 5 hours postoperatively using anterior segment optical coherence tomography (AS-OCT) (Casia, Tomey Corp.). The AS-OCT scans across the anterior ocular segment, including the main incision, and images the wound architecture. The presence of the 5 types of wound architectural features that exist was evaluated based on the classification system described by Calladine and Packard[19] as follows: epithelial gaping, endothelial gaping, endothelial misalignment, local detachments of Descemet membrane, and loss of coaptation along the wound. Among the 5 features, the loss of coaptation is considered to represent incomplete wound closure. The wound length was also measured using the biometry incorporated in the AS-OCT. The Seidel test was performed under slitlamp microscopy 5 hours postoperatively by 3 ophthalmologists (T.S., S.M., K.Y.).

Flare intensity was measured using the flare meter (FC-1000, Kowa Co., Ltd.) 5 hours postoperatively. Corrected distance visual acuity (CDVA) was examined on decimal charts preoperatively and at 24 hours postoperatively. Decimal visual acuity was converted to the logarithm of the minimum angle of resolution scale for statistical analysis. Corneal astigmatism and the manifest refraction spherical equivalent (MRSE) were evaluated with an autorefractometer/keratometer (KR-7100, Topcon Corp.). The grade of nuclear opalescence was determined by the ophthalmologist according to the Lens Opacities Classification System III.[20] During surgery, the surgery time, cumulative dissipated energy (CDE), and the total volume of irrigating solution used were recorded. Eyes with pseudoexfoliation glaucoma (PXG) had visual field sensitivity testing with a visual field analyzer (Humphrey Visual Field Analyzer, 30-2 program, Carl Zeiss Meditec AG) within