Original Article

Lens decompression technique for prevention of intraoperative complications during phacoemulsification of intumescent cataract

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Purpose: To evaluate intraoperative complications during phacoemulsification of intumescent cataract using lens decompression technique. **Methods:** Participants with intumescent cataract scheduled for phacoemulsification were recruited and divided into two groups. In both groups, after the anterior capsule was stained with trypan blue, the anterior chamber was filled peripherally with a dispersive ophthalmic viscosurgical device (OVD) followed centrally by a higher viscosity cohesive OVD (Healon GV). In Group 2, a 25-gauge needle was then inserted into the lens center and liquid cortex aspirated by pulling back on the syringe plunger. The outcomes measured were the incidence of capsular radial tears and the incidence of conversion to extracapsular cataract extraction (ECCE). **Results:** In Group 1 (20 eyes), capsular radial tears occurred in four eyes, and in two eyes, the procedure had to be converted to ECCE. In Group 2 (20 eyes), no capsular radial tears or conversion to ECCE was reported. **Conclusion:** Lens decompression technique reduced the risk of capsular radial tears and conversion to ECCE during phacoemulsification of intumescent cataract.

Key words: Intumescent cataract, lens decompression, liquefied cortex, phacoemulsification, radial capsular tear

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DOI:
10.4103/ijo.IJO_352_17

Quick Response Code:

Achieving a complete curvilinear capsulorhexis (CCC) of appropriate diameter is the cornerstone for a successful cataract surgery. Special care and attention are paid, even by experienced surgeons, when operating on eyes with intumescent cataract.[1]

Once the anterior capsule of the intumescent lens is perforated, the visibility, which was poor owing to absent red reflex, becomes even worse due to leakage of liquified cortical matter. The phenomenon that every cataract surgeon witnessed usually takes place within seconds of puncturing the anterior lens capsule when the elevated intralenticular pressure expands the initial capsule incision in an uncontrollable fashion, developing the Argentinean flag sign.[2]

Radial capsular tears may be limited to the anterior capsule, allowing careful phacoemulsification, or may necessitate conversion to extracapsular cataract extraction (ECCE) or may extend beyond the equator leading to more serious complications, such as zonular rupture, posterior capsule rupture, vitreous prolapse, nuclear drop, and posterior intraocular lens (IOL) dislocation.[3]

Several approaches have been described to minimize intraoperative complications when operating on intumescent cataracts, including the use of different types of ophthalmic viscosurgical devices (OVDs) or staining dyes.[2,4] Other authors applied different endodiathermy devices to create a CCC in intumescent lenses.[5-7] Anterior capsule puncture with positive anterior chamber pressure and two-stage capsulorhexis have considerably reduced the complications of intumescent cataract surgery.[8] Other authors suggested that, instead of allowing the higher intralenticular pressure to passively equilibrate with the anterior chamber pressure, the pressure within the lens should be actively reduced by aspiration of liquefied cortical matter.[2,9]

The present prospective study evaluated two surgical approaches and compared their intraoperative complications. In both groups, after the anterior capsule was stained with trypan blue, the anterior chamber was filled peripherally with a dispersive OVD followed centrally by a higher viscosity cohesive OVD, so the pressure in the anterior chamber was slightly higher than the intralenticular pressure. In Group 2, a 25-gauge needle was inserted into the lens center; liquid cortex was aspirated by pulling back on the syringe plunger, actively reducing intralenticular pressure.

Methods

This case series study was carried out on patients with intumescent cataract [Fig. 1]. Intumescent cataract diagnosis was based on lens swelling on slit-lamp examination and confirmed by ultrasound. Informed consent was obtained from

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Manuscript received: 14.05.17; Revision accepted: 27.07.17

Cite this article as: Nabil KM. Lens decompression technique for prevention of intraoperative complications during phacoemulsification of intumescent cataract. Indian J Ophthalmol 2017;65:1436-9.

all patients. All surgeries were performed by the same surgeon, the author, between October 2015 and November 2016.

Exclusion criteria included pseudoexfoliation syndrome, uncontrolled glaucoma, inadequate mydriasis (pupil diameter <6.0 mm), weak zonules, history of ocular trauma, and age <25 years. All patients were subjected to detailed ophthalmic examination using a BQ 900 slit lamp (Haag-Streit AG), axial length measurement using the OA-1000 optical biometer (Tomey Corporation; Nagoya, Japan), or A-scan ultrasound and corneal topography using Topographic Modeling System TMS-5 (Tomey Corporation; Nagoya, Japan). In the next step, the data were exported to OKULIX ray tracing software for IOL power calculation.

