• Review Article •

Etiology, pathogenesis, and management of acute intraocular lens opacification: a systematic review

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Abstract

● Millions of cataract surgeries with intraocular lens (IOL) implantation are performed worldwide. Although cataract surgery brings many benefits to the patients, the risk of various complications is still a concern. One of the infrequent adverse events but potentially affecting on patients' visual acuity and contrast sensitivity is losing the transparency of IOL. IOL opacification may lead to IOL removal or exchange, which is unpleasant to both the patient and the surgeon. Several reports of acute IOL clouding are available in the literature describing various etiologies of this phenomenon, however, the exact mechanism remained unclear in some cases. Herein, we aimed to review the causes and outcomes of intraoperative and early postoperative IOL opacification.

● **KEYWORDS:** intraocular lens; phacoemulsification; acute discoloration; acute opacification; cataract

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INTRODUCTION

Millions of cataract surgeries with intraocular lens (IOL) implantation are performed worldwide per year[1]. Improvement in surgical techniques and manufacturing of biocompatible and foldable IOLs led to excellent postoperative outcomes. Foldable IOLs are synthesized from different materials. Acrylate/methacrylate polymers and silicone elastomers are the two main groups[2-4].

Although cataract surgery brings many advantages to the patients, the risk of various complications is still a concern[5]. One of the infrequent adverse events that could reduce the patients' visual acuity and contrast sensitivity is losing the transparency of the IOL[6-7]. IOL opacification may lead to IOL removal or exchange, which is unpleasant to both the patient and the surgeon[1,8]. A significant proportion of explanted IOLs in an eye center in the United States was secondary to optic opacification or discoloration[9]. Several reports of acute IOL clouding are available in the literature describing various etiologies of this phenomenon, however, the exact mechanism remained unclear in some cases[10-11]. Herein, we aimed to review the causes and outcomes of intraoperative and early postoperative IOL opacification and provide a discussion on prevention from unnecessary IOL explantation in selected individuals.

MATERIALS AND METHODS

The required information was gathered by reviewing various databases including PubMed/Medline, Google Scholar, and Cochrane library, up to September 2021.

We systematically searched the literature using the following keywords: ("intraocular lens opacification" OR "intraocular lens clouding" OR "intraocular lens fogging" OR "intraocular lens discoloration") AND ("acute" OR "transient" OR "early" OR "reversible" OR "temporary" OR "intraoperative"). No limitations on publication status or study design were imposed. The most relevant papers to IOL discoloration until one month after implantation were collected. The reference list of eligible articles was also explored for additional resources. Finally, all of the selected studies were reviewed.

RESULTS

Intraoperative Intraocular Lens Opacification Intraoperative IOL opacification is defined as when the surgeon noticed the opacity during the operation. It is responsible for the majority

of acute IOL clouding cases in the literature. Different etiologic categories are discussed in the following sections.

Temperature fluctuation Reports of acute IOL clouding immediately after implantation of the IOL into the anterior chamber have been discussed, probably related to the storage condition. Transferring of the IOL from the outside temperature below freezing to the theater shortly before surgery is the common point of these studies. Sudden IOL implantation into the eye with a temperature of 37℃ is the hypothesized mechanism of this kind of opacification. The haziness was described in the optic plate's body without surface deposits and tended to be milky white. Both hydrophilic and hydrophobic acrylic IOLs were affected. The opacity was transient and lasted for less than 24h with spontaneous resolution[12].

