






CASE REPORT

Difficulties of Cataract Surgery in Lens-Induced Glaucoma Due to Subluxated Cataract

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**Abstract**

Introduction: Cataract is a disease of the eye in which the normal clear lens has opacified and obscured the passage of light. A mature cataract occurs when the lens is opacified. Lens subluxation is a condition when the crystalline lens is not in its anatomical position that can result in decreased anterior chamber depth. It is a potentially high risk of developing pupillary block, leading to lens-induced glaucoma (secondary angle closure glaucoma). In this case, the definitive therapy is lens extraction, which is challenging for cataract surgeons. This case report aims to expose the difficulties of cataract surgery in lens-induced glaucoma due to subluxated cataract. **Case Presentation:** A 56-year-old male presented with unable to see in his right eye, followed by foggy vision, glare when seeing the light, and a history of an acute glaucoma attack. His right best corrected visual acuity (BCVA) was 1/300, and the intraocular pressure (IOP) was 5 mmHg on therapy with glaucoma medications. Slit lamp examination of the right eye showed a shallow anterior chamber, irradiated iris, mid-dilated pupil, completely cloudy lens, and a capsular instability around 12 to 6 clock hours (180°/2 quadrant). This patient was diagnosed with mature cataract and lens-induced glaucoma due to subluxated mature cataract and was given glaucoma medications also underwent phacoemulsification (PE) along with Intraocular lens (IOL) and capsular tension ring implantation due to the lens instability and excessive lens movement. **Conclusions:** Cataract surgery for subluxated mature cataract and lens-induced glaucoma is challenging because of the shallow anterior chamber, capsular instability, and excessive lens movement. A thorough diagnosis, preoperative evaluation, postoperative monitoring, and evaluation are essential for safe cataract surgery, reducing the risk of complications and achieving a good result.

Keywords: cataract surgery; mature cataract; secondary glaucoma; lens-induced glaucoma; lens subluxation

Introduction

A cataract is a curable eye disease in which the normal clear lens has opacified and obscured the passage of light. It is a gradually progressive disease that significantly reduces a person's quality of life. This disease is one of the highest causes of blindness worldwide and still has become a problem in public health.^{[1],[2]} According to World Health Organization (WHO)^[3], cataract causes more than 20 million people to experience blindness, and this has resulted in cataracts being the leading cause of blindness in the world with a percentage of 51%. A mature cataract is one of the morphological forms of cataract, which is hallmarked by the presence of a total opacified lens. In a mature cataract, a red reflex cannot be obtained; also, the pupil appears white, are found in eye examination.^[4]

A subluxated crystalline lens (ectopia lentis) is a condition in which the crystalline lens is not in its anatomical position.^[5] It has resulted from either trauma, occurring spontaneously, or ocular problems; this forward movement of the displaced lens may decrease the depth of the anterior chamber and can cause angle closure. There is also a high risk of developing pupillary block, which can lead to lens induced glaucoma (secondary angle closure glaucoma).^[6] Management that can be done for lens-induced glaucoma due to a subluxated lens consists

of two laser iridotomies 180° and lensectomy. Two laser iridotomies 180° are a temporary treatment until the definitive lens extraction can be done to improve visual acuity (VA) and minimize the risk of recurrent pupillary block and peripheral anterior synechiae (PAS) formation.^[5]

Lens-induced glaucoma due to lens instability or subluxation in cataract surgery is challenging for surgeons. Determining the zonular status is important in this case. It can be determined by directly visualizing the lens equator with the dilated pupil or using gonioscopes to visualize the zonular fibers behind the pupil. If zonular disruption is extensive preoperatively, the surgeon may consider the cataract or lens removal, whether by extracapsular cataract extraction (ECCE), intracapsular cataract extraction (ICCE), or phacoemulsification (PE) with capsular hooks followed by suturing a capsular segment to stabilize the capsule during and after surgery. A capsular hook, capsular tension ring (CTR), or CTR segments can be used if the capsular support is insufficient for safe PE.^{[3],[7]}

Surgical management of subluxated cataract is challenging among surgeons. Even with the disturbance of the zonules in a subluxated cataract, this cataract surgery is relatively safe.^[8] With the various difficulties encountered, it is essential to diagnose correctly to know the proper treatment for the patient. Furthermore, it is also necessary to carefully monitor preoperative, intraoperative, and postoperative management. So that it will reduce the risk of complications and improve the visual outcome, in this case report, we present a case showing the difficulties of cataract surgery in lens-induced glaucoma due to subluxated cataract.

