COMPLICATIONS ASSOCIATED WITH CLEAR CORNEAL CATARACT WOUNDS DURING VITRECTOMY

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Purpose: The purpose of this study was to report the intraoperative surgical complications that occurred during vitrectomy surgery associated with clear corneal incisions from previous cataract surgery.

Methods: Retrospective, multicenter, case series, and chart review of five patients.

Results: Five patients, 3 men and 2 women, with a median age of 75 years (range, 59–78 years), were followed up for a median of 7.5 months (range, 6 months to 5 years). In each eye, the patient had previously undergone cataract surgery and intraocular lens implantation through a clear corneal wound. Each patient developed a surgical complication during the subsequent vitrectomy related to leakage through the clear corneal wound. Vitrectomy was performed for retained lens fragments (three), macular hole (one), and repair of combined rhegmatogenous/tractional diabetic retinal detachment (one). Twenty-gauge vitrectomy was performed in 3 cases; 23-gauge in 1 case; and a combined 25- and 20-gauge vitrectomy was used in 1 case. Median time between cataract surgery and vitrectomy was 8 days (range, 0–14 days). Median preoperative visual acuity was 20/200 (20/50 to hand motions), and median postoperative visual acuity was hand motions (20/40 to light perception). In all five eyes, the clear corneal wound was found to leak extensively with minimal manipulation of the sclera at the pars plana. Leakage through clear corneal wounds occurred during marking of the sclerotomy site (Case 1), during placement of a 23-gauge infusion cannula (Case 2), during lens fragmentation (Case 3), during retinotomy and retinectomy (Case 4), and during scleral depression (Case 4). Four eyes developed choroidal detachment associated with hypotony caused by leakage through the clear corneal wound. Three of these eyes developed hemorrhagic choroidal detachment with subretinal and/or vitreous hemorrhage. One eye developed iris incarceration and anterior subluxation of a sulcus-placed intraocular lens associated with leakage through the clear corneal wound. In all five cases, extra sutures were placed to secure the clear corneal incision, and the cases were able to be completed. Two eyes underwent repeat vitrectomy to address complications associated with hemorrhagic choroidal detachments. Median final visual acuity was 20/400 (range, 20/40 to hand motions). The retina remained attached in all cases at the latest follow-up visit.

Conclusion: Intraoperative complications related to clear corneal incisions can occur during pars plana vitrectomy. We recommend that cataract surgeons encountering complications during surgery should secure clear corneal wounds in anticipation of eventual vitrectomy surgery. It is incumbent on the retinal surgeon to carefully inspect the corneal wound at the start of the vitrectomy procedure and to close it with sutures if it appears to leak with minimal manipulation. This should help to minimize additional intraoperative and/or long-term complications.

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Since its introduction in 1994, sutureless clear corneal cataract incisions for cataract surgery have gained worldwide popularity because they offer less induced astigmatism and earlier postoperative visual recovery when compared with sutured scleral tunnel incisions.[1] A recent survey of U.S. cataract surgeons reported that 72% are using clear corneal incisions and that 92% of them prefer an unsutured wound.[2]

Known complications of clear corneal wounds include hypotony,[3–6] wound dehiscence,[7] expulsive iridodialysis,[8–13] dislocation of the intraocular lens,[14–16] intraocular cilium,[17] and endophthalmitis.[18–24]

