# DMEK Update

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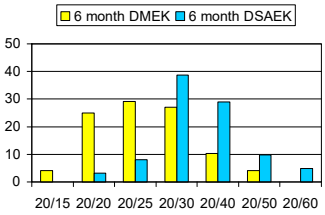
## WHERE ARE WE?

## WHERE ARE WE GOING?

## What We Know About DMEK

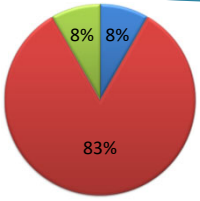
- Topical w/ MAC
- 80% air fill is adequate, gases optional
- 10-15% rebubble rate w/ air
- Primary failure rate 1%
- Rejection rate (Caucasians) on FML 1%
- Rejection rate (Caucasians) off steroids 5-6%
- More than half achieve BCVA 20/20-25

## DMEK Yields More 20/15-20/25 Than DSEK




*Cornea Research Foundation of America*

## DMEK vs. DSEK Fellow Eye Survey




Endothelial Keratoplasty: Fellow Eyes Comparison of Descemet Stripping Automated Endothelial Keratoplasty and Descemet Membrane Endothelial Keratoplasty

*Frederico P. Guerra, MD,* Arundhati Anshu, MD,* Marianne O. Price, PhD,* and Francis W. Price, MD†*

**Conclusions:** The majority of the patients preferred or would recommend the DMEK procedure. Faster visual recovery and better final visual acuity were the main benefits of the DMEK technique.

(*Cornea* 2011;30:1382–1386)

DMEK | DSAEK | Same both eyes

Ophthalmic Technology Assessment

**Descemet Membrane Endothelial Keratoplasty: Safety and Outcomes**

*A Report by the American Academy of Ophthalmology*

Sophie X. Deng, MD,* W. Barry Lee, MD,† Kristin M. Hammersmith, MD,‡ Anthony N. Kuo, MD,§ Jennifer Y. Li, MD,‖ Joanna F. Shen, MD,¶ Mitchell P. Weikert, MD,# Ross M. Shtein, MD**

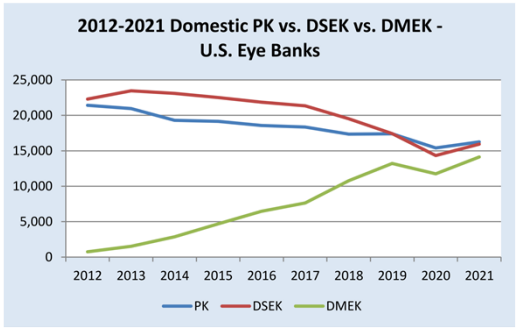
**Meta-Analysis of Postoperative Outcome Parameters Comparing Descemet Membrane Endothelial Keratoplasty Versus Descemet Stripping Automated Endothelial Keratoplasty.**

Review

Systematic Review and Meta-Analysis of Clinical Outcomes of Descemet Membrane Endothelial Keratoplasty Versus Descemet Stripping Endothelial Keratoplasty/Descemet Stripping Automated Endothelial Keratoplasty

**Descemet stripping automated endothelial keratoplasty versus descemet membrane endothelial keratoplasty: a meta-analysis.**

## DMEK vs DSEK Reviews




*EBAA Annual Report 2021*

## "Meta-analysis of Meta-Analyses"

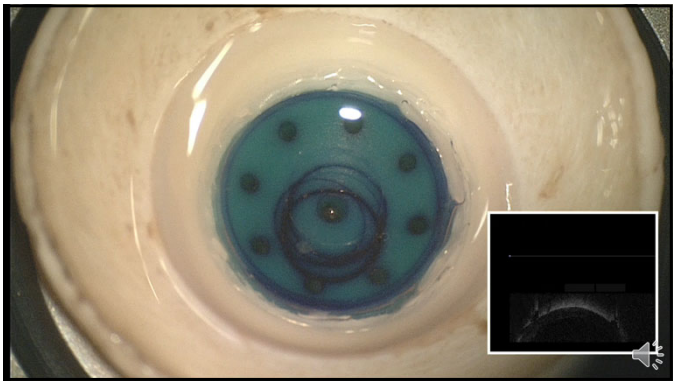
| Meta-analysis | # Studies | Postop BCVA | Partial Detachment /Rebubbling | ECL% | Graft Failure | Graft Rejection | Patient Preference |
|---|---|---|---|---|---|---|---|
| Deng, Lee, et al | 47 | DMEK | Similar* | Similar | Similar | DMEK | |
| Pavlovic, et al | 11 | DMEK | DSAEK | P>0.05 | P>0.05 | P>0.05 | DMEK |
| Singh, et al | 7 | DMEK | DSAEK | P>0.05 | | | DMEK |
| Zhu, et al | 7 | DMEK | DSAEK | P>0.05 | P>0.05 | P>0.05 | |

