Cannula-associated Ocular Injuries during Cataract Surgery: A Preventable Intraoperative Complication?
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Abstract:
Although rare, inadvertently dislodged cannula can occur during cataract surgery. We report two cases of cannula-associated ocular injury during stromal hydration of the main corneal incision despite the use of Luer-lock syringes. Case 1 suffered from an initially occult intraocular injury which led to a delayed presentation of vitreous prolapsing into the anterior chamber, presumed posterior capsular rupture, vitreous hemorrhage, and multiple retinal tears, which required a three-port pars plana vitrectomy and cryotherapy. Case 2 sustained an iris laceration, anterior capsular tear, and postoperative raised intraocular pressure with no late sequelae. The former case highlights the need for close monitoring postoperatively despite the absence of initial apparent evidence of intraocular injury. Herein, we propose a systematic approach in reducing the risk of inadvertent cannula-associated ocular injury.

Keywords:
Cannula, cataract surgery, complication, intraocular injury

Introduction
Cannula–syringe system is frequently used during cataract surgery. However, several cases of inadvertently dislodged cannula have been reported even with the use of Luer-lock syringes. We report two cases of cannula-associated ocular injury (COI) that occurred during cataract surgery despite the use of Luer-lock syringes. These cases remind us – as the ophthalmologists – the importance of recognizing this potential intraoperative complication and not to become complacent while performing any intraocular injection.

Case Reports

Case 1
A 75-year-old male underwent a right phacoemulsification with intraocular lens (IOL) implant under local anesthesia. His preoperative best-corrected visual acuity (BCVA) was 20/60 OD. Following uncomplicated phacoemulsification and IOL implantation, stromal hydration of the superior corneal wound was performed with a 27-gauge Rycroft cannula attached to a 3 ml Luer-lock syringe filled with balanced salt solution (BSS). Cannula tightness was checked by a scrub nurse before handing over to the surgeon. During wound hydration, the cannula unexpectedly dislodged from the syringe, with half of the cannula situated in the anterior chamber and half of it remained outside the eye. The cannula was withdrawn with no evidence of any intraocular injury. The incision was subsequently hydrated.

On 5-day postoperative, the patient attended the eye emergency department with decreased vision since the surgery. His BCVA was hand movements. Examination revealed vitreous in the anterior chamber extending from the superior (subincisional) area of the iris to the main corneal wound. IOL was well centered within the capsule...
bag with intact anterior capsulorhexis and posterior lens capsule. The fundal view was obscured by a dense vitreous hemorrhage. The patient underwent immediate right 23-gauge three-port pars plana vitrectomy. Two flat retinal holes with surrounding retinal hemorrhages were found at the far periphery of the inferior retina, and two U-shaped tears were identified at the superior retina around the equator. All retinal holes and tears were treated with cryotherapy. At 4-week postoperative, his BCVA improved to 20/40. Vitreous hemorrhage had fully resolved and retina remained flat. His BCVA improved to 20/30 at 6-month postoperative.

Case 2
An 85-year-old female underwent a left phacoemulsification with IOL implant under topical anesthesia. Her preoperative BCVA was 20/40 OS. Following uncomplicated phacoemulsification and IOL implantation, stromal hydration of the corneal wound was performed as Case 1. Tight fit was confirmed, and the hub of the cannula was held during the injection. During wound hydration, the cannula inadvertently shot off from the syringe across the anterior chamber, causing inferior iris laceration and anterior lens capsule tear. No hyphema was present and IOL remained centered. The corneal wound was subsequently rehydrated.

On 1-day postoperative, her BCVA was 20/30. Examination revealed an inferior iris laceration [Figure 1a and b] with an intraocular pressure (IOP) of 38 mmHg. IOL appeared stable despite an anterior capsular tear, and dilated fundus examination was unremarkable. A 3-day course of oral acetazolamide 250 mg and a 4-week course of maxitrol drop 4x/day were commenced. At 5-week postoperative, patient’s BCVA improved to 20/17 with an IOP of 13 mmHg. No late sequela was observed after 1 year. Incident reports were filed for both cases.

Discussion
The recommendation of Luer-lock syringe came to light after several reports of cannula dislodged from slip-lock syringes.\[4-6\] Luer-lock syringe is supposed to serve as a safety mechanism to eliminate the risk of dislodged cannula; however, such unfortunate intraoperative incident can still occur.[1-3] It can result in corneal edema, iris injury, hyphema, capsular tear/rupture, zonular dialysis, vitreous loss, vitreous hemorrhage, and macular/retinal damage.[1-7]

COI can potentially occur during different stages of cataract surgery, with stromal wound hydration being the most common stage.[4,6,7] This is because the tip of the cannula is partially or completely occluded during the hydration of corneal stromal wound, which increases the amount of pressure built up within the syringe during the injection, leading to sudden expellant of the cannula into the eye. Even with the use of Luer-lock syringe, such unfortunate intraoperative complication can still occur as demonstrated in our cases.

In Case 1, we postulate that the dislodged cannula shot through the capsule bag inferiorly and impacted the inferior retina resulting in round tears and vitreous hemorrhage. The sudden force exerted on the inferior capsule bag could potentially damage the superior zonular support accounting for the vitreous prolapsing into the anterior chamber and the superior U-shaped retinal tears from the vitreous traction. Such injury occurring at the extreme inferior periphery of the capsule bag was not detectable intraoperatively. Furthermore, the fact that the cannula had ricocheted out and sandwiched between the anterior and posterior lips of the corneal wound had given a false reassurance to the surgeon during the incident. Video recording was not available.

According to Bernoulli’s law, the resistance to flow is inversely proportional to the diameter of the cannula. Therefore, using cannulas with a larger inner diameter (e.g., 25-gauge Pearce Hydrodissection Cannula) should have a lower theoretical risk of dislodged cannula from the syringe in comparison to smaller cannulas (e.g., 27-gauge Rycroft) because the former causes less resistance to the flow when the fluid or viscoelastic agent was injected out from the syringe. It is also important to bear in mind that the resistance to flow is proportional to the viscosity of the injected material; therefore, higher force is required to inject substances such as Healon GV as compared to BSS.

Based on our two cases, we propose a systematic approach in preventing or reducing the risk of COI during cataract surgery [Figure 2]. In addition, Case 1 highlights the need for close follow-up, even when there are no signs of intraocular injury intraoperatively. We also advocate the use of a larger cannula (e.g., 25-gauge
Pearce Hydrodissection Cannula) during stromal hydration of the corneal wound. All theater staff and surgeons have been informed of this potential complication. The systemic approach, as described in Figure 2, has been instigated to reduce the risk in the future. A future population-based study examining the incidence and magnitude of COI will be beneficial.

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Conflicts of interest There are no conflicts of interest.

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