Adherence to the manufacture's guidelines regarding the storage temperature of the IOL is recommended to avoid abrupt changes in the temperature and subsequent aforementioned intraoperative IOL clouding. The underlying mechanism is not well known. A previous case report of IOL clouding in an acrylic hydrophilic IOL suggested that the imbibitions of water following a rapid temperature fluctuation is the causal factor[13]. Zhang *et al*[14] explained a possible cause in which increasing temperature may lead to microbubble production by releasing the air inside the IOL. This causes light refraction, which appears as IOL clouding[15-16]. They also hypothesized that the equilibrium in the air dissolution in the IOL and water would lead to resolution of the clouding after a while. Intraoperative opacification of a hydrophilic acrylic with hydrophobic surface IOL following storage in low temperature was described in a case report. The authors performed an *in vitro* experiment by placing a CT Spheris 504 IOL in a 37℃ balanced salt solution (BSS) after staying at 4℃ for 24h. The same IOL clouding occurred. They mentioned that consolidation of water vapor on a cold surface might explain the observed discoloration, which resolved within 24h[17]. A previously reported study described a transient AcrySof IOL fogging after warming in a heating cupboard at 47℃. They used this practice as a way to simplify and facilitate IOL implantation. The lens was clear before folding and the clouding occurred after unfolding into the eye. The IOL was removed and kept dry at room temperature, which led to spontaneously disappearance of opacity after 3h. The reason of the glistening was thought to be the hydration secondary to temperature rise and subsequent microvacuole formation. Dehydration after several hours after keeping the lens in a dry place would cause spontaneous clearing. They also encountered another similar case and therefore advised not to store an acrylic IOL at a temperature above 45℃. The implant should preferably keep at room temperature to avoid glistening[18]. A similar glistening formation related to the presumed temperature change of the packaging system's microenvironment in the first postoperative week was earlier described[19].

The IOL should be kept at room temperature before implantation to prevent from fluctuations in the temperature, especially in the winter season and in countries with cold climates. This phenomenon will almost always be spontaneously resolved with no permanent structural change. Accordingly, the ophthalmologists should be aware of the transient nature of this event and avoid unnecessarily removing the implant. Table 1 summarizes reports of intraoperative IOL opacification due to rapid temperature fluctuation[13-14,17-18,20-24].

Crystallization on intraocular lens surface Crystallization at the time of surgery is an uncommon event but can significantly reduce the visual acuity due to the persistence of deposits[25]. Silicone IOLs are more sensitive for this type of opacification.

Jensen *et al*[26] described a series of 11 patients with visually significant crystalline deposits on the IOL surface. During their investigation, the only consistent feature was using Healon GV, a high concentration and high molecular-weight hyaluronate sodium. They suggested that reaction between calcium in the irrigating solutions or the aqueous humor with the phosphate constituents of the ophthalmic viscosurgical device (OVD) is the possible underlying mechanism for formation of these deposits. The crystalline deposits could last for a long time (at least 6mo), especially in sequestration by posterior capsule with significant deterioration of visual acuity (20/40 or worse). More severe crystallization was associated with silicone IOLs. Capsulotomy may be helpful in selected patients. It is advisable that IOL loading should not take place too long prior to implantation into the anterior chamber. Application of the recommended IOL injector by the manufacturer is also beneficial to avoid intraoperative crystalline deposits.

Olson *et al*[27] later reported the IOL crystallization in 0.07% of cataract surgeries. The previous theory that described Healon GV as the only culprit in the formation of intraoperative crystallization was rejected because some cases were occurred using Amvisc Plus, Occucoat, and other viscoelastics. The degree of crystallization of polymethyl methacrylate (PMMA) IOLs was minimal, and all the significant cases had been noted with silicone IOLs. Correlation with BSS Plus was also statistically significant. The analysis of samples by scanning electron microscopy and X-ray photoelectron spectroscopy showed calcium-containing deposits. They assumed that the osmotic gradient created by using viscoelastic is responsible for calcium deposition on the IOL surface. The authors recommend IOL exchange in terms of encountering to this phenomenon in the operating room[27].

