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Phacoemulsification in the vitreous cavity for retained nuclear lens fragments

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PURPOSE. *To evaluate anatomic and functional results after surgery of retained lens fragments in the vitreous cavity after previous phacoemulsification.*
METHODS. *The authors studied retrospectively 18 patients who underwent pars plana vitrectomy (PPV) for retained nuclear lens fragments. Patients having only cortical material in the vitreous cavity were excluded. In all cases the nucleus or nuclear fragments were removed after a complete vitrectomy using perfluorocarbon injection in the vitreous cavity, associated with phacoemulsification in the vitreous cavity. The authors used a conventional phaco probe devoid of the silicone sleeve. Time lapse between cataract surgery and vitrectomy varied between 0 and 24 days (mean 8.2 ± 7.4). Follow-up was 33.9 ± 20.6 months (range 4 to 53).*
RESULTS. *The mean final best-corrected visual acuity (BCVA) was 20/45 (range 20/400 to 20/20). It was 20/40 or better in 33% of patients, reaching 40% when patients with previous macular disease were excluded. A total of 61% of patients reached a final BCVA ranging from 20/50 to 20/200. Retinal detachment occurred in one eye and topical medications were necessary to manage intraocular pressure in four cases.*
CONCLUSIONS. *PPV with intravitreous phacoemulsification is the technique of choice for dislocated nuclei or nuclear fragments in the vitreous cavity. (Eur J Ophthalmol 2006; 15:40-5)*

KEY WORDS. *Nucleus dislocation, Phacoemulsification, Vitrectomy*

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INTRODUCTION

Phacoemulsification is at present the technique of choice for the surgical treatment of cataracts and considered a safe surgical procedure. Nevertheless, a certain number of complications are still possible such as a tear in the posterior capsule or a zonule dialysis leading to a dislocation of the whole lens or part of it into the vitreous cavity. Although dislocation of lens fragments is a rare complication with an incidence varying from 0.1 to 1.0%, it constitutes a serious event due to the severe consequences this can have for the patient and the surgeon (1, 2). In fact, it can lead to certain conditions that may limit the final visual recovery: corneal edema, glaucoma, chronic intraocular inflammation, macular edema, and retinal detachment (3, 4).

Three-port pars plana vitrectomy (PPV) with phacoemulsification in the vitreous cavity is one method of solving this problem. We report our experience and discuss alternative procedures.

MATERIALS AND METHODS

Eighteen patients (10 male, 8 female), aged between 58 and 87 years (average 70.6 ± 8.3), were operated

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on by vitrectomy with phacoemulsification in the vitreous cavity for the extraction of dislocated nucleus or fragments of it in the Instituto Oftalmológico de Alicante by one surgeon (J.M.R.-M.). Clinical features and details of each case are summarized in Table I. All patients had previously undergone phacoemulsification by divide and conquer procedure through clear cornea. After posterior capsule tear and lens fragments dislocation, no intraocular lens was implanted and the surgical wound was closed. Patients presenting only cortex dislocation were excluded from this series. The presence of nuclear fragments was considered attending to its dense lamellar structure. The amount of retained nuclear fragments was calculated considering the size and number of the nuclear fragments (quarters). Nine of the patients presented more than 80% of the nucleus dislocated, and the remaining nine between 50 and 80%.

Eleven patients presented with a rise in intraocular pressure (IOP) after cataract surgery; inflammatory reaction was severe in one case. Two patients had mild corneal edema.

The time lapse between cataract surgery and vitrectomy ranged between 0 and 24 days (average 8.2 ± 7.4), two patients undergoing vitrectomy immediately after the complicated phacoemulsification. Best-uncorrected visual acuity before vitrectomy ranged between hand movement perception and 20/200.

High IOP and intraocular inflammation were treated with topical medication. In one case vitrectomy was postponed 24 days since mild corneal edema did not allow detailed visualization of the fundus.

Surgical technique

Three-port PPV was performed under local (peribulbar) anesthesia on an outpatient basis as previously described (5). Anterior vitrectomy was thoroughly performed, taking care to remove the residual cortical lens material and vitreous prolapsed into the anterior chamber, since removal of vitreous strands incarcerated in the corneal incisions is necessary to avoid further complications. Special care was taken to preserve the residual capsular support in order to allow sulcus implantation.

A complete vitrectomy was carried out to avoid the incarceration of vitreous strands in the phacoemulsification probe during the removal of lens fragments, which could lead to uncontrolled tractions over the retina and impaired aspiration of the phaco probe. During this surgical step some cortical material was removed with the vitrectomy probe.

Once the vitreous was removed, the nucleus was lifted and positioned in the center of the vitreous cavity by means of a perfluoro-octane injection. Phacoemulsification was performed with an ultrasound tip without its silicone sleeve using a bimanual technique with the 30° endoillumination pipe pick, with low ultrasound energy and pulse mode, taking care to deliver the ultrasounds in the middle of the vitreous cavity.