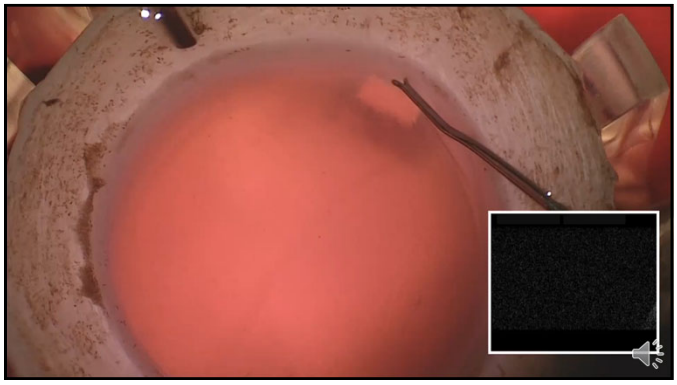
*All analyses noted limitations*

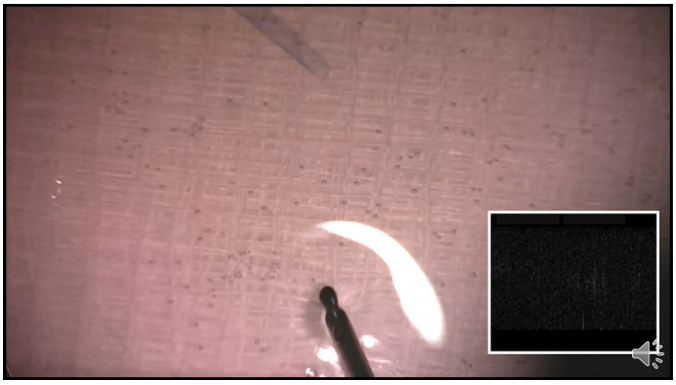
Table 1. Visual Outcomes and Complications of Descemet Membrane Endothelial Keratoplasty

