Capsular block syndrome associated with femtosecond laser–assisted cataract surgery

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We report intraoperative capsular block syndrome occurring during the first 50 femtosecond laser–assisted cataract surgeries performed in our facility. Two patients had uneventful combined laser fragmentation, capsulotomy, and corneal incision procedures. In both cases, following transfer to the operating room and manual removal of the laser-cut capsulotomy, posterior capsule rupture was noted during hydrodissection, resulting in posterior dislocation of the lens. Pars plana vitrectomy, removal of the crystalline lens, and sulcus implantation of an intraocular lens were performed in both patients with good visual outcomes. Femtosecond laser–assisted cataract surgery changes the intraoperative environment with the generation of intracapsular gas and laser-induced changes in the cortex. With awareness of the changed intraocular environment following laser lens fragmentation and capsulotomy and a modification of the surgical technique, no additional cases of intraoperative CBS have been seen in more than 600 laser-assisted cataract surgery procedures performed to date at our facility.

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according to Lens Opacities Classification System III\(^2\) and axial length of 23.06 mm had planned cataract surgery using the femtosecond laser (LenSx, Alcon Labs, Inc.) to create the capsulotomy and corneal incisions and to perform lens fragmentation. Following application of the patient interface and suction, the anterior and posterior capsules were identified and marked under direct optical coherence tomography (OCT) imaging. The ellipsoid lens fragmentation pattern was programmed to be 1000 \(\mu\)m anterior to the posterior capsule and 500 \(\mu\)m posterior to the anterior capsule. During the procedure, normal gas spread was observed posterior to the fragmentation pattern, within the lens nucleus, and behind the anterior capsulotomy (Figure 1). No errors or malfunctions were noted during the laser procedure.

During the operative procedure, an ophthalmic visco-surgical device (OVD) was injected through the primary incision, the anterior chamber deepened normally, and the capsulotomy was removed without evidence of an anterior capsule tear. A hydrodissection cannula was introduced and balanced salt solution injected. Immediate wrinkling and movement of the lens capsule and iris were noted, and the lens shifted posteriorly at the superior pole, suggestive of a posterior capsule tear. Because of lens dislocation, the eye was closed and a vitrectomy performed on the same day. The vitreoretinal surgeon noted the crystalline lens intact on the retinal surface with the laser fragmentation pattern and residual gas within the substance of the intact lens (Figure 2). The lens was removed, and a posterior chamber intraocular lens (IOL) was inserted in the ciliary sulcus. An intact laser-cut capsulotomy was confirmed on retroillumination (Figure 3). Depth and energy calibration checks performed on the femtosecond laser at the end of the surgical day were within specifications. The postoperative course was uneventful, and femtosecond laser-assisted cataract surgery was performed in the fellow eye 8 weeks later. The hydrodissection technique was modified as described below, and surgery was completed without complication. The corrected distance visual acuity in both eyes was 20/20.

Case 2

A 78-year-old man with dense grade 4 nuclear sclerotic cataract (NO4, NC4, according to Lens Opacities Classification

Figure 1. Normal intracapsular gas bubble pattern following laser lens fragmentation and capsulotomy.

Figure 2. Residual gas bubble within the dislocated crystalline lens.

Figure 3. Retroilluminated view revealing intact laser-cut capsulotomy.

Figure 4. Optical coherence tomography imaging following application of the patient interface showing a mature dense nucleus.
System III and axial length of 24.14 mm had planned cataract surgery using the femtosecond laser to create the capsulotomy, lens fragmentation, and corneal incisions. No posterior spread of gas was noted during lens fragmentation, and the laser procedure was completed without complication. The OCT imaging confirmed a large dense nucleus (Figure 4). The initial intraoperative stages of surgery were identical to those in Case 1, and the capsulotomy was removed normally without evidence of tear. Following hydrodissection, the phacoemulsification tip was inserted into the eye and irrigation commenced. The crystalline lens was noted to be unstable and subluxated 90 degrees into the vitreous. The eye was closed and a vitrectomy performed on the same day. Following removal of the lens, an IOL was placed in the sulcus. As reported in Case 1 (which was performed on the same surgical day), depth and energy calibration checks on the femtosecond laser were within specifications. The postoperative course was uneventful, and the CDVA was 20/20.

**DISCUSSION**

The 2 cases of posterior capsule rupture and lens dislocation following hydrodissection we describe are consistent with descriptions of intraoperative CBS in the literature. Sudden wrinkling and movement of the lens capsule, tilting and instability of the lens following hydrodissection, or unexpected dislocation of the lens into the vitreous at the commencement of phacoemulsification suggest a posterior capsule rupture due to intraoperative CBS. Intraoperative pupillary block and subsequent rupture of the posterior capsule is thought to occur if the injected hydrodissection fluid does not flow freely around the lens within the capsular bag and out through the anterior capsulotomy and corneal incision. Rapid accumulation of fluid behind the lens–capsule complex can mimic a threatened expulsive hemorrhage. The eye becomes especially vulnerable when a highly cohesive OVD is injected into the anterior chamber prior to hydrodissection. The presence of a normal capsule preoperatively strongly suggests intraoperative CBS; however, in cases of a weakened posterior capsule (e.g., trauma, hypermature cataract, or congenital posterior polar cataract), spontaneous posterior capsule rupture can occur without intraoperative CBS.

Both of the cases occurred in older patients with mature cataracts, which are recognized risk factors for CBS. In addition, analogous to the increased incidence of intraoperative CBS following capsulorhexis versus can-opener style capsulotomy, the uniform capsulotomy created with the femtosecond laser may increase the potential for blockage of fluid egress by the elevated nucleus following hydrodissection. The presence of intracapsular gas and laser-induced changes in the cortex are unique to femtosecond laser–assisted cataract surgery and may represent additional risk factors for intraoperative CBS in high-risk patients. The underlying mechanism appears to be resistance to the flow of injected fluid around the lens nucleus, adding to capsule distension, or increasing resistance around the edge of the laser-cut capsulotomy.

Given these potential risk factors, we recommend the following intraoperative procedures be performed during laser-assisted cataract surgery:

1. Reduce the OVD fill prior to anterior capsule removal to avoid overinflating the anterior chamber.
2. Decompress the anterior chamber before and during hydrodissection by exerting pressure on the posterior lip of the corneal incision with the elbow of the cannula.
3. Decompress the lens capsule during hydrodissection by elevating the anterior capsule with the tip of the hydrodissection cannula during injection.
4. Inject the hydrodissection fluid slowly and titrate the volume based on the visible expanding fluid wave.
5. Use a pre-chopper or blunt-tipped side-port instrument to split the hemispheres prior to hydrodissection to allow the gas and/or injected fluid to come forward.

With awareness of the changed intraocular environment following laser lens fragmentation and capsulotomy and a modification of the surgical technique, as described above, no additional cases of intraoperative CBS have been seen in more than 600 laser-assisted cataract surgery procedures performed to date at our facility.

**REFERENCES**