Original Article

Outcomes of Descemetopexy with Isoexpansile Perfluoropropane after Cataract Surgery

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Abstract

Purpose: To report the indications, anatomical outcomes, functional outcomes and limitations of descemetopexy with intracameral injection of isoexpansile perfluoropropane (14% C3F8) in eyes with Descemet's membrane (DM) detachment after cataract surgery.

Methods: This retrospective non-comparative interventional case series included 67 eyes of 67 patients who underwent descemetopexy at a tertiary eye hospital. The procedure consisted of descemet's membrane reattachment by injecting isoexpansile perfluoropropane (14% C3F8) intracamerally. Outcome measures were reattachment of DM, improvement in visual acuity, resolution of corneal edema, causes for failure of DM reattachment and complications.

Results: Sixty-seven eyes of 74 patients were analyzed. Phacoemulsification (56.71%) had the highest DM detachment as compared to manual SICS in 19 (28.36%) and ECCE in 10 (14.93%) eyes. Descemetopexy with 14% C3F8 resulted in anatomical reattachment of DM in 71.64% and functional improvement in visual acuity in 74.63% of treated eyes. The location and the extent of DM detachment did not influence DM reattachment. Complete reattachment of DM occurred in all 26 eyes (100%) with planar type detachments, whereas with non-planar type detachments only 22 eyes (53.7%) achieved complete reattachment.

Conclusion: Descemetopexy with isoexpansile perfluoropropane offers good surgical outcomes regarding visual acuity and resolution of corneal edema.

Keywords: Descemet's Membrane Detachment; Descemetopexy; Isoexpansile Perfluoropropane

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INTRODUCTION

Descemet's membrane (DM) detachment is an uncommon condition with a wide range of etiologies; the most common being a localized detachment occurring during cataract surgery.[1,2] As clear cornea incision cataract surgery has become popular, increased surgical manipulation at the peripheral border of DM seems to have increased the prevalence of DM detahment.[2] In addition, non-surgical DM detachments have been reported due to birth injury, trauma, congenital glaucoma and keratoconus.[3] Some patients may be anatomically predisposed to DM detachment possibly due to an abnormality in the fibrillary stromal attachment to DM.[4] As the natural history and prognosis of DM detachment is unclear, appropriate timing and effective intervention for this complication has been an area of controversy.

DM detachment is an important cause of surgery related corneal edema which may lead to irreversible

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corneal decompensation. Prompt recognition and management of this complication may lead to a better visual outcome. Treatment alternatives include injection of an intracameral air bubble or viscoelastics, suture transfixation of DM, injection of isoexpansile gases (sulfur hexafluoride, SF6, or perfluorpropane, C3F8) with or without the use of sutures, and finally corneal transplantation.[5-10]

In the present case series, we report the indications, anatomical and functional outcomes, and limitations of descemetopexy using an intracameral injection of isoexpansile perfluoropropane (14% C3F8) in eyes with DM detachment following cataract surgery.

METHODS

This retrospective interventional single-center study was conducted at Dr. Shroff's Charity Eye Hospital, New Delhi, India, over a period of four years (from January, 2007 to December, 2010). Approval was obtained from the institutional review board.

The study included all eyes that had undergone descemetopexy with isoexpansile perfluoropropane (14% C3F8) injection for DM detachment and significant corneal edema within one week after cataract surgery (grade 2 or more) or corneal edema that persisted later than one week of conservative management with hypertonic saline and topical steroids (any grade of corneal edema). Subjects who had undergone cataract surgeries elsewhere were also included. Techniques of cataract surgery included phacoemulsification, small incision cataract surgery and extracapsular cataract extractions. Patients were excluded if DM detachment was due to other causes or if they had received another modality of treatment. Eyes with comorbidities affecting the visual outcome (corneal scar, dystrophies, glaucoma, retinal problems, and optic neuropathies) were also excluded from the study.