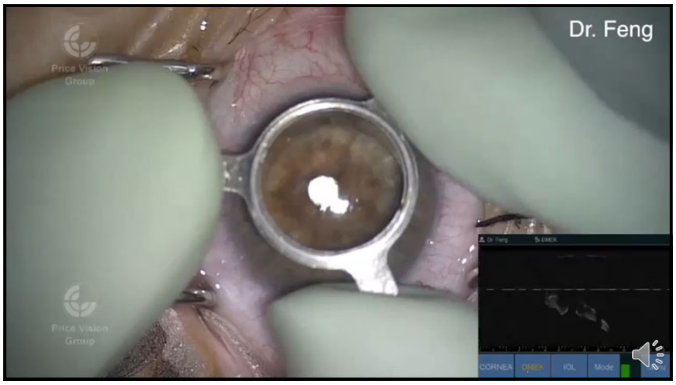
| Author(s), Year | Country | Level of Evidence | Total No. of Eyes | Follow-up (mos) | Subgroups (No.) | Mean Snellen Best-Corrected Visual Acuity after Descemet Membrane Endothelial Keratoplasty | Best-Corrected Visual Acuity (6 mos) | Endothelial Cell Loss (%) | Air Injection Rate (%) | Primary Graft Failure Rate (Secondary Graft Failure Rate) (%) | Immune Rejection Rate (%) | Other Complications |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Price et al,[10] 2014 | United States and Germany | I | 297 | 12 | PF (164) | — | — | 30 | — | — | 0 | CME, 0%; cataract, 1%; ICP elevation, 21.9% |
| | | | | | FML (161) | — | — | 31 | — | — | 1.4 | CME, 1.0%; ICP elevation, 6.1%; 5% of the eyes after DMEK/CE needed to change to PF |
| Price et al,[11] 2015 | United States | I | 233 | 12 | PF (162) | — | — | 29 | — | — | 0 | ICP elevation, 25%; corneal ulcer, 1% |
| | | | | | Lotepredinol (167) | — | — | 32 | — | — | 0 | ICP elevation, 11%; allergic reaction, 3% |
| Rudolph et al,[14] 2012 | Germany | II | 30 | DMEK (6.5); DSEK (12.6); PK (103) | DMEK (30) | 20/29 | — | — | — | — | — | |
| | | | | | DSEK (20) | 20/31* | — | — | — | — | — | — |
| | | | | | PK (10) | 20/40* | — | — | — | — | — | |
| Tourtas et al,[12] 2012 | Germany | II | 38 | 6 | DMEK (38) | 20/30 | ≥20/25 (50%) | 41 | 82 | — | — | |
| | | | | | DSEK (35) | 20/46* | ≥20/25 (6%)* | 39 | 20* | — | — | |
| Feng et al,[13] 2013 | United States | II | 361 | 3 | Donor prepared on day of surgery (130) | — | — | 28 | 15 | 1.5 (−) | — | |
| | | | | | Donor prepared 1 day before surgery (167) | — | — | 29 | 13 | 1.9 (−) | — | |
| | | | | | Donor prepared 2 days before surgery (71) | — | — | 29 | 14 | 2.8 (−) | — | |
| Chaurasia et al,[15] 2014 | United States | II | 492 | 6 | DMEK (292) | 20/25 (median) | — | 27 | 30 | 3.1 (0) | 0 | CME, 1% |
| | | | | | DMEK/CE (200) | 20/20 (median) | — | 25 | 29 | 3.5 (0) | 0 | CME, 1.5% |

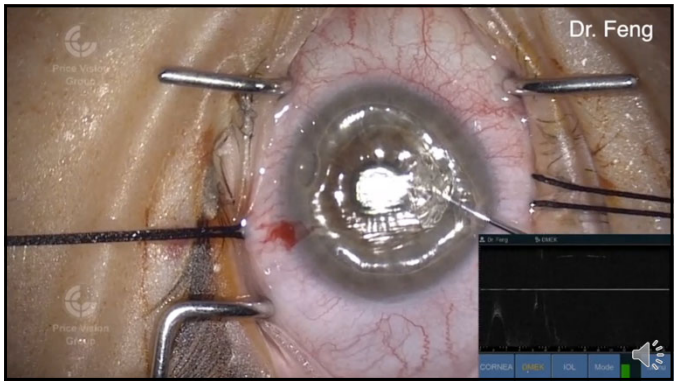
*Deng SX, et al. Ophthalmology 2018; 125(2):295-310*