The parameters used were as follows: energy 75% in linear mode, aspiration 200 mmHg, and 10 pulses per second. The leakage resulting from the difference between the sclerotomy measuring 1.4 mm (20 G) and the phaco probe measuring only 0.9 mm avoided any scleral burn.

The last step consisted of the implantation of an intraocular lens on the capsular remains, if sufficiently stable, by reopening the clear cornea incision. Perfluorocarbon was aspirated and a minute exploration of the peripheral retina with indentation was carried out. Endophotocoagulation of any retinal tear found was performed.

RESULTS

Pre- and postoperative visual acuity was recorded using the Early Treatment Diabetic Retinopathy Study (EDTRS) scale. Mean final best-corrected visual acuity (BCVA) was 20/45 (range 20/400 to 20/20). Six of the 18 patients operated (33%) reached a final BCVA of 20/40 or better.

This percentage increased to 40% when patients with previous retinal disease were not considered. In 11 cases (61%) the final BCVA obtained ranged between 20/50 and 20/200. In one case the final BCVA did not exceed 20/400 due to high myopic atrophic maculopathy.

One diabetic patient with preproliferative retinopathy required treatment with panretinal photocoagulation (endolaser) during vitrectomy. In two cases the existence of a retinal tear was detected, proceeding to its treatment with endolaser and fluid gas exchange.

Retinal detachment did not appear in the postoperative period in any case.

An intraocular lens was implanted in 16 eyes on the capsular remains. In one case the intraocular lens was not implanted since the patient was highly myopic and there was not sufficient capsular support. In another case these remains did not allow intraocular lens implantation; consequently it was implanted in the anterior chamber.

Follow-up was 33.9 ± 20.6 months (range 6 to 53). No patient presented corneal edema postoperatively and IOP was well controlled by topical treatment in all cases. One patient (5.5%) developed a rhegmatogenous retinal detachment in the lower nasal quadrant in the early postoperative period (35 days), which was treated by scleral buckling, vitrectomy with fluid gas exchange, and tear endophotocoagulation, achieving retinal reattachment and a final BCVA of 20/100. One patient developed a choroidal detachment, which resolved spontaneously.

DISCUSSION

Dislocation of the nucleus or a fragment of it into the vitreous cavity is an uncommon complication of cataract surgery which occurs most of the time associated with phacoemulsification. Small incisions, hydrodissection, and phacoemulsification raise anterior chamber pressure, inducing a posterior luxation of the lens in case of a posterior capsule tear. This is more frequent in difficult cases such as very hard cataracts, trauma, pseudoexfoliation syndrome, previously vitrectomized eyes, and during the learn-

TABLE I - CLINICAL FEATURES AND DETAILS OF EACH CASE

Patient	Sex	Age, yr	Eye	Size nucleus luxated, %	Complications post phaco	Lapse time, d	BUCVA pre vitrectomy	Follow-up, mo	BCVA final	Complications post vitrectomy
1	M	68	R	80	⇧IOP	6	0.05	46	0.9	None
2	M	66	R	90	None	3	0.05	44	0.3	None
3	F	80	R	70	⇧IOP	10	HM	51	0.8	⇧IOP
4	F	76	R	90	⇧IOP	7	HM	52	0.7	Retinal tear*
5	F	60	R	70	⇧IOP	3	HM	47	0.4	None
6	F	58	R	80	⇧IOP	12	0.1	43	0.2	None
7	M	79	R	90	None	9	CF	51	0.4	⇧IOP
8	M	73	R	60	⇧IOP	2	CF	49	0.4	None
9	M	67	R	80	⇧IOP Corneal edema	9	0.05	45	0.7	RD (35 days)
10	F	78	R	70	⇧IOP	18	0.1	53	0.4	DR
11	F	59	R	90	No	1	HM	45	0.05	High myopia
12	M	76	R	90	⇧IOP Corneal edema	24	HM	50	0.8	None
13	M	63	R	100	-	0	-	7	0.2	⇧IOP
14	M	63	R	100	⇧IOP	11	HM	6	0.7	None
15	F	77	R	90	None	2	HM	6	0.2	†
16	M	75	R	100	-	0	-	6	0.4	Retinal tear*
17	M	67	R	50	Vitreitis	7	CF	6	0.2	None
18	F	87	R	50	⇧IOP	24	HM	6	0.2	ARMD ⇧IOP
Mean		70.6	80.5		8.2			33.9	0.44	
SD		8.3	15.8		7.4			20.6	0.2	
Range		58/87	50/100		0/24			6–53	0.05/0.9	

*Intraoperative retinal tear
†Postoperative choroidal detachment
BUCVA = Best-uncorrected visual acuity; BCVA = Best-corrected visual acuity; IOP = Intraocular pressure; HM = Hand movements; CF = Counting fingers; DR = Diabetic retinopathy; RD = Retinal detachment; ARMD = Age-related macular degeneration (atrophic)

ing curve of the phacoemulsification technique.