Preoperative examination consisted of assessment of visual acuity, evaluation of corneal edema and type of DM detachment. Best-corrected visual acuity (BCVA) was assessed using Snellen's visual acuity chart and converted to logMAR notations for analysis. Corneal edema was evaluated at the slit lamp and graded from 0 to 3 based on its extent [Table 1]. DM detachment was suspected in eyes with non-resolving corneal edema after cataract surgery, when the stromal edema was confined to the area of detachment whereas, the cornea beyond the area of detachment was clear and compact [Figure 1]. Detached DM may be visualized as a clear floating membrane in the anterior chamber behind the area of stromal edema [Figure 2]. Anterior segment optical coherence tomography (AS-OCT) was performed only in patients with no clear clinical evidence of DM detachment. On AS-OCT, DM detachment was evident as an undulating, linear, hyper-reflective structure in the anterior chamber [Figure 3]. Descemet's membrane detachment was classified into planar type with the Descemet's membrane separation of less than 1 mm and non-planar type with a separation of greater than 1 mm.[5] The surgical technique employed for cataract extraction, including phacoemulsification, manual small incision cataract surgery (SICS) or conventional extracapsular cataract extraction (ECCE) was noted. The time interval between cataract surgery and descemetopexy (interim period) was also recorded.

Table 1. Grading of corneal edema

Grades	Extent of edema
0	No corneal edema
1	<3 mm in diameter
2	>3 mm and <5 mm in diameter
3	<5 mm in diameter

Isoexpansile C3F8 gas was prepared similar to the method described by Lucena et al[11] The site of entry was in the area where DM was attached which was identified at the slit lamp prior to the procedure. Under an operating microscope, taking aseptic precautions, isoexpansile C3F8 was injected intracamerally using a 30 gauge needle mounted on a 2 ml disposable syringe, to fill 2/3 of the total anterior chamber volume with a gas bubble. Before injection, intracameral entry of the tip of the needle was ensured by touching the intraocular lens or the iris. Postoperatively, patients were advised to maintain supine posture with chin elevation for three days. Topical antibiotics and steroids in tapering doses were prescribed.

Postoperatively, status of the DM and corneal edema were recorded on the first day and weekly thereafter for four weeks. BCVA could not be measured during the week after the intervention due to the presence of C3F8 bubble in the visual axis and was recorded on every visit thereafter. DM status was noted after the absorption of C3F8 bubble from the anterior chamber using slit lamp examination and AS-OCT (in some cases) and recorded as completely attached [Figure 4], partially attached or not attached. The time interval for resolution of corneal edema was recorded. C3F8 bubble was evaluated for its size, position and duration of persistence in the anterior chamber. Associated complications were also recorded.

SPSS version 23.0 (SPSS Inc., Chicago, Illinois, USA) was used for statistical analyses. Mean values (±standard deviation) were calculated for continuous variables while percentages were calculated for categorical variables. The significance of difference between pre- and post-intervention variables was evaluated with *t*-tests. A

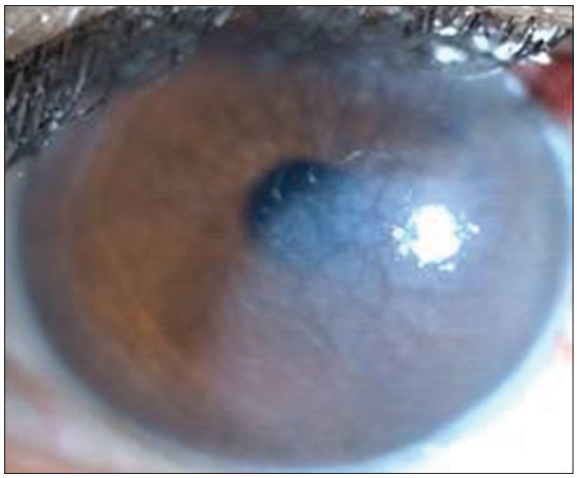

Figure 1. Descemet's membrane detachment following cataract surgery; note the localized corneal edema with a distinct demarcation between edematous and compact cornea.

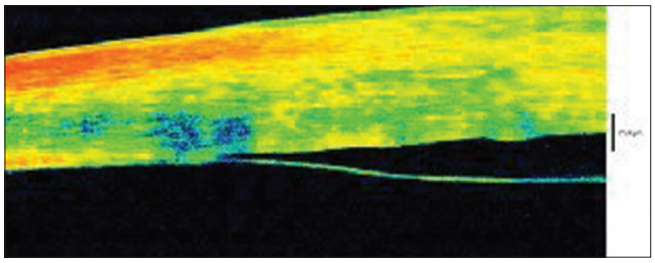

Figure 3. Anterior segment optical coherence tomography image of Descemet's membrane detachment following cataract surgery; an undulating, linear, hyper-reflective structure is seen in the anterior chamber.

P value of less than 0.05 was considered as statistically significant. The association between selected variables with DM attachment was computed using multivariate logistic regression models.