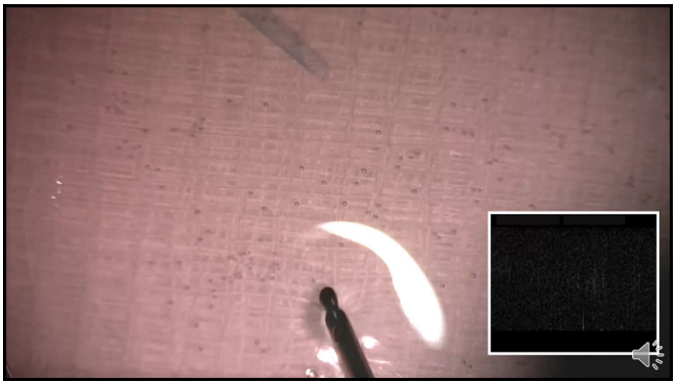


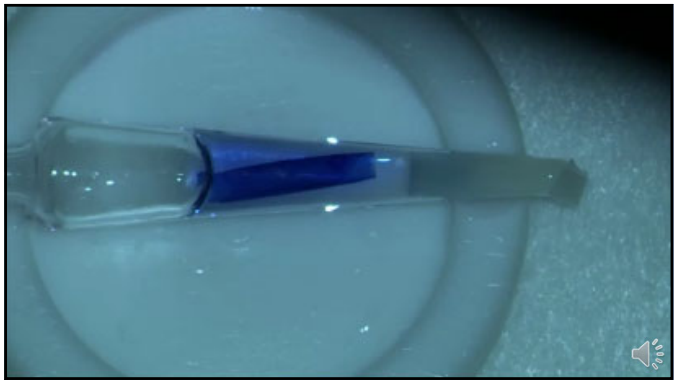


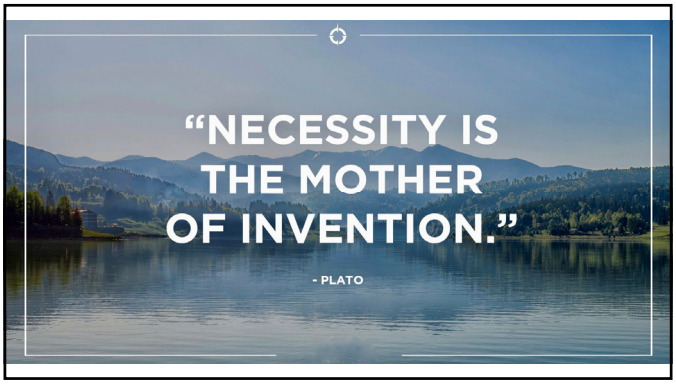



Dr. Feng


Dr. Feng






"NECESSITY IS
THE MOTHER
OF INVENTION."
- PLATO

## As Plato Predicted

| What Are Our Needs? | | What's New? |
|---|---|---|
| Shortening learning curve | → | New injectors, instrumentation |
| Mitigating risk of tissue loss | → | Expanded eye bank preparation options |
| Expanding donor pool<br>Minimizing difficult donor unfolds | → | Endo-in vs endo-out |
| Rescuing failed PK's | → | Descemetorhexis vs none |
| Reducing rebubble rate | → | Air vs SF6 vs C3F8 |

Clinical Science

# Endothelium-in Versus Endothelium-out Insertion With Descemet Membrane Endothelial Keratoplasty

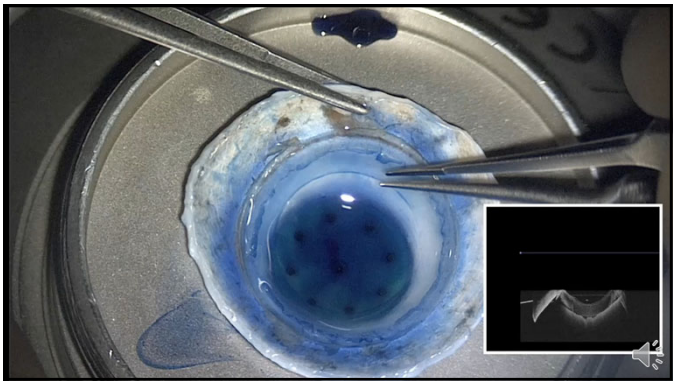
*Marianne O. Price, PhD,* Marek Lisek, BS,* Meagan Kelley, BS,* Matthew T. Feng, MD,† and Francis W. Price, Jr, MD†*

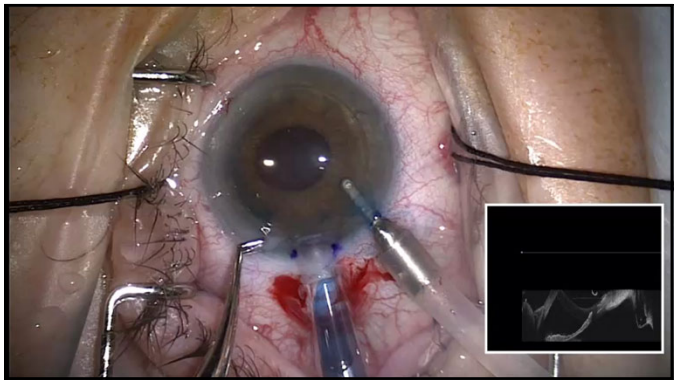
Cornea. 2018 Sep;37(9):1098-1101. doi: 10.1097/ICO.0000000000001650.

## Study Purpose

- To compare standard endothelium-outward injection of DMEK with the Busin trifold endothelium-inward injection method.*

*Busin et al. Ophthalmology 2016;123:476:83.