Another study in 2006 reported two patients who developed significant granular and crystal-like deposits on the surface

Table 1 Summary of articles related to intraoperative IOL opacification due to rapid temperature fluctuation

Study	Age (y), sex	Type of IOL	Features of discoloration	IOL storage condition	Outcome
Tyagi *et al*[13]	52, male	Hydrophilic acrylic IOL (PhysIOL)	Immediate clouding	Transfer at a temperature below 0°C, 10min before surgery	Clearing started at the periphery of the optic after 45min. The IOL was completely transparent 3h postoperatively.
Helvacı[20]	70, male; 45, female; 58, female	Acrylic hydrophobic IOL (Acriva UD613, VSY, Istanbul, Turkey)	Immediate whitening	Storage at cold temperature immediately before use	All three IOLs were entirely cleared on the first postoperative day.
Gutierrez[17]	80, female	Hydrophilic acrylic IOL with a hydrophobic surface (CT Spheris 204; Carl Zeiss Meditec)	Immediate homogenous and complete opacification	Storage at a cold place for 12h	The IOL was completely cleared 24h postoperatively.
Sonbolestan and Abtahi[21]	61, male	Foldable, 13 mm, one-piece, square edge, and 25% hydrophilic acrylic IOL (Cristal®, Cristalens, France)	Immediate milky white discoloration that changed to dense white after seconds	Storage at temperature -10°C immediately before surgery	The IOL was completely cleared one day after surgery.
Liu *et al*[22]	79, female	Trifocal IOL (AT LISA tri 839MP, Carl Zeiss)	Immediate clouding	Transfer at a temperature of -3°C, 10min before surgery	After one hour, the IOL was removed and exchanged with another same type of IOL. The second IOL opacified too and replaced with a ZCB00 (Allergan) after 8min. The removed IOL became transparent after 5min *in vitro*.
Zhang *et al*[14]	25, male	Trifocal IOL (AT LISA tri 839MP, Carl Zeiss)	Immediate clouding	Transfer at a temperature of -7°C, 30min before surgery and warming at 35°C for 15min before implantation	The IOL turned completely transparent 3h postoperatively.
Danese *et al*[23]	83, female	Sutureless scleral fixated hydrophilic acrylic IOL	Milky white discoloration of central optic immediately after removing from its package before folding which changed to dense white opacity	Delivery at -1°C for 90min and storage at 19°C for 1h before implantation	The IOL turned transparent on the first postoperative day.
Lee and Han[24]	N/A	Hydrophilic IOL (Claré, Cristalens Industries)	Total IOL clouding during implantation	Storage at temperature -8°C and exposure to room temperature (26°C) 1h before implantation	The diameter of the opacity decreased to 3 mm after 4h and less than 1 mm after 8h. The IOL was cleared 24h after the operation.
McKibbin *et al*[18]	78, female	AcrySof lens (Model MA30BA)	Semi-opacity of the IOL optic after unfolding in the bag	Warming the lens in a heating cupboard at 47°C before folding	The IOL was exchanged with a rigid PMMA lens after 5min. The explanted IOL was placed dry at room temperature in its packaging and cleared spontaneously after 3h.

IOL: Intraocular lens; PMMA: Polymethyl methacrylate.

of single-piece hydrophobic acrylic IOLs immediately after injection into the eye (loaded with Viscoats and Healon GVs, respectively). IOLs were removed and analyzed. They did not find calcium on the surface of lenses and liquid chromatography/mass spectroscopy showed albumin and hemoglobin, which are typically found in aqueous. They hypothesized that crystallization and drying out of OVDs could occur during IOL loading in the cartridge. Various gross appearances could be seen based on the type of viscoelastic used[28]. Plastic exfoliations from the cartridge may result in intraoperative deposits between the IOL and posterior capsule when the hydrophilic acrylic lens is implanted without viscoelastic[29].

Early Postoperative Intraocular Lens Opacification We assessed cases of IOL clouding up to one month after surgery. Here the classifications are provided based on the presumed etiologies. Some of the mentioned underlying pathologies occurred before the IOL implantation but we put them in the postoperative category because no opacity was noted during the surgery. There are different explanations for it. First, elapsing of time is required for interactions to cause visible haziness. Second, there is a possibility of preexisting opacity, which is missed by the surgeon due to poor visualization through a surgical microscope.