RESULTS

A total of 74 eyes of 74 patients were initially included; seven eyes with incomplete data or loss to follow-up were excluded, thus eventually 67 eyes were available for analysis. Mean patient age was 64.8 ± 10.1 (range, 45-90) years and male/female ratio was 1:1.58. Out of 67 patients, 30 subjects had undergone cataract surgery at our center whereas, 37 (55.2%) other cases had been referred from other centers. Out of the 30 in-house patients, 24 (80%) cataract surgeries had been performed by trainee cataract surgeons including fellows and short term cataract trainees. Phacoemulsification was performed in 38 (56.71%), manual SICS in 19 (28.36%) and ECCE in 10 (14.93%) eyes. The time interval between cataract surgery and descemetopexy procedures (interim period) is detailed in Table 2.

Figure 2. Descemet's membrane detachment following cataract surgery; note the clear membrane in the anterior chamber underneath the area of stromal edema.

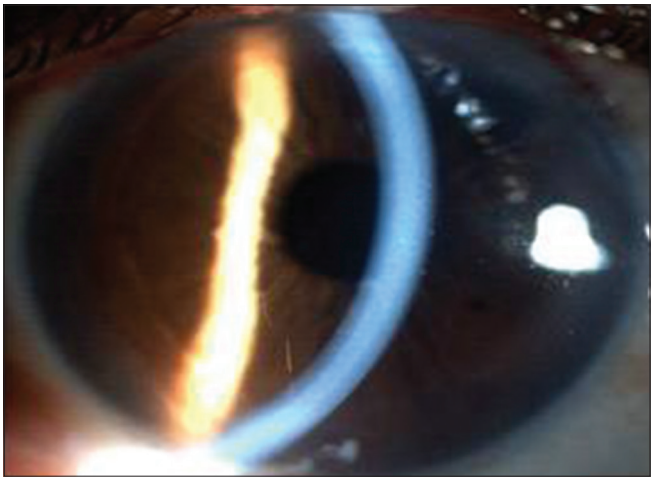

Figure 4. Successful reattachment post descemetopexy: Compact cornea with resolution of edema.

DM Status

The majority (80%) of DM detachments was noted at the site of the main incision, while 20% occurred at the side port incision. DM detachments were classified as planar in 26 (38.81%) and non-planar in 41 (61.19%) eyes [Table 3].

After the intervention, complete DM reattachment was observed in 48 eyes (71.64%), partial attachment occurred in 12 eyes (17.91%) while non-attachment was present in 7 eyes (10.44%). The location and the extent of DM detachment did not influence DM reattachment. Complete reattachment of DM occurred in all 26 eyes (100%) with planar type detachments, whereas with non-planar type detachments, 22 eyes (53.7%) achieved complete reattachment while 19 eyes (46.3%) demonstrated no or only partial reattachment.

Eyes with interim period longer than three months had very low reattachment rates in comparison to those

Table 2. Duration between cataract surgery and descemetopexy (interim period)

Interim period	Number of eyes
<1 week	10
1 week to 1 month	38
1 to 3 months	11
> 3 months	8

Table 3. Type of descemet's membrane detachment

Number of eyes (%)			
Planar		Nonplanar	
26 (38.81)		41 (61.19)	
Peripheral only	Combined peripheral + central	Peripheral only	Combined peripheral + central
10	16	2	39

with shorter interim periods [Figure 5]. Multivariate logistic regression analysis revealed that a shorter interim period was significantly associated with a higher rate of DM reattachment ($P = 0.005$); on the other hand, age ($P = 0.24$), the extent of corneal edema ($P = 0.19$) and intraocular pressure ($P = 0.35$) were not associated with DM reattachment. Mean duration of interim period in the attachment group was 22.3 ± 21.8 days and 70.6 ± 70.5 days in no or partial attachment group ($P = 0.013$).

Visual Acuity

Mean BCVA was 1.5 ± 0.5 logMAR prior to descemetopexy which was improved to 0.6 ± 0.5 logMAR after descemetopexy ($P < 0.0001$, Table 4). Fifty (74.63%) eyes achieved more than 2 Snellen lines of visual acuity by four weeks after intervention [Figure 6]. Pre-descemetopexy visual acuity was 1.41 ± 0.54 logMAR in the reattachment group and 1.60 ± 0.39 logMAR in the no or partial attachment group ($P = 0.129$).