Case presentation

A 56-year-old male patient came to the outpatient ward complaining that his right eye had been unable to see since 1.5 months before he came to the clinic. Previously, the patient complained of blurred right eye vision six months ago, accompanied by foggy vision and glare when seeing the light. However, the ophthalmologist did not check the patient's eye due to the COVID-19 pandemic. There were no complaints of red, watery, painful eyes or seeing black shadows when the patient came to the clinic. There were no other complaints in the left eye.

The patient previously complained of sudden pain and redness in his right eye accompanied by sudden blurred vision 1.5 months before his visit. He came to the emergency room near his house, was given some medications, and was hospitalized for three days. Then, the patient's condition improved. He had another attack one month after his first incidence with similar complaints without redness in his right eye. Then he came to the ophthalmologist and was given oral acetazolamide, slow release potassium tablets, and timolol eye drops

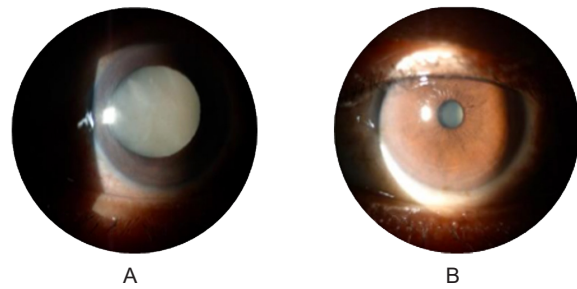


Figure 1. Anterior segment examinations; (A) The right eye showed irradiated iris, mid-dilated pupil, total opacified lens, capsular instability 180° (2Q); and (B) The left eye showed minimal cloudiness of the lens.

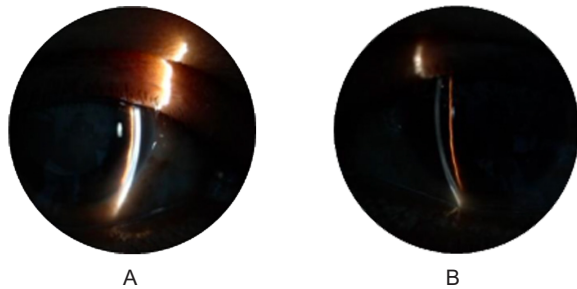


Figure 2. Anterior segment examinations with slit illumination; (A) The right eye showed shallow anterior chamber, and (B) The left eye within the normal limit.

consumed regularly. There was a medical history of hypertension, and he was given amlodipine 10 mg irregularly. A history of allergy, diabetes mellitus, heart disease, stroke, eye trauma, or previous eye surgery were denied. There was a history of wearing reading glasses.

There was no brachydactyly (short digits) on the general examination, and the other examination was normal. On ophthalmology examination, the VA of the right eye (OD) was 1/300. The intraocular pressure (IOP) was 19.5 mmHg on topical and oral glaucoma medication (timolol eye drops and acetazolamide thrice daily). A slit lamp examination revealed a shallow anterior chamber, and the iris was an irradiate, mid-dilated pupil with a diameter of 5-6 mm; the lens was completely cloudy also, and there was capsular instability from around 12 until six clock hours (180°) and iris pigment was found in the lens capsule (Figures 1-2). There was no phacodonesis or iridodonesis. The OD's posterior segment examination was difficult to evaluate due to the total lens opacity. Gonioscopy showed a closed anterior chamber angle, and indentation gonioscopy showed PAS at 90° in the inferior quadrant. In this patient, ultrasonography examination was performed with the result of OD obscura corpus vitreous (Figure 3). Biometry on the right eye revealed anterior chamber depth (ACD) of 1.54 mm with lens thickness (LT) of 4.57 mm.

The VA of the left eye was 6/6, and the IOP was 11.7 without any glaucoma medication. The anterior segment of the left eye showed minimal cloudiness of the lens and deep a anterior chamber (Figures 1-2). Examination of the left eye posterior segment found clear media, the optic

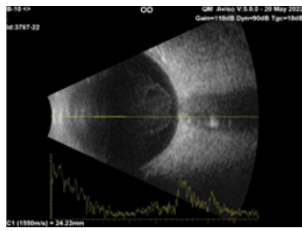


Figure 3. Ultrasonography of the right eye showed vitreous opacification. disc had a cup-disc ratio of 0.3, and the neuroretinal rim was normal, according to the ISNT rule. Other funduscopy examinations of the left eye were within normal limits, with no glaucomatous optic neuropathy.