Intraocular lens contamination, manufacturing defects, and changing hydrophilicity The manufacturing process, IOL design, and material are essential features for evaluating the causes of decreasing in IOL transparency. Surgeons and scrub nurses may miss the preexisting haziness of the IOL because of viewing through the surgical microscope with

lower magnification and higher illumination in comparison to postoperative slit-lamp examination[30]. The quality control of all production steps will help to avoid IOL opacification and additional surgery for IOL removal.

Opacification of the silicone optic of an Allergan Medical Optics SI18NB lens was noted seven days after surgery. A nucleus-shaped brown discoloration in the central area was attributed to a material defect and low molecular weight silicone fractions not cross-linked during the manufacturing process. Light scattering from water vapor that diffused into the silicone material in the anterior chamber caused a brown haze. This finding was stable in follow-up visits and did not affect the patient's visual acuity[31]. Others stated that the interaction with some intracameral medications, inadequate filtering, or instability of silicone material could lead to discoloration of silicone IOLs[32].

Hilgert *et al*[33] published a case series of four patients who developed silicone IOL opacification on the first postoperative day. The optic was homogenously affected by non-progressive milky gray/yellow opacity resulting in lens explantation in three patients. Analysis of an explanted IOL revealed that the clouding was only observed in a hydrated state and no deposits were found. They explained the theory of IOL contamination after the manufacturing process because the affected lenses were from different lots. Exogenous molecule contaminants (terpenes and ketones) could change the hydrophilicity of the hydrophobic silicone IOL giving rise to the influx of water and early opacification of silicone lenses[33].

Another similar event observed with the same IOL, SI-40NB IOL (Allergan) showed a brown haziness the day after surgery. Incubation of the explanted lens in saline at room temperature did not change the opacity after two months. Microscopic examination exhibited numerous abnormal spheroid structures in the central area far from the surface. They hypothesized that it could be related to the chemical compositions of the Allergan silicone IOL or the sterilization process with ethylene oxide gas exposure. The incorporation of water into silicone IOL may be the responsible pathologic phenomenon. Adequate resolution of this type of clouding is unlikely over time, and IOL exchange is often necessary to improve visual function[34]. However, a case report in 2011 described a diffuse translucent milky white haziness throughout the substance of an AMO Z9002 silicone lens one day after uncomplicated cataract surgery. Clearing of the lens periphery was observed eight days after surgery. The central haze disappeared as well on postoperative day 14. Contamination with industrial chemicals is possible during the manufacturing, sterilization, or packaging process. The mechanism used to explain the initial clearing of the lens periphery was the entrapment of gas or liquid molecules in the lens material and releasing them into the anterior chamber based on the law of diffusion. The peripheral part of the IOL is thinner than the central area. So, less time is required for the diffusion of the contaminants. Besides that, the lens epithelial cells in the capsular bag may have some role in the rapid resolution of opacity in the periphery. A similar pattern of clearing in the same IOL design should be closely visited due to the possibility of spontaneous resolution with excellent visual gain[30].

Werner *et al*[35] published data from an analysis of 6 explanted 3-piece silicone lenses due to optic opacification a few hours following implantation. Gross and microscopic studies showed that the IOLs became clear at dry state but whitened during hydration. Gas chromatography/mass spectrometry (GC-MS) analysis was performed. Suspect exogenous chemicals (general classes: terpenes and ketones) were found. These compounds are used in industrial cleaning agents and fumigants. Most IOL packages are semipermeable for the sterilization process. The introduction of contaminants and chemicals through these packages is possible *via* aerosolizing solutions during the disinfection of the storage rooms. This could result in changes in the material toward hydrophilicity and allowing water entrance after implantation in the eye. Further evaluation revealed that all 6 IOLs were kept in the a same place in Brazil preoperatively[35].

