

## Basics of fluid air exchange in vitreoretinal surgery

### FLUID AIR EXCHANGE

Fluid air exchange (FAE) is the substitution of fluid in the posterior cavity of eye with air with the aim to drain the subretinal fluid (SRF) and achieve a flat retina. FAE is followed by endolaser to the retinal breaks.

It is also performed in cases of an attached retina:

- After vitrectomy for vitreous hemorrhage, a partial/complete FAE helps in tamponading the retina and prevention of rebleed
- After silicone oil removal, few cycles of FAE are performed to remove the residual silicone oil droplets to remove the residual silicone oil droplets.

### Technique of fluid air exchange

Three important things are to be ascertained before starting of FAE:<sup>[1-3]</sup>

1. Complete removal of vitreous at the edge of tears or posterior retinotomy (PR) is mandatory
2. Endocautery of edge of all the tears to facilitate in visualization and prevent excessive bleeding
3. Always check the air infusion pressure prior to starting it. It is generally kept at 30–35 mm Hg.

Flexible soft-tip cannulas are preferred over rigid cannulas for internal drainage of SRF because they can be angulated into the subretinal space and are less likely to damage the choroid.

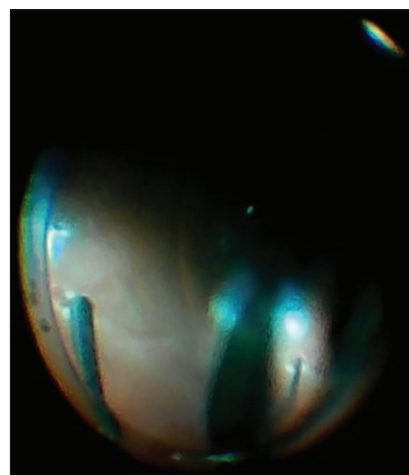
Air infusion is then switched on.

Air is then insufflated, and the air bubble is enlarged to fill the anterior vitreous.

When the globe is partially filled with air, one may get double reflexes, and it is necessary to refocus the microscope and maneuver the extrusion cannula over the break/PR.

The extrusion cannula is kept over the break/PR [Figure 1] and SRF will be removed as the eye fills with air.

The retina may not flatten initially because fluid from the vitreous cavity often goes through retinal breaks or through the PR into the subretinal space.



**Figure 1:** The extrusion cannula is kept over the retinotomy. The reflex from air is visible as it starts to fill the cavity

If difficulty is encountered in the initial part of the exchange and fluid cannot be aspirated while the silicone tube is in the subretinal space, the tube is withdrawn from the subretinal space and aspiration is applied in the vitreous cavity just anterior to the retinotomy. When the air level meets the PR, the silicone tip is gently slipped obliquely into the subretinal space, and aspiration is once more applied.

Care must be taken not to push the needle tip forcibly against the retinal pigment epithelium because choroidal hemorrhage may occur.

When the retina flattens posteriorly over the silicone tube, it is slowly withdrawn from the subretinal space while gently aspirating SRF.

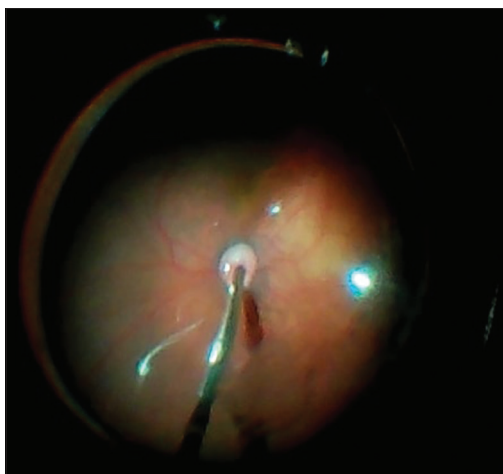
At this point, all or most of the SRF has been removed.

Residual fluid can be aspirated over the optic nerve to complete the FAE. It is done by plunging the tip of the extrusion cannula into the fluid meniscus over the optic nerve [Figure 2].