All surgeries were preceded by topical moxifloxacin hydrochloride 0.5% eye drops instilled every 2 h initiated 1 day preoperatively, complete asepsis, perioperative conjunctival sac sterilization with povidone–iodine 5%, topical anesthesia using tetracaine hydrochloride 1.0%, and pupil dilation.

In all eyes, a 2.5 mm clear corneal incision was tunneled at the limbus at 11 o'clock using Alcon steel blade keratome 2.5 mm (Alcon Laboratories; Ft Worth, TX, USA). Anterior capsule was stained with trypan blue (Visionblue Staining Solution, Dutch Ophthalmic, USA) under air [Fig. 2]. The anterior chamber was filled peripherally with a dispersive OVD (Visicrom 2%, Croma-Pharma GmbH; Leobendorf, Austria) followed centrally by a higher viscosity cohesive OVD (Healon GV, Abbott Medical Optics Inc.,; Santa Ana, USA).

In Group 2, a 25-gauge needle was then introduced into the anterior chamber through the main incision, with the bevel down facing the anterior capsule. The needle was inserted into the lens center and liquid cortex aspirated by pulling back on the syringe plunger, aspirating 0.1–0.2 ml of liquefied cortex. No dry taps were encountered [Fig. 3 and Video 1].

In all eyes, CCC was initiated using a bent 25-gauge needle through the main incision, then, the leaf of the opened anterior capsule was held using Koch capsulorhexis forceps (Geuder AG), and the capsulorhexis was continued circularly [Video 2]. Then, a self-sealing clear corneal stab incision was fashioned at the limbus at 2 o'clock position using Alcon steel blade superblade 15° (Alcon Laboratories; Ft Worth, TX, USA), and a second clear corneal self-sealing stab incision was created at the 10 o'clock position.

In both study groups, the stop and chop phacoemulsification technique was applied without hydrodissection or delineation using a 30° phaco tip using Alcon Infiniti system (Alcon Laboratories; Ft Worth, TX, USA), followed by removal of the remaining cortical matter through the side ports using bimanual irrigation/aspiration (I/A). Finally, the posterior capsule was polished.

In uneventful cases, a hydrophilic acrylic IOL (Aqua-Sense IOL, Ophthalmic Innovations International, OII) was inserted in the capsular bag using medium viscosity OVD to protect the corneal endothelium. After bimanual I/A of the OVD, stromal hydration of the incisions was performed and the eye patched. Postoperatively, topical moxifloxacin (0.5% Vigamox, Alcon) and corticosteroid (1% Econopred Plus, Alcon) were prescribed five times daily for 1 week, and nonsteroidal anti-inflammatory (0.1% Nevanac, Alcon) eye drops were prescribed three times daily for 1 week; then, corticosteroid and nonsteroidal anti-inflammatory eye drops were used alone for the following 3 weeks.