Gray white to faint brown discoloration of an Array SA40N silicone multifocal IOL 1wk after implantation was reported to be related to lens hydration. After 3mo, the patient presented with a blurry vision, which finally led to IOL removal. Light microscopic analysis of the explanted lens was negative for any deposits on or within the IOL material. A chromatographic peak for lidocaine was also noted. Keeping the lens in a dry state resulted in gradual clearing from the peripheral area toward the center. Permeability of the lens material to water and increasing hydrophilicity was attributed to processing defects[36].

Another study mentioned transient homogenous central opacification of a MemoryLens IOL (model CV232, Ioltech) on the first postoperative day, which cleared after a week. Although the exact cause was unknown, the contamination during manufacturing was postulated to be a possible mechanism[37].

Intraocular lens discoloration secondary to intracameral dye The use of capsular dyes in cataract surgery helps better visualization of the anterior capsule during capsulorhexis in advanced cataracts.

Evaluation of interaction between different IOLs (PMMA, silicone, three-piece hydrophobic acrylic, single-piece hydrophobic acrylic, and single-piece hydrophilic acrylic) and trypan blue 0.1%, fluorescein sodium 2%, and indocyanine green (ICG) 0.5% revealed that only the hydrophilic acrylic

materials uptake the dye and get stained. The most significant color change occurred with the use of fluorescein. Careful irrigation of dye can be helpful to avoid lens staining. In addition, the authors do not recommend hydrophilic acrylic IOLs when intraocular dyes are required[38].

A previous study reported IOL explantation due to permanent blue discoloration by trypan blue dye (0.1%). The IOL was a high water content (73.5%) hydrophilic acrylic lens (Acqua, Mediphacos). The patient presented with dark double vision one week after surgery. Examination showed a decentered dark blue stained IOL. No changes were seen after 40d and the lens was replaced with a PMMA IOL with satisfactory results. Evaluation of the explanted IOL and experimental staining of two unused Acqua IOLs with trypan blue 0.01% and 0.001% was performed. The unused IOLs showed permanent staining even with 100 times more diluted concentration. The blue discoloration was denser in the optic periphery and did not clear after 24h of lens immersion in a balanced salt solution at 37℃. The analysis demonstrated that staining was much lighter in the hydrated state than a dry state. This IOL is implanted in a dry state and will expand after hydration in the bag. Uptake of the dye might occur in the remaining residual amounts of trypan blue during IOL hydration in the anterior chamber. Reviewing of surgical and clinical charts of the Department of Ophthalmology of the Hospital da Piedade revealed 12 cases of postoperative IOL staining, of which ten were asymptomatic. The authors stated that the Acqua lens is not an appropriate option when using trypan blue dye[39].

Another study reported corneal edema and IOL blue discoloration after inadvertent utilization of methylene blue instead of trypan blue dye in phacoemulsification. The lens was a silicone IOL (S140NB) which was explanted and analyzed. The surface and internal substance showed permanent staining. Experimental staining of 16 lenses (4 silicone, 4 hydrophobic acrylic, 4 hydrophilic acrylic, and 4 PMMA) was done with immersion in 0.5 mL of methylene blue (1%, 0.1%, 0.01%, and 0.001%). The most intense staining occurred with hydrophilic acrylic IOLs, and also all were permanently stained except PMMA[40].

Intraocular lens coating by ointments Penetration of ophthalmic ointments through clear corneal incisions after completion of phacoemulsification was hypothesized by Werner *et al*[41]. They reported eight patients with toxic anterior segment syndrome (TASS), which had an oily film like material/oily bubble in the anterior chamber. All the patients underwent IOL explanation. Also, penetrating keratoplasty was performed in four cases. An oily substance was found coating both surfaces of the IOLs during analysis. Therefore, cataract surgeons should check the wound integrity at the end of surgery[41].

Intraocular lens discoloration by povidone iodine Early hydrophobic silicone IOL opacification by povidone-iodine has been demonstrated in an experimental setting. The IOL staining was seen to be concentration-dependent. The duration of exposure was also determined. The most significant risk is when the povidone-iodine is instilled at the end of surgery. Inadvertent leakage could lead to the entrance of the toxic chemical into the anterior chamber. Complete wound closure is strongly advocated to prevent IOL and corneal endothelial damage by povidone-iodine[42].