Hypotony can be a common finding after clear corneal cataract surgery. In 2001, Shingleton et al[3] measured intraocular pressures during the first 30 minutes after uncomplicated clear corneal cataract surgery. They report that in >20% of patients, the intraocular pressure measured ≤5 mmHg. However, a follow-up study published 6 years later by the same group found that only 6% of patients develop hypotony immediately after cataract surgery, suggesting that greater experience with wound construction can improve surgical outcomes.[6] The amount of hypotony has said to be related to the method of wound construction and the size of the wound where larger[4] and more perpendicular[25] incisions showed lower postoperative intraocular pressures. In vitro studies have shown that India ink tended to traverse across a clear corneal incision and into the anterior chamber in eyes.[26] This transit of dye across the wound occurred mainly during hypotonus conditions[5] or in instances in which external globe manipulation was performed.[26] Optical coherence tomography of these eyes shows gaping wounds with <5 mmHg to 10 mmHg reduction of intraocular pressure.[5] It is common practice to check the wound site for leakage before the conclusion of cataract surgery because it is estimated that 1.6% (56 of 3,500) of cases required a suture to close a wound because of wound leakage.[22] Scleral tunnel and limbal wounds may also leak,[27] but to our knowledge, there have been no published complications associated with scleral tunnel and limbal wounds during vitrectomy.

We report five cases of complications that occurred during vitrectomy surgery associated with unsecured clear corneal cataract wounds. In all five cases, intraocular fluid was found to leak extensively through a previously created clear corneal incision after cataract surgery.

Selected Case

A 76-year-old man underwent cataract extraction with intraocular lens implantation in the right eye on August 22, 2007, which was complicated by retained lens fragments. He was brought back to the operating room on August 29, 2007, for pars plana vitrectomy and removal of intraocular lens fragments. Preoperative vision measured hand motions, and intraocular pressure was 39 mmHg in the right eye.

At the beginning of the vitrectomy during the insertion of a 23-gauge infusion cannula at the inferotemporal pars plana, a gush of fluid exited the sutureless clear corneal cataract wound and the eye became hypotonus. The anterior segment wound was immediately secured using multiple 10-0 nylon sutures. An infusion cannula was successfully placed through the pars plana in the superonasal quadrant and the globe quickly reformed. Subsequently, another attempt was made to place an inferotemporal cannula into position. However, on removal of the sclera cannula, drainage of blood coming up through the trocar was noted. A localized hemorrhagic choroidal detachment and a significant vitreous hemorrhage were observed. The intraocular pressure was raised to tamponade the bleeding, and the inferotemporal and superotemporal cannulas were able to be placed. A 25-gauge microvitreoretinal (MVR) blade was used to make sure that the cannulas extended into the vitreous cavity. On visualization of the posterior pole, diffuse hemorrhage was seen covering the posterior pole. The hemorrhage and lens particles were then removed. At the end of surgery, the retina was attached but there was a significant hemorrhagic choroidal detachment temporally.

One day postoperatively, the patient had developed a new 40% hyphema and vitreous hemorrhage. A hemorrhagic choroidal detachment was seen on ultrasonography. One month later, because the hyphema and vitreous hemorrhage had not cleared, the patient was brought back to the operating room for an anterior chamber washout and pars plana vitrectomy. Initially, because of the inability to visualize posteriorly, an anterior chamber maintainer was placed at the 4-o'clock position and sewn to the sclera for stabilization. A separate paracentesis was made at the 12-o'clock position to wash out the anterior chamber. There was some instability of the temporal anterior segment wound, and some of the corneal sutures were replaced. After the wound was stabilized, the anterior chamber was washed out. A vitrectomy instrument was then placed into the eye, and the blood was removed from the anterior segment. During posterior vitrectomy, early proliferative vitreoretinopathy was noted. A scleral buckle (275 tire with 240 band) was placed, and epiretinal membrane dissection was performed. Perfluorocarbon liquid was then used to reattach the retina and to also express out any subretinal hemorrhage. The retina was reattached, but poor visualization precluded any

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Table 1. Preoperative Demographics

Case No.	Age (Years)	Sex	Preoperative Diagnosis	Preoperative VA	Time After CE/IOL (Days)	Sutures in Clear Corneal Wound
1	78	M	RLF	20/50	8	Y
2	76	M	RLF	HM	7	N
3	72	M	RLF	20/80	9	N
4	59	F	Cat, PDR, RRD, TRD, and rubeosis	HM	0	Y
5	75	F	MH	20/200	14	N