According to the medical history, physical examination, and supporting examination, OD mature cataract and lens-induced glaucoma due to subluxated mature cataract were diagnosed. The patient was given acetazolamide every eight hours orally, potassium tablet once a day, topical anti-glaucoma timolol eye drops every 12 hours, diclofenac sodium eye drops three times a day, and artificial tear eye drop six times daily only on his right eye. In addition to medical therapy, the patient was also treated with surgical management. PE, an IOL implantation and a CTR were chosen.

During the preoperative assessment two hours before the surgery, there was an elevated IOP of 26.7 mmHg, so the patient has given acetazolamide 250 mg two tablets orally. After that, the patient was given glycerin 1 cc/kg bodyweight or as much as 67 cc, and was evaluated one hour later. The IOP was 22.2 mmHg after glycerin administration. The IOP of the left eye was within normal limits.

Subconjunctival anesthesia with 2% lidocaine injection was performed during the operative period, followed by main port creation at one o'clock. This surgery was challenging due to the shallow anterior chamber. It reduced the tight confines of the anterior segment of the eye. Subsequently, capsulorhexis of the anterior capsule using the continuous curvilinear capsulorhexis (CCC) technique. During capsulorhexis, capsular instability around 12 until six clock hours (180°) was found, and the lens movement became excessive. A CTR with a diameter of 13.0 mm was fitted to stabilize the lens. Afterward, when the lens was relatively stable, PE was performed using the stop-and-chop technique. It was followed by aspiration irrigation of the remaining cortex and foldable IOL insertion with a power of 18.50 D and a diameter of 12.0 mm in the bag. The surgery was concluded with corneal hydration and intracameral injection of 5 mg cefuroxime (Figure 4).

After the surgery patient was hospitalized for one day and got a dexamethasone injection of 5 mg intravenous, dexamethasone, neomycin sulfate, polymyxin b sulfate eye drops every four hours, timolol eye drops every 12

hours, acetazolamide orally three times a day, potassium tablets orally once a day, and analgesic mefenamic acid. One day after surgery patient claimed that the pain in the right eye was reduced, but the VA had not improved. The examination found that the VA was 1/300 while the IOP was 17.0 mmHg. Anterior segment examination found that conjunctival hyperemia was reduced, a thick Descemet fold in the visual axis, and an air bubble was in the front eye chamber. IOL was in place and well-centered in the bag.

On the seventh day of postoperative control, the eye pain had decreased and only appeared a few times. The VA was also improved. The natural VA was 6/85, while the IOP was 9.1 mmHg. No conjunctival hyperemia was found on the anterior segment's evaluation, but there was a flare. IOL was in place and well-centered in the bag (Figure 5).

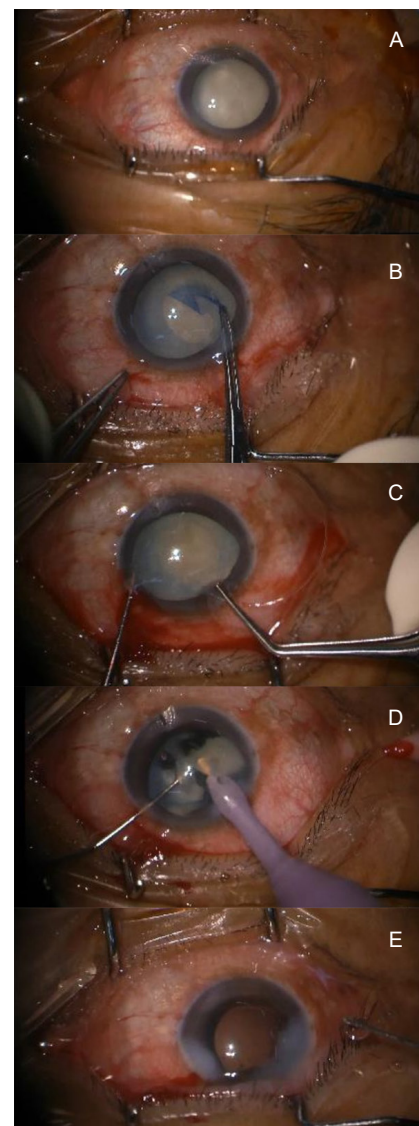


Figure 4. Clinical photographs showing steps of phacoemulsification along with IOL and CTR implantation; (A) Preoperative right eye condition, showed capsular instability; (B) Capsulorhexis using the CCC technique; (C) 13 mm diameter of CTR was inserted to stabilize the unstable lens; (D) Phacoemulsification using the stop-and-chop technique; and (E) After the Phacoemulsification, IOL, and CTR implantation was performed.

