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Management of Post-DALK Descemet's Membrane Detachment with Intracameral C_3F_8 Injection: Report of Two Cases

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Abstract
Purpose:
To report the occurrence of Descemet's membrane detachment (DMD) occurring after deep anterior lamellar keratoplasty (DALK) performed in two patients and the successful management of the same with intracameral perfluoro propane gas (C_3F_8) injection at a concentration of 10%.
Methods:
Two patients who underwent DALK for keratoconus developed postoperative DMD. Both patients were managed with intracameral 10% C_3F_8 gas.
Results:
In both cases, reattachment of the Descemet's membrane was achieved on postoperative day 1 following gas injection which was confirmed on anterior segment optical coherence tomography (ASOCT), with subsequent improvement in corneal clarity and visual outcomes.
Conclusion:
Early recognition and timely management of postoperative DMD using intracameral C_3F_8 gas injection can result in successful reattachment and good visual recovery.
Keywords: *Deep anterior lamellar keratoplasty, Descemet's membrane detachment, C_3F_8 gas injection, micro perforation, corneal surgery.*

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I. Introduction:

Descemet's membrane detachment (DMD) is a sight threatening complication that can occur following various intraocular procedures like cataract surgery, trabeculectomy, etc and deep anterior lamellar keratoplasty (DALK) is no exception. Spontaneous resolution of DMD may occur if it is small. Peripheral DMDs even though non-visual axis involving can have a tendency to progress towards the center and completely detach later leading to vision loss which if left undiagnosed or unattended pose the risk of significant morbidity and visual impairment secondary to endothelial dysfunction and corneal decompensation. Hence, patients with peripheral DMD are kept on regular follow-up to monitor its progression. However, in cases of large non-planar DMDs or those that are involving the visual axis, intracameral air or isoexpansile gases are injected with the aim to tamponade the Descemet's membrane (DM) onto the grafted tissue at the earliest setting as possible.

If the corneal clarity is permissible to visualize the DM, DMD may be diagnosed on slit lamp examination. However, it would not be possible in cases of diffuse and severe corneal oedema, wherein anterior segment optical coherence tomography (ASOCT) is a useful tool to detect the presence, location and size of the DMD.

In this case report, we discuss the successful management of 2 DMDs post DALK with the use of non-expansile concentration of gas C_3F_8 (10%)

Case reports:

Two patients diagnosed with advanced keratoconus underwent DALK surgery.

Case 1

A 29 years old male patient diagnosed with advanced keratoconus was planned for DALK surgery. Pre-operative slit lamp examination of the patient showed an ectatic cornea with prominent corneal nerves and complete Fleisher's ring. There was no evidence of any signs of scarring suggestive of previous old hydrops.

Intra-operatively, a type 2 bubble was achieved. A manual dissection till the pre-descemetic layer was done and donor graft was sutured onto the host bed with 16 (9-0) nylon sutures. Surgery was uneventful otherwise. On post-operative day 1, patient had a vision of Counting fingers close to face (CFCF). A slit lamp examination revealed an edematous graft with diffuse stromal and Descemet's folds (Fig 1). Anterior Segment optical coherence tomography (ASOCT) revealed a multiple planar DMDs including one at the center (Fig 2).
He was planned for C_3F_8 (10%) injection the same day. 0.2 cc of C_3F_8 was taken in a 2 cc syringe and the rest of the syringe was reconstituted with air. Under peribulbar anaesthesia, an inferior peripheral iridectomy was made using microscissors and C_3F_8 (10%) was injected through a 30 G needle attached to the syringe. A full chamber bubble was left in situ and patient was instructed to lie supine immediately for atleast 4 hours. Intraocular pressure (IOP) checked after 4 hours with Icare tonometer (Icare Finland Oy, Revenio group) was 18 mm Hg.
The next day, unaided vision recorded was 6/60 with an IOP of 16 mm Hg. Slit lamp examination showed reduction in the corneal edema and Descemet's folds with 50 % bubble partially obscuring the pupil. ASOCT showed an attached DM throughout the cornea. Post-operative 1 week review of the same patient showed a clear graft with attached DM and complete resorption of gas bubble (Fig 3).