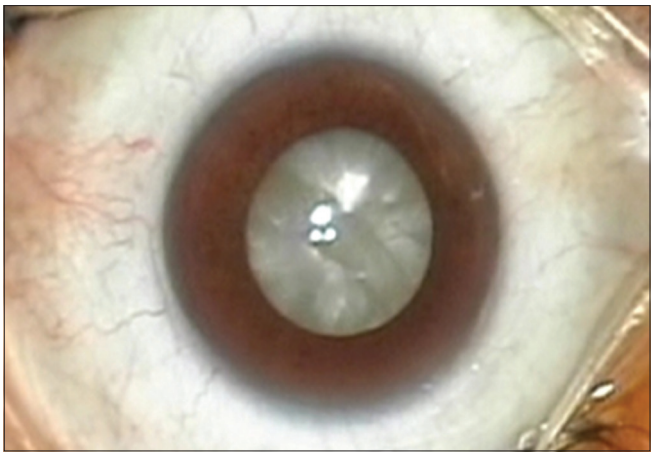

Figure 1: Preoperative image of an intumescent cataract

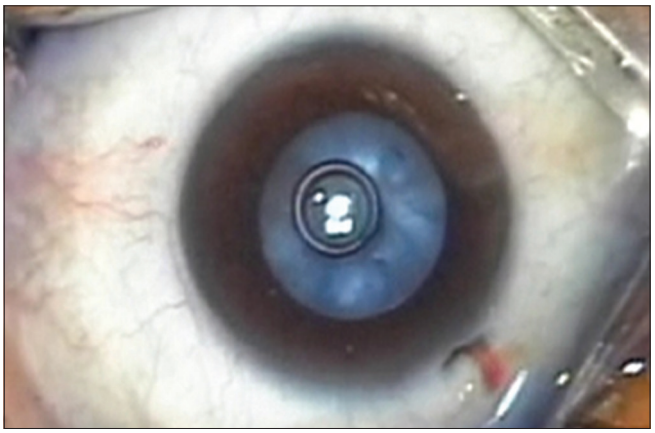

Figure 2: Trypan blue staining of the anterior capsule

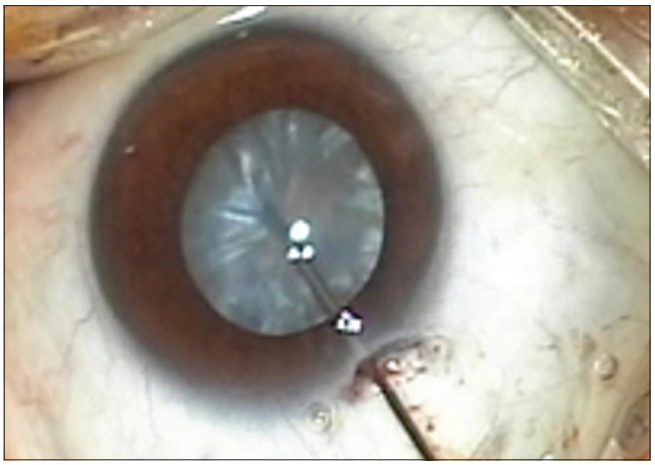

Figure 3: 25-gauge needle insertion into the lens, bevel down, under the anterior capsule, aspirating liquefied cortical matter

Statistical analysis

All descriptive statistical analyses were performed using IBM SPSS software (SPSS, Inc., version 20.0). Comparisons between groups for categorical variables were assessed using

Chi-square test. The Kolmogorov–Smirnov test was used to verify the normality of distribution of variables. Student's *t*-test was used to compare the two groups for normally distributed quantitative variables. Significance of the obtained results was judged at the 5% level. $P = 0.05$ was considered statistically significant.

Results

The 40 eyes of the studied participants were divided into two groups of 20 eyes each. In Group 1, the mean participant age was 66.9 years ± 3.1 (standard deviation [SD]) (ranging from 60 to 71 years), and in Group 2, it was 66.9 years ± 3.4 (SD) (ranging from 60 to 72 years). Group 1 included 9 males and 11 females while Group 2 included 8 males and 12 females. Table 1 shows preoperative and intraoperative data in the two study groups.

Radial capsular tears occurred in four eyes in Group 1 and were not encountered in Group 2. In uneventful cases in both groups, the capsulorhexis diameter averaged 5 mm, with no statistically significant difference between them. Two of the eyes with a radial capsular tear, endangering the equator, could not be managed by phacoemulsification, and the technique had to be converted to ECCE, with intracapsular IOL implantation, without posterior capsular rupture or vitreous loss.

Discussion

This study compared two approaches to creating a CCC in patients with intumescent cataract and assessed the incidence of intraoperative complications in each technique. Intumescent cataract remains, even for more experienced surgeons, a surgical challenge owing to the absence of the red reflex and the high intralenticular pressure. Several recently published studies describe different measures that can be used to overcome these difficulties.

Several reports applied various types of dyes and OVDs[2-4,10] while other studies made the use of diathermy or high-frequency diathermy for the creation of an anterior capsulotomy.[5-7,11] Neodymium: YAG laser capsulotomy was applied to prevent extension of the capsular tear to the lens periphery in intumescent cataracts.[12,13]

Gimbel[8] described a two-stage capsulorhexis technique which was initiated centrally and could be enlarged later to the intended size. Bhattacharjee *et al*.[14] initially released the intralenticular pressure after filling the anterior chamber with OVD and applied the high magnification of the operating microscope without capsule staining. Another applied an assisted slit illuminator mounted in the vicinity of the operating microscope to improve anterior capsule visualization and overcome the absence of the red reflex.[15]

Despite all studies and efforts to minimize intraoperative complications in intumescent cataract, the complication that might take place within seconds of puncturing of the anterior capsule is that the high intralenticular pressure expands the initial capsule incision in an uncontrolled way with the development of the Argentinean flag sign.[9] Therefore, instead of allowing the higher intralenticular pressure to passively equilibrate with the anterior chamber pressure, the pressure within the lens should be actively reduced by a closed system aspiration of liquefied cortical matter.