Corneal Edema

There was complete resolution of corneal edema in 48 (64.8%) eyes [Figure 7]. Mean duration for resolution of corneal edema in the reattachment group was 1.10 ± 0.31 weeks.

Comparative Analysis of Parameters

C3F8 bubble evaluation

Mean duration of persistence of C3F8 bubble in the anterior chamber was 3.07 ± 0.82 weeks [Figure 8]. Rebubbling was required in 4 (5.97%) eyes due to inadequate tamponade (small bubble/leak). The gas bubble migrated into the vitreous cavity in one aphakic eye.

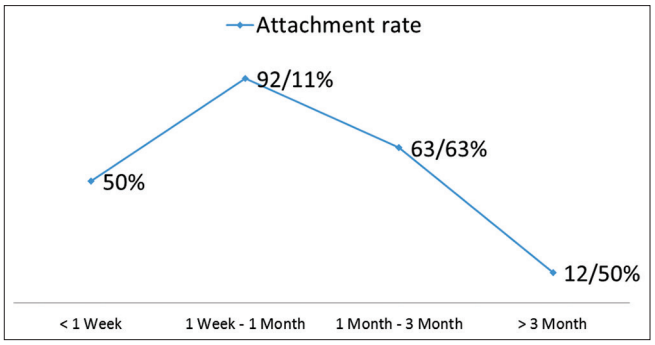

Figure 5. Descemet's membrane attachment rate in relation to the interim period between surgery and C3F8 gas injection.

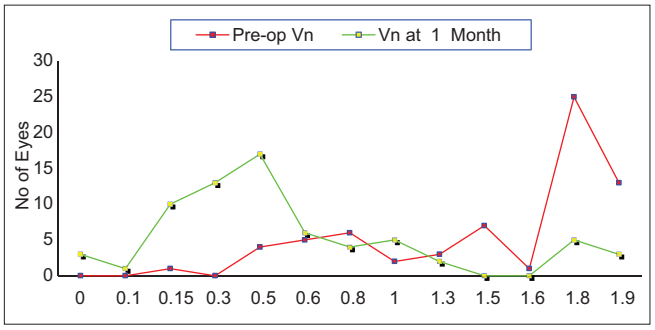

Figure 6. Visual acuity improvement. Pre-op Vn, pre-operative vision; Vn, vision.

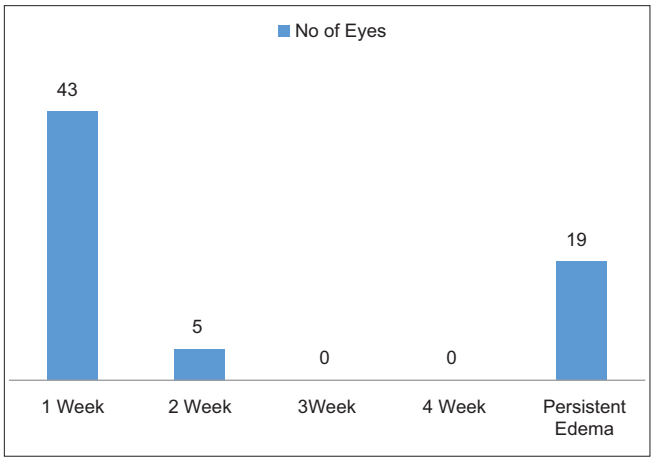

Figure 7. Resolution of corneal edema following descemetopexy.

Complications

Intraocular pressure increased in 9 (13.43%) eyes due to pupillary block (7 eyes) and a large bubble (2 eyes). This was managed with dilating drops in three eyes while, other 6 eyes required a paracentesis. Mild corneal scarring (grade 0.5 to 2 or more) was present in 46 (95.8%) patients in the attachment group as a sequel of

Table 4. Comparison of preoperative and postoperative visual acuities

BCVA (LogMAR)	Number of eyes (%) (preoperative)	Number of eyes (%) (postoperative at 1 month)
0-0.48	5 (7.46)	42 (62.69)
>0.48-1	13 (19.40)	15 (22.39)
>1	49 (73.13)	10 (14.93)
Mean VA predescemetopexy - 1.5±0.5	*P*<0.0001 (statistically significant)	
Mean VA postdescemetopexy - 0.6±0.5		

VA, visual acuity; BCVA, best corrected visual acuity; LogMAR, logarithm of the minimum angle of resolution

Table 5. Postoperative corneal haze in the attachment group

Grade	Corneal haze	Number of eyes (*n*=48)
0	Clear cornea	2
0.5	Mild but distinct haze	22
1	Well defined diffuse haze	21
2	Moderate haze that obscures iris details	3
3	Complete obscuration of anterior chamber and iris	0

DM detachment. However, visually significant corneal scarring (grade 2 or more) occurred in only 3 (6.25%) eyes in the attachment group [Table 5]. Inadvertent intrastromal gas injection occurred in one eye (1.49%).