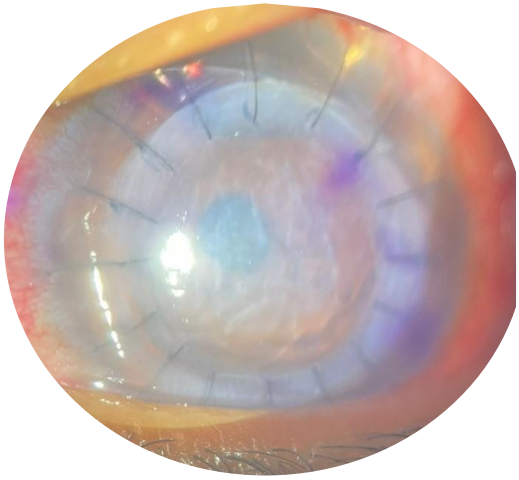

Fig 1: Post-operative day 1 image of Case 1 post DALK showing a well centred graft with central DM folds

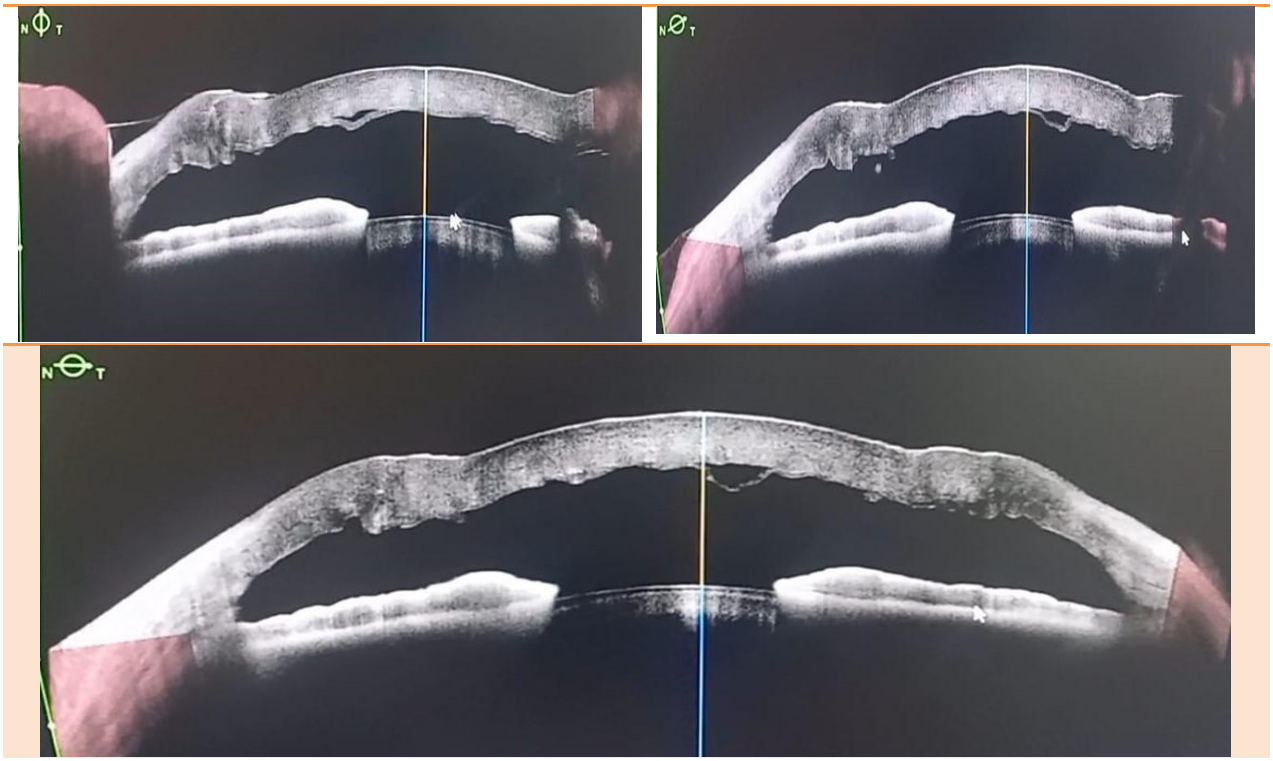

Fig 2: ASOCT showing multiple small planar DMDs each of them involving the central 3 mm zone of cornea.

Fig 3: Post-operative day 7 image of post C_3F_8 (10%)injection in the same patient (Case 1) showing complete resolution of DM folds and clear graft.

Case 2

A 16 years old female patient diagnosed with advanced keratoconus was planned for DALK surgery. Pre-operative slit lamp examination of the patient showed an ectatic cornea with prominent corneal nerves, a complete Fleisher's ring and paracentral apical scarring suggestive of previous old hydrops.