A bright reflex disappears as the needle tip enters the fluid meniscus; this reflex reappears as the fluid level drops below the needle tip during aspiration.

### Drainage from a peripheral break without liquid perfluorocarbon liquids

In rhegmatogenous retinal detachment (RRD), when the causative break is located at or posterior to the equator, endodrainage is usually done without perfluorocarbon liquids (PFCL).



**Figure 2: Residual fluid is aspirated by plunging the extrusion cannula into the fluid over the disc**

Putting the soft tip cannula under the detached retina helps in decreasing the posterior fluid.

Maneuvering the head position can be helpful.

#### **Drainage with perfluorocarbon liquids**

It is preferred in cases of bullous RRD or RRD that is associated with retinal breaks anterior to the equatorial zone.

It avoids the creation of PR.

The steps involved are:

- PFCL is injected up to the level of the posterior edge of the break
- Do not overfill as it risks the subretinal migration of PFCL
- The surface tension from the PFCL bubble displaces the SRF through the break
- Maneuvering the patients head might facilitate the SRF removal
- FAE with the soft-tip cannula positioned at the top of the PFCL bubble displaces peripheral (anterior) SRF through the break
- Once the fluid sandwiched between the PFCL and air is removed, the soft-tip cannula is then dipped into the remnant PFCL meniscus over the disc to completely remove it.

#### **Posterior retinotomy**

- The peripheral drainage retinotomy should be created in an area most accessible to the drainage instrument
- The best location is in the peripheral retina posterior to either the temporal or nasal sclerotomy
- This location allows direct access of the soft silicone tube of the silicone-tipped needle to the drainage retinotomy and points the silicone tube, when inserted into the retinotomy, toward the posterior pole

- If an encircling scleral buckle is present, the drainage retinotomy should not be made immediately posterior to the scleral buckle because, as the retina flattens, the retinotomy will become obscured by the buckle
- It is better to make the retinotomy over the posterior portion of the buckle, where it can be observed throughout the exchange.

#### **Difficulties encountered in fluid air exchange**

In pseudophakic eyes with posterior capsulotomy, intraocular lens (IOL) condensation may significantly impair visibility.

**Tip:** Coating the posterior surface of the IOL with a dispersive viscoelastic substance is the most efficient way to resolve this problem.

Corneal striate keratopathy or pupillary constriction can occur in the aphakic eye that can reduce visualization and interfere with FAE.

**Tip:** One can put dispersive viscoelastic substance behind corneal endothelium to improve visualization.

In the presence of ACIOL/large posterior capsule rent, air may try to come into the anterior chamber (AC) which will lead to impaired visualization.

**Tip:** AC may be filled with viscoelastic before starting of FAE which will push the iris back and prevent the air from coming into the AC.<sup>[4]</sup>

Decreased visibility can also occur when PFCL droplets are left behind which are seen as vapors.

**Tip:** Best option is to revert back to fluid and remove residual PFCL and drain SRF through the PR.

In cases of open globe injury, although rare, venous/pulmonary air embolisms have occurred.<sup>[5]</sup>

**Tip:** (a) Always check the infusion line placement into the vitreous cavity to avoid inadvertent suprachoroidal air infusion. (b) Perform a slow FAE with low infusion pressure. (c) Maintain stable blood pressure while preventing it to go too low.

#### **Financial support and sponsorship**

Nil.

#### **Conflicts of interest**

There are no conflicts of interest.

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Submitted: 27-Jul-2020 Accepted: 29-Jul-2020 Published: 23-Dec-2020

Access this article online	
<b>Website:</b> www.kjophthal.com	<b>Quick Response Code</b> 
<b>DOI:</b> 10.4103/kjo.kjo_111_20	

**How to cite this article:** Gujral GS. Basics of fluid air exchange in vitreoretinal surgery. *Kerala J Ophthalmol* 2020;32:284-6.