Breakdown of ocular-blood barrier One bilateral reversible IOL opacification case has been reported in a woman with a history of diabetic retinopathy and chronic myelogenous leukemia. The patient underwent bilateral phacoemulsification and hydrophilic acrylic IOL (Akreos MI-60) implantation one month before notifying the significant IOL cloudiness on the anterior surface of both lenses. Bilateral intravitreal injection of bevacizumab was done for treating severe cystoid macular edema in the first postoperative month. One week later, clearing the opacity started with nearly complete resolution after two months. Alterations in the ocular blood barrier and increasing vascular permeability secondary to surgery and the underlying diseases (diabetes and leukemia) could affect aqueous humor composition. The pattern of central clearing is compatible with the role of aqueous in dissolving the deposits based on the concentration gradient. In this case, anti-vascular endothelial growth factor injection reversed the haziness[43].

Postoperative inflammation Kim *et al*[44] introduced a 72 years old female for whom a hydrophobic acrylic IOL (Tecnis ZCB00) was implanted during cataract surgery. She presented with significant IOL opacification over the entire anterior surface of the lens, sparing the central region two weeks after surgery. Slit-lamp examination showed mild anterior chamber reaction as well. The frequency of topical corticosteroid eye drop increased. The concentric opacity wholly resolved after four weeks. Two main reasons were discussed. The first is the possibility of temporary growth of lens epithelial cells because of the beginning of opacification from the peripheral optic. Another hypothesis is the presence of an atypical and delayed form of TASS. The accompanying anterior chamber reaction and resolution of clouding after frequent steroid prescription favor inflammatory origin[44]. Similarly, there is a report in a 68-year-old woman who experienced temporary IOL opacification[45].

Miscellaneous A study by Mehta[46] described seven to nine thin elongated oval-shaped markings on the posterior surface of Aquafold IOL (model CB F32 UVA, Omni Lens Pvt. Ltd.). The lines were 3-7 mm long parallel to each other and perpendicular to the direction of the lens folding in the cartridge and eventually disappeared after four months. These

unusual lines were not compatible with folding marks and they were also uncommon for being inflammatory in origin due to linear configuration and late complete resolution. It has been mentioned that mild secondary calcification of some residual viscoelastic/ethylene oxide as a nidus could be the underlying reason[46].

Another published report of early postoperative opacification discussed a patient with cataract and dense vitreous hemorrhage who underwent a triple pars plana vitrectomy, phacoemulsification, and IOL implantation. On the third postoperative day, many small brown corpuscles with the appearance of a dusty haze were seen on the lens surface. The IOL was a single-piece AcrySof acrylic (SA60AT, Alcon, USA). The surgeons explanted and exchanged it with another same type of lens which remained clear. After analysis, proteinaceous material (particularly fragments consisting of 17 aminoacids) was identified on the IOL surface but there was no triamcinolone or calcium. A probable theory is the adherence of the hemocyte element of the residual vitreous hemorrhage to the adhesive AcrySof surface[47].

Parkin and Pitts-Crick[48] discussed a milky opacification throughout the whole body of an AMO PhacoFlex IOL (Model S130NB, Allergan) on the first day following cataract extraction in a 69-year-old man. After four days, the affected IOL was replaced with a PMMA lens due to its adverse effect on visual acuity. Heating at 50°C cleared the opacity of the explanted lens. No specific cause was identified regarding the manufacturing process[48].

DISCUSSION

IOL opacification may have severe adverse effects on visual function and contrast sensitivity[49-51]. Several pathologic processes have been proposed for the loss of transparency of the implanted IOLs[52]. Although no direct cause and effect relationship was demonstrated, knowledge of these different mechanisms and patterns of IOL clouding is essential for cataract surgeons. It could guide them to make the best decision for their patients.