DALK using Anwar's big bubble technique was done. There was a small central 0.5 mm perforation during removal of stromal flaps. However, full chamber air bubble was maintained and hence surgery was continued and donor graft was sutured onto the host bed with 16 (9-0) nylon sutures. Post operatively, on day 1, patient had a vision of 5/60. A slit lamp examination revealed a relatively clear graft with few DM folds. ASOCT revealed a small nasal DMD not reaching the pupillary zone (Fig 4). Owing to the peripheral and planar nature of DMD, she was asked to review back in 1 week to note any sign of progression or spontaneous reattachment.

At 1 week postoperative review, her vision dropped to 1/60 and slit lamp examination showed an edematous graft with grade 3 haze and a central shallow DMD. ASOCT revealed a shallow large subtotal DMD with attachments to overlying stroma only at few points occasionally (Fig 5).

She was planned for C_3F_8 (10%) injection the same day. C_3F_8 (10%) was reconstituted similar to that in the first case. Under peribulbar anaesthesia, an inferior peripheral iridectomy was made using micro scissors and C_3F_8 (10%) was injected through a 30 G needle attached to a syringe. Interface fluid was milked through the perforation using 26G hydro cannula after visualization. An improvement in corneal clarity was noted in 5 minutes after the procedure. A full chamber bubble was left in situ and patient was instructed to lie supine immediately for atleast 4 hours. IOP checked after 4 hours with Icare tonometer (Icare Finland Oy, Revenio group) was 16 mm Hg.

The next day, unaided vision recorded was 6/60 with an IOP of 13 mm Hg. Slit lamp examination showed reduction in the corneal edema and Descemet's folds with 50 % bubble partially obscuring the pupil (Fig 6). ASOCT showed an attached DM throughout the cornea. Post-operative 1 week review of the same patient showed a clear graft with attached DM (Figs 7 and 8).

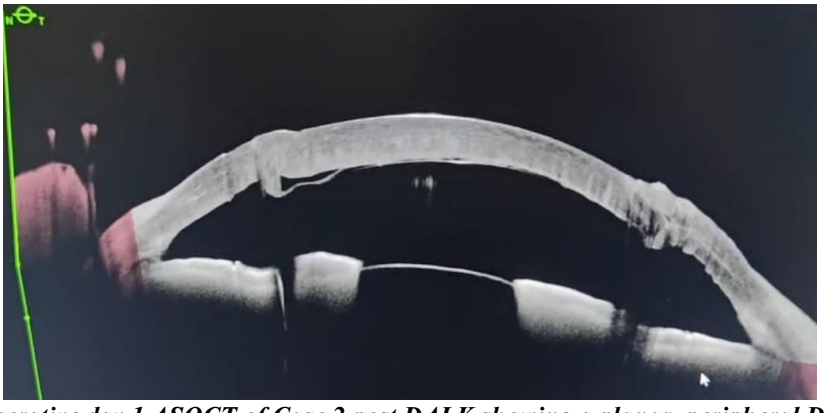

Fig 4: Postoperative day 1 ASOCT of Case 2 post DALK showing a planar, peripheral DMD in nasal quadrant.