VA, visual acuity; CE/IOL, cataract extraction and intraocular lens implantation; M, male; F, female; RLF, retained lens fragments; Cat, cataract; PDR, proliferative diabetic retinopathy; RRD, rhegmatogenous retinal detachment; TRD, tractional retinal detachment; MH, macular hole; HM, hand motions vision; Y, yes; N, no.

attempt to add laser photocoagulation. Because of this, 5,000-centistoke silicone oil was placed into the eye and filled up to the level of the intraocular lens implant. Air was left in the anterior chamber.

In the following months, the patient developed a fibrinous pupillary membrane and progressive capsular opacification preventing adequate visualization of the posterior segment. Ultrasonography showed that the retina remained attached with peripheral traction. Some of the silicone oil was seen coming into the anterior chamber. After discussion of the risks and benefits, it was decided to return to the operating room for a vitrectomy to remove the pupillary membrane, any preretinal or subretinal membranes, and to perform a silicone oil replacement and endolaser photocoagulation.

After the anterior membranes were removed, posterior findings included massive epiretinal membranes and a macular pucker. The membranes were dissected and air-fluid exchange was performed. Endolaser photocoagulation was placed on and posterior to the scleral buckle as well as around several retinal holes. Silicone was injected into the vitreous cavity up to the level of the pupil. At the 6-month follow-up examination, the patient's vision remained at light perception. The retina remained attached.

Results

Table 1 indicates the preoperative characteristics of the patients in this series. All 5 patients (5 eyes), 3 men and 2 women, with a median age of 75 years (range, 59–78 years), had cataract surgery using a clear corneal incision. Sutures were placed within the clear corneal wound in two of five eyes. Median time between clear corneal cataract surgery and vitrectomy was 8 days (range, 0–14 days). Pars plana vitrectomy was performed for retained lens fragments (three), macular hole (one), and for repair of a combined rhegmatogenous and tractional diabetic retinal detachment (one). Median preoperative Snellen visual acuity was 20/200 (range, 20/50 to hand motions).

Intraoperative demographics are detailed in Table 2. Twenty-gauge vitrectomy was used in 3 cases, 23-gauge vitrectomy in 1, and a combined 25/20-gauge vitrectomy

Table 2. Intraoperative Demographics

Case No.	Gauge Surgery	Anesthesia	Point of Hypotony	AC Complication	CD	RD	VH	Mgt
1	20	MAC	During marking of sclerotomy site	Retina adhered to iris and IOL	Heme	Y	Y	Sutured wound
2	23	MAC	Insertion of infusion cannula	AC shallowed	Heme	Y	Y	Sutured wound; AFX; DIA; and EL
3	25/20	MAC	During lens fragmentation	AC shallowed	Heme	N	N	Sutured wound
4	20	MAC	During retinectomy and retinectomy	AC shallowed, viscoelastic extruded	Serous	Y	Y	Sutured wound; PFC; and SO
5	20	GEN	During scleral depression	Iris incarcerated through corneal wound; sulcus IOL subluxed into AC	N	N	Y	Sutured wound

AC, anterior chamber; CD, choroidal detachment; RD, retinal detachment; VH, vitreous hemorrhage; Mgt, management of intraoperative complications; MAC, monitored anesthesia care; GEN, general anesthesia; IOL, intraocular lens; Heme, hemorrhagic choroidal detachment; Y, yes; N, no; AFX, air-fluid exchange; DIA, diathermy; EL, endolaser; PFC, perfluorocarbon liquid; SO, silicone oil.