Posterior segment evaluation found clear media, the round pupil with a firm border, the optic disc had a cup disc ratio of 0.4, and the neuroretinal rim was normal according to the ISNT rule. The dose of dexamethasone, neomycin sulfate, and polymyxin-b sulfate eye drop was tapered every six hours, and an anti-inflammation agent, prednisolone acetate eye drop, was given. Timolol eye drops twice a day, and acetazolamide is stopped.

Two weeks postoperatively, there was no complaint. The VA was 6/8 with the correction of spheres +0.5 and cylinders -0.25. It became 6/6.5, and the IOP was 18.1 mmHg. A slit lamp examines no conjunctival hyperemia or signs of inflammation, such as flares or cells. The anti-inflammation agent was reduced to every 12 hours, and timolol was stopped. One month postoperatively patient had no complaint; the VA was 6/8 with the correction of spheres +0,5 and cylinders -0,25 became 6/6.5. The IOP was 16.7 mmHg without any glaucoma medication. Anterior segment examination was within normal limits. The patient was planned to be given bifocal glasses.

Discussion and conclusions

Cataracts are abnormal conditions in the eye's lens in the form of cloudiness that blocks the passage of light from entering the retina, which can cause a decrease VA. Therefore, cataracts are one of the highest causes of blindness worldwide.^[1] In Indonesia, cataract was found in 210,000 Indonesians or about 0.1% of the 250 million total population yearly. Only 80.000 patients in Indonesia have cataract surgery, despite the country's high number of cataract patients. Therefore, the number of cataract patients in Indonesia is still the highest in Southeast Asia.^[9] A mature cataract is one of the morphological forms of cataract and it is typically characterized based on symptoms such as gradually blurry and foggy vision until vision loss and are when seeing the light. The presence of total opacified lenses hallmarks this type of cataract. In mature cataract a red reflex cannot be obtained; also, the pupil appears white, are found in slit lamp examination.^[3] At the end of 2019, a new outbreak spread throughout the world, namely COVID-19. Several policies existed during the pandemic, such as lockdowns and activity restrictions. It indirectly decreased the number of patients that visited the hospital for treatment due to limited activity and the patient's fear of infection with COVID-19. When the patients are delayed in going to the hospital, it could lead to the progression of the disease, further intensifying the difficulties. This includes cataract cases, where according to Bhalerao et al.^[10], there was a significantly higher proportion of mature, brown, or black cataracts and phacomorphic, phacolytic, or Morgagnian cataracts when compared to 2019 before the lockdown.

Severe cases manifest progressive blurry vision caused by the progression of cataracts due to the altered lens position, lens tilt, or increasingly spherical lens

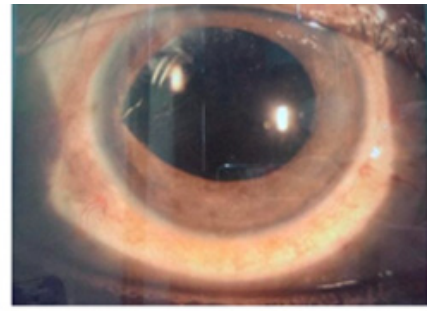


Figure 5. Right eye postoperative patient's picture day-7.

configuration resulting from zonular weakness. Zonular weakness can cause a lens subluxation.^[11] The dystopia of the lens can be divided into subluxation and luxation, depending on the amount of zonular support. Subluxation occurs when the lens partially remains in the pupillary area of the posterior chamber. Luxation occurs when the zonule completely ruptures, allowing the lens to migrate to the anterior chamber or vitreous cavity.^[12]