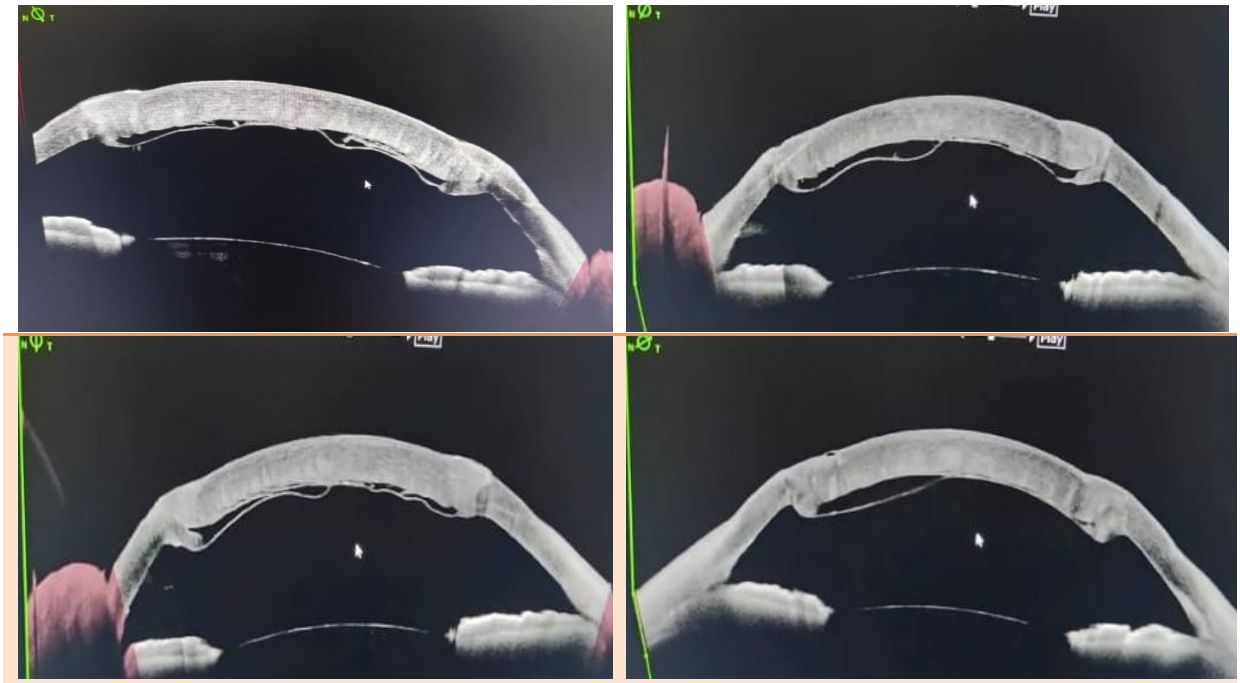

Fig 5: Postoperative day 7 ASOCT of Case 2 post DALK showing shallow DMD throughout the cornea

Fig 6: Post-operative day 1 image of post C_3F_8 (10%) gas injection in Case 2 post DALK showing a well centred graft with few DM folds and half chamber bubble.

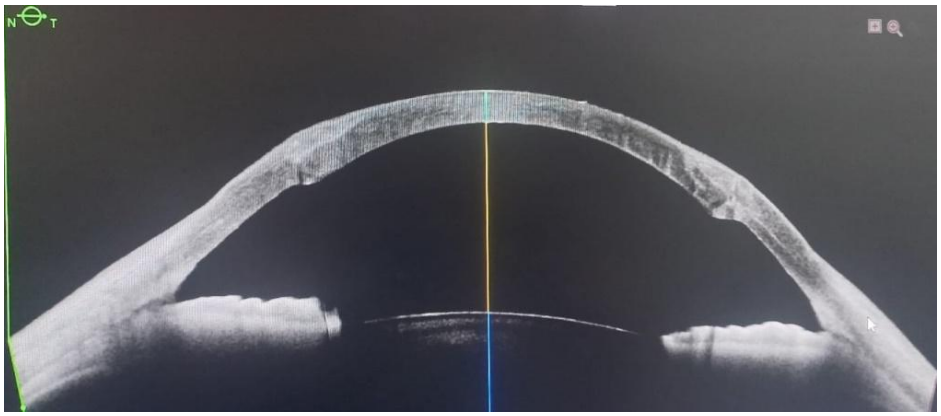

Fig 7: Postoperative day 7 post C_3F_8 (10%) gas injection ASOCT of Case 2 post DALK showing an attached DM throughout the graft.

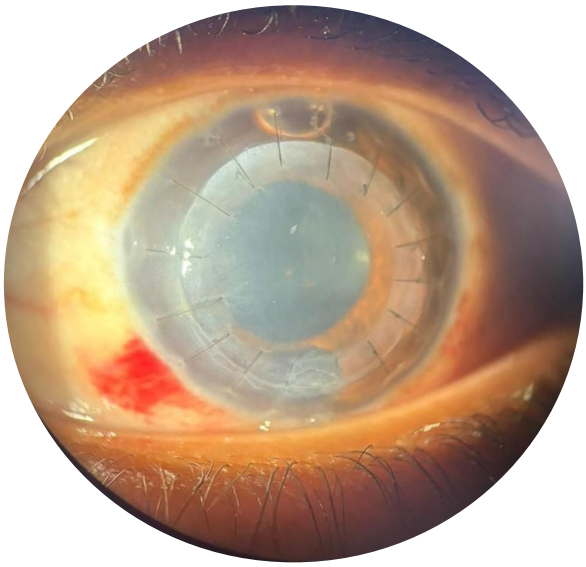

Fig 8: Postoperative day 7 post C_3F_8 (10%) gas injection of Case 2 post DALK showing clear graft and small gas bubble superiorly.