Table 3. Postoperative Demographics

Case No.	Follow-Up	Reoperation	Final Anatomy	Final VA
1	5 years	PPV, SB, MP, GFX, EL, RET, and drain CD	Retina attached, subretinal fibrosis, macular scar, RPE atrophy, and CD resolved	3/200
2	6 months	1. PPV, MP, GFX, EL, and SO 2. PPV, SO removal	Retina attached, CD resolved	HM
3	7.5 months	None	Persistent macular edema	20/40
4	6 months	SB, PPV, PFC, MP, RET, EL, and SO exchange	Retina attached	CF3'
5	2 years	None	Retina attached, MH closed	20/100

VA, visual acuity; PPV, pars plana vitrectomy; SB, scleral buckle; MP, membranectomy; GFX, gas-fluid exchange; EL, endolaser; RET, retinectomy; CD, choroidal detachment; SO, silicone oil; PFC, perfluorocarbon liquid; RPE, retinal pigment epithelium; CD, choroidal detachment; MH, macular hole; HM, hand motions vision; CF, count fingers vision.

was used in 1 case. In all five cases, the clear corneal wound was found to leak extensively with minimal manipulation of the sclera at the pars plana. In three cases, the anterior chamber shallowed. In 1 case (Case 5), the iris was found incarcerated through the corneal wound and the sulcus placed intraocular lens subluxed into the anterior chamber. In 1 case (Case 1), the retina was detached and found adhered to the iris and intraocular lens. Choroidal detachments occurred in 4 of 5 eyes (80%), and a retinal detachment was found in 4 of 5 eyes (80%). Vitreous hemorrhage was seen in 4 of 5 eyes (80%). In all 5 cases, the intraoperative complication was managed with the placement of additional 10-0 nylon sutures through the clear corneal wound incision.

Postoperative demographics are detailed in Table 3. Median follow-up time was 7.5 months (range, 6 months to 5 years). Three cases (60%) required reoperation for proliferative vitreoretinopathy and subsequent retinal detachments. Three cases (60%) required membrane dissection, relaxing retinotomy, endolaser, and long-acting gas or silicone oil tamponade with or without scleral buckling to achieve successful reattachment. In the 4 cases in which intraoperative choroidal detachment occurred, 3 cases (75%) resolved without further surgical intervention. One case required surgical sclerotomies to drain the choroidal detachment. One case resulted in subretinal fibrosis, retinal pigment epithelial atrophy, and a macular scar (Figure 1). In the three cases in which a retinal detachment occurred, the retinas were successfully reattached at the final postoperative visit. One case (20%) resulted in persistent macular edema. Median final visual acuity was 3/200 (range, 20/40 to hand motions).

Discussion

Complications associated with clear corneal wounds have been previously reported,[3–24] and these studies suggest that clear corneal wounds may be vulnerable for patients undergoing vitrectomy surgery. We report five cases in which complications during vitrectomy surgery occurred as a result of an insecure clear corneal cataract wound. In each case, intraocular fluid was observed exiting through the clear corneal wound causing hypotony. This efflux of fluid through a corneal wound may occur at any time during the vitrectomy surgery with minimal posterior pressure at the level of the pars plana. Although our results show

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Fig. 1. Color fundus photograph of the patient depicted in Case 1 taken 4 years after a vitrectomy surgery for retained lens fragments. A suprachoroidal hemorrhage occurred at the time of vitrectomy and was further complicated by a retinal detachment postoperatively. Although the retina was successfully reattached and the choroidal hemorrhage was drained, significant subretinal fibrosis developed leaving a poor visual outcome.

that clear corneal wound leakage can occur with any gauge of vitrectomy surgery, it may be especially important during small-gauge (23 and 25 gauge) vitrectomy in which excessive manipulation of the globe can occur during placement of the trocars at the pars plana. Even if sutures are placed through a clear corneal wound, the closure may not be adequate to withstand routine manipulation encountered during subsequent vitrectomy. This was noted in 2 of our cases (Cases 1 and 4). The opening of these clear corneal wounds at the start of vitrectomy may lead to sudden hypotony and the development of serous and hemorrhagic choroidal detachment or displacement of intraocular content.