A subluxated crystalline lens (ectopia lentis) is a condition when the crystalline lens is not in its anatomical position.^[5] It has resulted from spontaneous trauma or ocular problems, this forward movement of the displaced lens.^[3] There are four types of severity of zonular weakness. It consists of mild, that only affects less than one quadrant, moderate zonular weakness, which affects 1-2 quadrants, severe zonular weakness that affects 2-3 quadrants, and very severe zonular weakness which affects more than three quadrants. Suppose zonular disruption is extensive preoperatively for the management. In that case, the surgeon may consider the cataract or lens removal, whether by ECCE, ICCE, or PE with capsular hooks followed by suturing a capsular segment to stabilize the capsule during and after surgery. A capsular hook, CTR or CTR segments can be used if the capsular support is insufficient for safe PE. The function of capsular hooks is to support the anterior capsule edge in weakened zonular fibers. It is inserted through paracentesis incisions, and the capsule is centered for PE by adjusting the tension on each hook. By applying an outward force against the capsule equator in areas where zonular fibers are missing or weak, a CTR may initially operate as a tool to offer intraoperative support during cataract removal. The last use of CTR is as an implant for long-term IOL stability. A modified CTR or CTR segment sutured to the scleral wall may also control insufficient zonular support. However, a pars plana approach by a vitreoretinal surgeon should be considered if there is significant lens instability with more than 180° of zonular dialysis and for total dislocation. The selection of tools used in this surgery is based on the severity of the zonular weakness. If it is mild (<1Q), the surgeon can use the rigid IOL; if it is moderate (1-2Q), use CTR; for severe zonular weakness (2-3Q), can use modified CTR or CTR segment and if it is very severe (>3Q) scleral fixation is the best that can be chosen.^{[3],[13]}

The anterior chamber's depth may be decreased due to lens subluxation due to the displaced lens moving forward. It can cause angle closure and a high risk of developing pupillary block, leading to lens-induced glaucoma (secondary angle closure glaucoma).^[6] There are five types of lens-induced glaucoma, dislocated lens, lens particle glaucoma, phacomorphic glaucoma, phacolytic glaucoma, and phaco anaphylaxis.^[14] In this case, we diagnosed dislocated lens as lens-induced glaucoma because of a history of acute glaucoma (sudden vision loss followed by red eyes, pain in the right eye, and elevated IOP). When the patient came to the outpatient ward, the IOP level was controlled using glaucoma medication. Anterior segment examination showed a shallow anterior chamber, mid-dilated pupil, and iris pigment in the lens capsule. Those complaints and physical examinations were followed by 180° lens subluxation so that lens-induced glaucoma was diagnosed due to lens subluxation or dislocation.

Management that can be done for lens-induced glaucoma due to subluxated lens consists of two laser iridotomies 180° and lensectomy. The creation of two laser iridotomies 180° apart so that both will not be occluded simultaneously by the lens. This treatment relieves the pupillary block temporarily. Meanwhile, lens extraction is the definitive treatment usually indicated to improve VA and minimize the risk of recurrent pupillary block and PAS formation.^[5] In this case, we choose a definitive treatment, lens extraction. Lens extraction surgery successfully lowered IOP in eyes with secondary glaucoma associated with lens subluxation.^[15] During the surgery, some difficulties were encountered, such as a shallow anterior chamber that could reduce the tight confines of the anterior segment of the eye. Also, there was capsular instability from around 12 until six clock hours (180°), so the lens movement became excessive. We performed PE with the support of CTR for the zonular weakness and IOL implantation. Because the subluxation, in this case, is moderate subluxation (2Q), with this CTR posture, we may remove the nuclear material and cortical tissue more safely while inserting the IOL of our choice into the capsular bag.^[3] Additionally, for at least 60 days after surgery, the CTR can lessen unfavorable IOL movement.^[16] In eyes with capsular decentration or high potential for decentration, it is advisable to avoid using premium IOLs like multifocal and toric lenses.^[3]

During the COVID-19 pandemic, the lockdown and people's fear of COVID-19 infection made them reluctant to go to the hospital, including for cataract cases. That matters worsen the cataract's maturity and intensify the difficulties when the patient comes to the hospital. Lens-induced glaucoma due to subluxated mature cataracts in cataract surgery is challenging for surgeons. With recent advances in equipment and instrumentation, better surgical techniques, and an understanding of

fluid dynamics, the surgeon can perform relatively safe cataract surgery in compromised zonules.^[8] With the various difficulties encountered, it is essential to make the diagnosis correctly and a thorough preoperative evaluation so that the surgeon can determine the appropriate surgical approach for lens removal and the subsequent technique of intraocular lens placement. After a successful surgery, it is essential to do an evaluation. In this case, it was expected that the patient could control the hospital periodically to check the progressivity of zonula lysis, IOP, and posterior segment evaluations.

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