IOL opacification may be detected during implantation. The most common presumed cause in intraoperative IOL clouding is rapid temperature change. Almost all of these IOLs transferred shortly before implantation into the operating room in subzero temperature. Sudden temperature rise after introduction into the anterior chamber may cause the incorporation of water into the IOL material. Microbubble formation, water vapor consolidation on a cold surface, and subsequent light refraction are also described. The IOL will be clear after several minutes to hours following dehydration. Delayed IOL exchange is recommended in the setting of storage in cold temperature because of the high rate of spontaneous resolution. Taking precautions to IOL storage conditions to prevent from rapid temperature fluctuations is important. It is suggested to store the IOL at room temperature and consider the manufacturer's guidelines.

In contrast, crystallization of the IOL surface due to the reaction between calcium in the irrigating solutions with the phosphate of the OVD is unlikely to clear spontaneously. Drying out of OVD is another possible cause. It is particularly visually significant with silicone lenses. The surgeons could load IOLs shortly before implantation by using an appropriate injector and irrigate the viscoelastic carefully to avoid this complication. It is advisable to remove the lens if such complications during surgery is encountered. Capsulotomy may also be beneficial in some patients.

Several factors could be involved when a surgeon detects IOL clouding in postoperative visits. We reviewed these cases up to the first month following surgery. It should be mentioned that no definite rule and definition is available regarding the duration of acute IOL opacification. The preoperative manufacturing process is critical. Careful monitoring is required particularly during IOL packaging, disinfection, and storage procedures. Accidental introduction of volatile chemicals such as disinfectants and insecticides into the IOL through vapor-permeable packaging is a likely event that may change the hydrophilicity of the lens material. As a result, IOL hydration could occur and IOL clearance would be affected. It is mainly seen with silicone lenses, which will demonstrate gray-white or brown haze. A pattern of peripheral clearing is described. However, this type of opacity often requires IOL exchange due to its persistence and reduction of vision.

Permanent IOL blue discoloration was reported due to residual amounts of intraocular trypan blue dye. The most vulnerable lenses were hydrophilic acrylic IOLs. Careful irrigation of intracameral dyes is important to avoid IOL staining. Complete wound closure is also essential for preventing from the entrance of povidone-iodine or prescribed ophthalmic ointments into the eye. These are other probable causes of IOL discoloration.

Postoperative inflammation and TASS were implicated in a few cases. The opacity is potentially reversible. Corticosteroids have a leading role in the management.

Regardless to the shape, productive company, material properties, and surface technology of materials, acute IOL discoloration can be occurred in almost all types of IOLs such as hydrophilic acrylic IOL, acrylic hydrophobic IOL, hydrophilic acrylic IOL with a hydrophobic surface, trifocal IOL, silicone IOL, and PMMA IOL[14-18,20-24,53-57]. However, some types of discoloration are more common is some particular types of IOLs. This fact shows that acute IOL discoloration whether intraoperative or early postoperative is relatively unpredictable and should not change the surgery plan

or IOL selection. On the other hand, incidence of this event is extremely unremarkable compared to the number of performed cataract surgeries. Also, the role of underlying diseases such as diabetes mellitus and uveitis in acute IOL discoloration is unclear. However, we think unlike late IOL opacifications, this role is not significant since the number of reported cases of acute discoloration with underlying conditions like diabetes mellitus is extremely low.

Almost all of these mechanisms are theoretical and ophthalmologists may encounter patients with no definable origin for loss of lens clarity. Several variables are involved in decision making for IOL explantation, including the severity and pattern of the opacification, the level of visual dysfunction, patient's visual demands, other ocular and systemic comorbidities, and observation of any sign of clearance in follow-up visits.

In conclusion, most of the acute IOL opacifications could be avoided by taking precautions in manufacturing and storage conditions. Keeping the IOL dry and clean away from rapid temperature fluctuations is advisable. The role of standard surgical procedures and choosing of proper surgical materials should also be considered. Conservative management before IOL explantationis a reasonable approach in many patients.

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