Risk Factors

The type of DM detachment affected the prognosis of reattachment with the planar variety having a better prognosis. Eight eyes had an interim period longer than 3 months and showed significantly lower reattachment rates. Out of these 8 eyes, 7 (87.5%) failed to show resolution of DM detachment with descemetopexy, indicating that longer interim periods were associated with poor attachment outcomes. Inadequate tamponade due to small bubble, migration of bubble into the vitreous cavity in an aphakic eye and inadvertent intrastromal injection of gas were other factors predisposing to nonattachment.

DISCUSSION

DM detachment can lead to significant visual impairment from persisting corneal edema which can be reversed with early intervention as shown in the current series. There were significantly high rates of DM detachment in the hand of trainee surgeons. Improper techniques of instrument entry into the eye with the phaco probe and instruments such as nucleus manipulators or cannulas, and improper anterior chamber maintenance are the most likely causes of DM detachment.

DM detachment should be suspected when there is localized corneal edema with a distinct demarcation between the edematous and compact cornea. AS-OCT

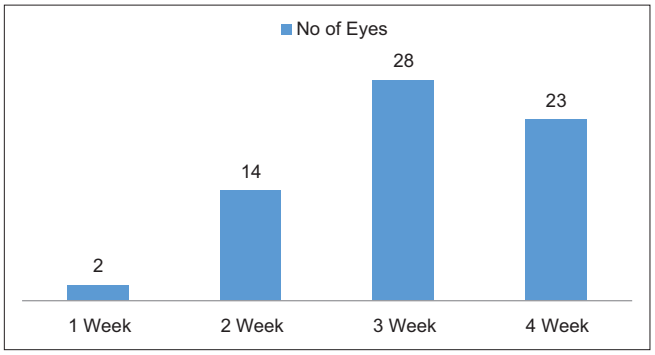

Figure 8. Duration of persistence of C3F8 bubble in anterior chamber.

is a useful tool in confirming the diagnosis. The results of the current study indicate that phacoemulsification led to a larger percentage of DM detachment as compared to manual cataract surgeries. This may be explained by the fact that currently the total number of phacoemulsification surgeries far exceeds the number of manual cataract surgeries.

Planar DM detachments showed 100% attachment rate as compared to non-planar DM detachments which had an attachment rate of only 53.7%. However, the extent and location of DM detachment did not influence the prognosis. Time interval from cataract surgery to descemetopexy had a direct impact on the outcome of descemetopexy. Complications of intervention were few and could be managed medically or by simple secondary procedures.

There are few studies and case reports available in the literature demonstrating the usefulness of isoexpnasile perfluoropropane for descemetopexy after cataract surgery. Furthermore, the number of cases studied has been quite few. Our results are comparable to previous studies in terms of DM attachment, visual acuity improvement and resolution of corneal edema.[11] However, Lucena et al[12] and Shah et al[13] have reported success rates of 100%. This difference may be attributed to their small sample size.

To the best of our knowledge, the present study enrolled the largest number of eyes with post cataract surgery DM detachment allowing detailed analysis of various factors affecting the outcome of attachment. We used 14% C3F8

for descemetopexy as it is readily available at our institute. Our study did not compare the results of C3F8 with air or observation with no intervention. Another limitation of our study was that we did not analyze the endothelial toxicity of C3F8 gas. The retrospective nature of the study and lack of AS- OCT analysis in all patients are among other limitations of this study.

In summary, descemetopexy using isoexpansile C_3F_8 for DM detachment after cataract surgery led to successful DM reattachment and visual improvement. It is not the extent but the type (planarity) of DM detachment which affects the prognosis for attachment. The time interval between cataract surgery and descemetopexy (interim period) carries prognostic significance and late intervention is associated with poor results. Early recognition of DM detachment and early descemetopexy with isoexpansile perfluoropropane has reasonably successful anatomical and functional outcomes.

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Nil.

Conflicts of Interest

There are no conflicts of interest.

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