Suprachoroidal hemorrhagic detachments during vitrectomy surgery are rare. The incidence of hemorrhagic choroidal detachments during vitrectomy surgery is estimated to be between 0.05 and 0.4%.[28] In our series, choroidal detachment occurred in four of our patients, three of whom were hemorrhagic. Hemorrhagic choroidal detachments may be associated with marked fluctuations in the intraocular pressure during intraocular surgery.[28–30]

Typically in vitrectomy surgery, prolonged hypotony does not occur. In our series, the choroidal detachments occurred after a rapid efflux of fluid out of the clear corneal wound secondary to routine globe manipulation. In 2 of the cases, the intraocular pressure could not be stabilized quickly because the infusion cannula had not yet been secured (Cases 1 and 2), resulting in prolonged hypotony. This may account for the fact that in 2 of the cases, in which an infusion cannula was secure and therefore reestablishment of adequate intraocular pressure could be achieved quickly, there was only a temporary serous choroidal detachment (Case 4) or no choroidal detachment at all (Case 5).

Visual outcomes after suprachoroidal hemorrhage as a result of any intraocular surgery are generally guarded. Roughly, one third to less than half of patients retain vision of $\geq$20/200.[31–36] Signs associated with a worse visual prognosis include retinal detachment, retinal incarceration,[36] vitreous incarceration,[35] and hemorrhage extending to the posterior pole.[34] In the 3 patients in our series who experienced hemorrhagic choroidal detachments, the 1 patient in whom the hemorrhage spared the fovea maintained 20/40 vision, whereas the other 2 patients with extensive subfoveal hemorrhage fared not $>$3/200 and hand motions vision. The patient, Case 4, who developed a serous choroidal detachment intraoperatively ended with resolution of the choroidals but with only counting fingers vision at the 6-month follow-up. The poor visual outcome was attributed to complications related to the proliferative diabetic retinopathy and the combined traction and rhegmatogenous retinal detachment involving the fovea.

Three of the five patients in our series experienced a suprachoroidal hemorrhage during vitrectomy surgery for retained lens fragments after clear corneal cataract surgery. Retained lens fragments occur in $\sim$3 in 1,000 phacoemulsification cataract procedures.[2] Although rare, choroidal detachments have been described during vitrectomy surgery for retained lens fragments in three large retrospective studies.[37–39] To the best of our knowledge, none of these studies suggest that the suprachoroidal hemorrhage was a direct result of acute hypotony after egress of intraocular fluid through an insecure wound.

In our series, 1 case (Case 5) developed iris incarceration through the clear corneal wound with subluxation of the sulcus-placed intraocular lens into the anterior chamber during scleral depression. It is likely that even minor manipulation of the globe posterior to the clear corneal incision opened the wound allowing a gush of fluid, along with the iris, to exit through the wound. As the anterior chamber flattened, it is possible that the increasing positive posterior pressure could have forced the intraocular lens to subluxate anteriorly. Several case reports have described expulsive iridodialysis through clear corneal wounds in which blunt trauma is the most common cause,[8–11,13] although expulsive iridodialysis through a clear corneal incision has also been reported after Valsalva.[12] In each instance, it is possible that excessive posterior pressure forced intraocular contents out of the clear corneal wound. These reports highlight the fact that these wounds can be fairly insecure for many years after clear corneal cataract surgery.

To the best of our knowledge, no other cases of complications during vitrectomy surgery associated with clear corneal wound closures have been previously described. Although rare, these complications can result in disastrous consequences. If a surgeon performing anterior segment surgery experiences complications during their surgery that makes subsequent vitrectomy likely, it may be necessary to secure the clear corneal wound with sutures. Furthermore, retinal surgeons should recognize the possible danger of insecure clear corneal wounds and start their vitrectomies by first inspecting and securing any clear corneal wound that may potentially leak.

Key words: suprachoroidal hemorrhage, intraocular lens subluxation, choroidal detachment, retained lens fragments.

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