II. Discussion:

Mackool and Holtz classified DMDs into a planar type, with the Descemet's membrane separated less than 1 mm from the corneal stroma, and a non-planar type, with a separation of greater than 1 mm. These two types can be further divided by whether the detachments are limited to the peripheral cornea, or if they involve both the peripheral and central cornea.[1] Planar detachments involving the periphery do not interfere with the visual acuity and does not require intervention in most cases. However, non-planar detachments, those involving the central area and large, extensive detachments require aggressive therapy to prevent endothelial dysfunction, subsequent DM fibrosis and marked reduction in visual acuity.[2]

DMDs have been noted to occur spontaneously, either intraoperatively or postoperatively, or be a result of instrumentation handling during surgery. Risk factors for spontaneous DMD in keratoconus patients have been postulated to be due to progressive long standing stretch due to ectasia. [3] Intraoperative cause for DMDs could be secondary to a perforation during stromal dissection or during deflating a big bubble or due to unrecognized type 2 bubbles or during inadvertent micro perforation while suturing the graft onto the host bed. Postoperatively, it can be caused due to pulling effect of a post-inflammatory retro corneal membrane along the graft-host junction along the DM.[3]

Postoperative development of a double anterior chamber with intact DM in DALK has to be differentiated from intraoperative DMD. One possible explanation postulated for such a phenomenon is temporary endothelial shock, which briefly halts endothelial pumping activity. Another observation in delaying DM reattachment in DALK is the use of intraoperative OVD.[4] An interesting mechanism of double chamber formation is the mechanical stretching of junctional endothelial intercellular complexes during surgery, wherein the endothelial pumping may not be able to build sufficient negative sucking pressure in the secondary chamber because of substantial reverse influx from the anterior chamber.[5]

The management of DMDs is dependent on the timing of occurrence, its length and extent, the available resources and the experience of the operating surgeon. Traditionally, observation was suggested with the hopes of spontaneous resolution but the mean time for resolution of DMD with medical treatment alone was reported to be 9.8 weeks with a high failure rate of 46.67%. [6] There is an isolated case report of spontaneous DM reattachment by observation post DALK in a pediatric patient but the reason of spontaneous reattachment is unaccounted for till date.[7] Hence, without a large sample cohort study, mere observation for large DMDs post DALK cannot be conclusive for a good visual outcome each time especially for pediatric patients. In short, spontaneous reattachment with a medical line of treatment is reported to be prolonged and unpredictable.

Various surgical techniques are listed for the management of DMDs which include Descemetopexy with air/gas (SF6 /C3 F8) [1]with or without sutures[8], Mechanical tamponade with viscoelastic material, Descmetotomy, manual reposition, interface fluid drainage and endothelial keratoplasty.

Small perforations (less than 1 mm) need not be an obstacle for continuing with DALK if it is managed by injecting the air in anterior chamber for internal tamponade of DM. Large perforation, if happened during early stage of stromal dissection, needs to be converted to penetrating keratoplasty (PKP), but if it happens at late stage, away from the center, and if identified early and managed adequately, DALK can be successfully performed.[7]

Gases can be preferred over air in cases of inferior non-planar (>1 mm) DMD or superior DMD with scrolled edges or central planar or non-planar DMD, a long standing DMD or taut DMDs following fibrosis and inflammation. [3,9]

Use of non-expansile concentrations of C3F8 have also been studied with benefit in reattachment of DM in early and late (upto 10 weeks) without the risk of post gas injection pupillary block glaucoma.[10] Compared to air descemetopexy, C_3F_8 provides a longer intraocular residence time, ensuring prolonged tamponading effect which is of prime importance particularly in extensive or delayed DMDs. The use of 10% C_3F_8 provides a balance between adequate duration and safety, thereby minimizing IOP elevation spikes and avoiding pupillary block when appropriate postoperative positioning is maintained.

The cause of DMDs was different in both the cases (Probably due to micro-perforation during suturing or manual dissection in the first case and obvious perforation in the second case). However, both of them had a different timing and nature of presentation of DMDs. Ultimately, post 10% C_3F_8 gas injection, both of them had similar anatomical and visual outcomes at the end of 1 week. But, long term follow-up upto a year with a large sample size is needed to prove the role of a lower concentration of C_3F_8 gas.

III. Conclusion:

The novelty of this report lies in the occurrence of DMDs after DALK in two eyes, both successfully managed with 10% C_3F_8 gas injection spaced a week apart with no incidence of rise of IOP postoperatively. Literature specifically describing the use of C_3F_8 for post-DALK DMD is limited, and these cases add valuable clinical evidence supporting its safety and effectiveness in this setting.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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