The need for surgery in cases of retained lens fragments will depend on the composition of the retained material (nucleus or cortex) and its size. Small cortical fragments are resolved in 2 to 3 months in most cases, while nuclear fragments can be found 2 years after surgery (3). The slow resorption of nuclear fragments generates an easily manageable intraocular inflammation. Meanwhile, the presence of large amounts of cortical material can be responsible for a very intense inflammation, requiring vitrectomy (3).

As a general rule it is advisable to remove any retained lens material, even if initially well tolerated, since they induce chronic inflammation which can lead to secondary glaucoma, chronic uveitis, and cystoid macular edema (3, 5, 6). Vitrectomized eyes achieve better functional results in the long term with less incidence of glaucoma and uveitis when compared to nonoperated eyes (7-10).

Perfluorocarbons are helpful in protecting the retina from possible impacts produced by the projection of hard nuclear fragments during phacoemulsification and reflecting the ultrasound energy at their surface (11). They are also highly recommendable when a bullous retinal detachment or a giant retinal tear coexists with the dislocated nuclear fragments (12).

According to recent studies, 41 to 69% of the eyes operated reach a BCVA of 20/40 or better (7, 13-18). Kageyama et al recently reported BCVA of 20/40 or better in 82% of cases when vitrectomy is performed immediately after phacoemulsification (19). Nevertheless, 18 to 30% of the patients do not reach 20/200 because of glaucoma or retinal or corneal complications (15, 20-23). The incidence of retinal detachment ranges from 3.4% to 17.5% (13, 14, 17-19, 21, 23-26). These results are comparable to those obtained in our series concerning both visual recovery and complication rates.

There is no agreement in the published data about the time lapse between cataract surgery and vitrectomy. Some authors perform vitrectomy immediately after cataract surgery when it is possible (7, 27), but generally it should be performed 3 to 8 days later, depending on the inflammatory status of the eye, the IOP, and the transparency of the cornea. Immediate vitrectomy means that the patient undergoes only one surgical session and avoids the complications derived from the presence of lens fragments in the vitreous. The disadvantages of this technique are inadequate mydriasis, insufficient corneal transparency (edema or striate keratopathy), and probably insufficient staff expertise.

Two methods have been suggested to eliminate the nucleus or its fragments from the vitreous cavity using three-port PPV. The first one is the extraction of the fragments through a corneal or sclerocorneal incision after vitrectomy, once the vitreous cavity has been filled with perfluorocarbon and the fragments lifted to the pupil (12, 28, 29). After protecting the corneal endothelium with viscoelastic material, the nucleus can be manually removed (1). This technique is recommended only for very hard nuclei which would need high ultrasound energy and long phaco times, or when rhegmatogenous retinal detachment coexists (12). Two disadvantages can be considered: the need to enlarge the capsulorhexis with the consequent loss of support for subsequent implantation of a posterior chamber intraocular lens and the reopening of the corneal incision, causing additional endothelial trauma and induction of astigmatism (the incision must be large enough to allow the exit of the nucleus) (11).

The second method is phacoemulsification of the lens fragments in the vitreous cavity (8, 25, 26, 30-32). This procedure has several advantages: maintenance of the capsulorhexis (25), no need for enlargement of the corneal incision (25, 33), and good control of IOP during the whole procedure by separate infusion port (26). This technique can be performed with a 20-gauge fragmentation tip or with a phacoemulsification tip, as in our series.

However, the use of ultrasound in the vitreous cavity implies risks. Histologic studies have shown that acoustic energy at low intensities induces lesions in the outer and inner segments of photoreceptor cells, appearing as discrete pigment reactions visible by indirect ophthalmoscopy (34). A retinal tear can occur with greater energies, and with even higher energies a rupture of all the retinal layers might appear, including choroidal vessels and subsequent bleeding into the vitreous cavity (34).

Treatment of a dislocated nucleus or a fragment of it should be performed by an expert vitreoretinal surgeon. The technique of choice is vitrectomy with phacoemulsification of the nucleus in the vitreous cavity, followed by posterior chamber intraocular lens im-

plantation. Vitrectomy should be carried out as soon as possible, provided that the visualization conditions are sufficient to perform the vitreous surgery without problems, managing inflammation and IOP with topical medication until surgery. Moreover, we recommend the anterior segment surgeon not to implant the intraocular lens, since the absence of it allows for a better cleaning of the anterior chamber with better visualization of the fundus.

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