Table 1: Comparison between the two studied groups according to different parameters

Parameter	Group 1 (*n*=20)	Group 2 (*n*=20)	*P**
Age (years)			
Mean±SD	66.9±3.1	66.9±3.4	0.924
Median (range)	67.5 (60-71)	67 (60-72)	
Gender, *n* (%)			
Male	9 (45)	8 (40)	0.749
Female	11 (55)	12 (60)	
A scan lens thickness (mm)			
Mean±SD	4.2±0.4	4.1±0.4	0.443
Median (range)	4.2 (3.6-5)	4.1 (3.6-5)	
R1 (mm)			
Mean±SD	7.8±0.2	7.9±0.3	0.583
Median (range)	7.7 (7.5-8.2)	7.9 (7.4-8.3)	
R2 (mm)			
Mean±SD	7.6±0.2	7.6±0.3	0.933
Median (range)	7.6 (7.3-7.9)	7.6 (7.1-8.3)	
Axial length (mm)			
Mean±SD	23.5±0.9	23.8±1.1	0.431
Median (range)	23.6 (21.9-25.1)	23.6 (21.7-25.9)	
Biometry (D)			
Mean±SD	22±3.4	21.4±3.1	0.562
Median (range)	21 (16-29)	22 (16-27)	
Radial tear, *n* (%)			
No	16 (80)	20 (100)	0.106
Yes	4 (20)	0	
ECCE conversion, *n* (%)			
No	18 (90)	20 (100)	0.487
Yes	2 (10)	0	
Posterior capsule rupture, *n* (%)			
No	20 (100)	20 (100)	1
Yes	0	0	
Dropped nucleus, *n* (%)			
No	20 (100)	20 (100)	1
Yes	0	0	
Vitreous loss, *n* (%)			
No	20 (100)	20 (100)	1
Yes	0	0	
IOL implantation, *n* (%)			
No	0	0	1
Yes	20 (100)	20 (100)	

Qualitative data were described using number and percent and were compared using Chi-square test while normally quantitative data were compared using student *t*-test. *Statistically significant at $P \leq 0.05$. R1: Radius of curvature of the flat corneal meridian, R2: Radius of curvature of the steep corneal meridian, ECCE: Extracapsular cataract extraction, IOL: Intraocular lens, SD: Standard deviation, D: Diopters

In the present study, in all eyes, the anterior capsule was stained with trypan blue to enhance visualization and reduce capsular elasticity. The complication rate was higher, though not statistically significant, in Group 1, which used

peripherally dispersive OVD followed centrally by a higher viscosity cohesive OVD (Healon GV), than in Group 2, where lens decompression technique was applied. In Group 2, a 25-gauge needle was introduced into the anterior chamber through the main incision, with the bevel down, inserted into the lens center, and 0.1–0.2 ml of liquid cortex was aspirated by pulling back on the syringe plunger, actively reducing intralenticular pressure. The needle bevel was facing down to prevent aspiration of the anterior capsule into the needle, occluding it.

In all eyes in Group 2, active reduction of intralenticular pressure prevented the egress of liquefied cortical matter, protecting against the occurrence of radial capsular tears, allowed the completion of CCC, followed by uneventful stop and chop phacoemulsification technique and in the bag implantation of a foldable IOL. In group 1, radial capsular tears occurred in four eyes; in two of them, phacoemulsification was completed while in the other two cases, with radial capsular tears endangering the equator, the procedure had to be converted to ECCE with intracapsular IOL implantation, without posterior capsular rupture or vitreous loss.

Conclusion

The lens decompression technique is reliable, safe, and more advantageous than the combined use of a dispersive and a higher viscosity cohesive OVD because it actively reduces intralenticular pressure by aspiration of liquefied cortical matter.

Further, larger group studies are recommended to confirm our findings and to investigate the role of femtosecond laser in intumescent cataract.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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