## Study Design

- Review of data collected prospectively
  - DMEK for FECD
- Outcomes:
  - Tissue unfolding time
  - Rebubbling rate
  - Regraft within 6 months
  - 6-months endothelial cell loss

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## Endo-in vs. Endo-out comparison

| | Group 1 N = 245 | Group 2 N = 161 | Group 3 N = 172 | Group 4 N = 176 |
|---|---|---|---|---|
| Surgeon | A | B | B | B |
| Configuration | Endo-out | Endo-out | Trifold | Trifold |
| A/C maintainer | No | No | No | Yes |

All injected with IOL injector

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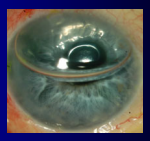
## Rebubble rates comparable Endo-In vs. Endo-Out



| Group 1 Scroll | Group 2 Scroll | Group 3 Trifold | Group 4 Trifold | P-value |
|---|---|---|---|---|
| 12% | 10% | 10% | 13% | 0.77 |

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## Regraft rate within 6 m comparable Endo-In vs. Endo-Out

| Group 1 Scroll | Group 2 Scroll | Group 3 Trifold | Group 4 Trifold | P-value |
|---|---|---|---|---|
| 0.8% | 1.2% | 2.3% | 0.6% | 0.43 |

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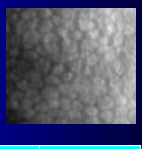
## 6-m cell loss comparable: Endo-in vs. Endo-out



| Group 1 Scroll | Group 2 Scroll | Group 3 Trifold | Group 4 Trifold | P-value |
|---|---|---|---|---|
| 28±11% | 30±13% | 28±15% | 27±13% | 0.77 |

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## Unfolding time comparable

- Time from injection to air fill
  - Measured by one surgeon (B) in 120 cases
  - Donor age range: 35-75 years*

| N = 60/group | Endo-out Scroll | Trifold + A/C maintainer | P value |
|---|---|---|---|
| Unfold time (min) | 6.0 ± 3.5 | 5.4 ± 3.0 | 0.43 |

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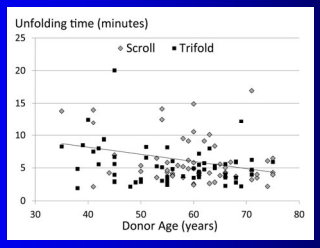
## Unfolding time vs. donor age

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## Unfolding time considerations

- IOL injector had nominal 2.2 mm lumen
- Trifold with younger donor tissue sometimes spontaneously recurled into scroll in injector
- Smaller lumen or larger graft diameter might prevent this
- We used 8 mm diameter, while Busin used 8.25 mm (2.9 min, Yu AC, et al. Am J Ophthalmol 2020;219:121-31
- (Pre-)load earlier? Solar SJ et al. Cornea 2020; 39(8):1062-5

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## Conclusions

- Trifold comparable to endo-out insertion
  - Rebubble rate, 6m cell loss, 6m regraft rate, unfolding time
    - Trifold younger donors sometimes re-scrolled in injector
- Choice is a matter of surgeon preference
- Parekh M, et al. Acta Ophthalmol 2017;95(2):194-8: trifold (0.96 min) vs Jones (4.92 min) unfolding
- Chong EW, et al. Cornea 2020;39(1):104-9
- Ho J, et al. Cornea 2020;39(3):358-61

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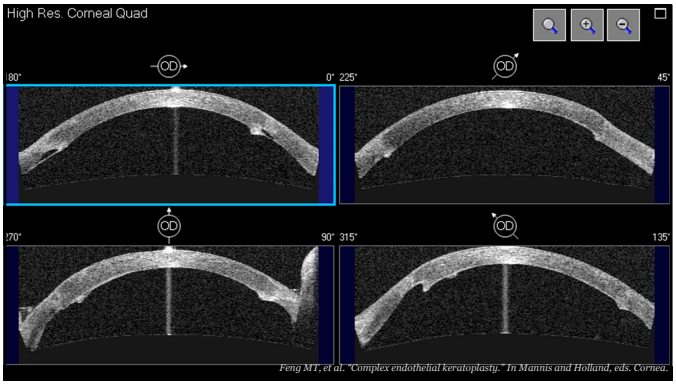
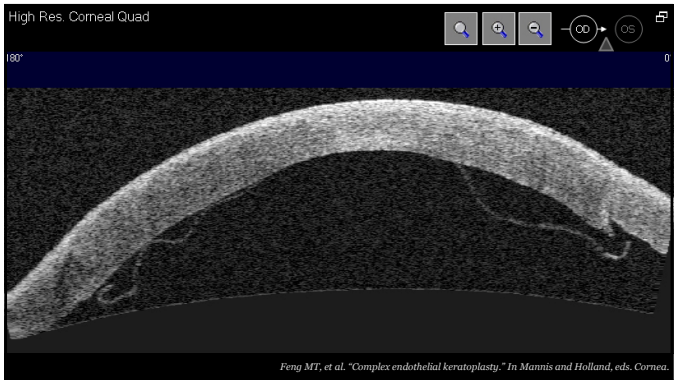
Multicenter Study > Cornea. 2020 Jan;39(1):13-17. doi: 10.1097/ICO.0000000000002046.

### Descemet Membrane Endothelial Keratoplasty Under Failed Penetrating Keratoplasty Without Host Descemetorhexis for the Management of Secondary Graft Failure

Jorge L Alió Del Barrio [1,2], Andrea Montesel [1], Vivian Ho [3], Maninder Bhogal [3]




> Cornea. 2019 Aug;38(8):976-979. doi: 10.1097/ICO.0000000000002000.

### Anterior Chamber Rebubbling With Perfluoropropane (C3F8) After Failed Rebubbling Attempts for Persistent Descemet Membrane Endothelial Keratoplasty Graft Detachments

Yariv Keshet [1,2], Yoav Nahum [1,2], Irit Bahar [1,2], Eitan Livny [1,2]

**WHITE PAPER:** Intracameral C3F8 Injections (Draft)

**PREPARED BY:** Matthew Feng for PVG on 3/29/19, in consultation Teresa Troutman

**BACKGROUND:**
10-14% C3F8 (perfluoropropane) is a longer-acting gas than air or even SF6 (sulfur hexafluoride). It is routinely used by retina surgeons. There are several clinical situations in which we inject air into the eye, usually the anterior chamber (intracameral). We have identified certain cases which are at high risk for needing multiple air injections. Repeat injections increase costs, risks, and inconvenience to patients and introduce added costs, staffing requirements, and scheduling inefficiencies in our clinics. A 50% bubble of 10% C3F8 lasts 1-2 weeks in the anterior chamber (Yeshet Y, et al. Cornea, in press).

**BENEFITS:**
Injecting C3F8 is expected to reduce the number of repeat injections required. This reduces pain, infection risk, and duration of antibiotic usage for patients as well as reduces the number of add-on procedures for the practice.

**RISKS:**
*Serious risks*
C3F8 is non-expansile at 10-14%. If improperly drawn up, it becomes expansile which can result in elevated IOP, pupil block, and permanent optic neuropathy.

*Intermediate risks*
Longer-acting gases such as C3F8 carry higher risks of calcium opacification of hydrophilic acrylic IOL's and cataractogenesis in phakic patients. However, repeat applications of shorter-acting gases may result in a similar risk profile cumulatively.

*Minor risks*
Increased rates of posterior iris synechiae formation have been reported for SF6 and would be expected for C3F8 as well. However, repeat applications of shorter-acting gases may result in a similar risk profile cumulatively.

**COST ANALYSIS:**
*Costs*
20g = approx. 10-15 uses*
125g = approx. 200 uses*
450g = approx. 450 uses*

*Cost/use depends on number of purges before drawing up gas for administration and assumes minimal waste by surgeon/staff and closing the tank after usage. All gases/liquids/oils have 18 month dating from FDA. For our needs during an 18 month period, the 20g tank is most appropriate.

$593.74 20g tank C3F8 (Alcon, 3/29/19 pricing)

Other supply and staff costs are not enumerated here because they would cancel out when comparing an intracameral air injection versus intracameral C3F8 injection. The marginal cost of C3F8 is conservatively estimated to be $60 per injection.

## Summary: DMEK Updates

- Pending further studies, the choice between traditional endo-out and endo-in (trifold) DMEK is surgeon preference
- Host Descemetorhexis is not always mandatory for DMEK rescue of failed PK
- 10% C3F8 gas may have a niche in high rebubble risk situations