Most surgical subspecialties evolve to provide increasingly less-invasive approaches for patients. This trend often maximizes outcomes while minimizing patient recovery, surgical comorbidities, and cost. One of the common keys to success is appropriate patient selection.

Similarly, ophthalmic surgery is increasingly moving away from hospitals and into ambulatory surgical centers (ASCs). Although there are often improvements in efficiency and turnover time, ASCs quite frequently are limited in staffing for emergency night and weekend cases. Thus, surgeons are forced to seek alternate arrangements to perform emergent cases, such as macula-threatening rhegmatogenous retinal detachments.

These trends are reflected in the use of pneumatic retinopexy. Michael N. Cohen, MD, and Chirag P. Shah, MD, MPH, in this installment of Practical Retina, provide a timely review of successful pneumatic retinopexy. They provide their insights on appropriate patient selection, as well as tips and tricks for every step of the procedure to maximize outcomes. Lastly, they indicate when more-invasive approaches are needed. This review is sure to be of use for both newly minted ophthalmologists learning the technique to seasoned vitreoretinal surgical veterans who wish to pick up some pneumatic retinopexy pearls.

### PREOPERATIVE ASSESSMENT

#### Patient Selection

The preoperative steps taken during clinic are perhaps the most vital to securing good outcomes. Assessing the patient’s...
tolerability to scleral depression is the first clue of his/her ability to undergo the procedure. The necessity and overall duration of head positioning must be reviewed preoperatively. The patient must be physically and mentally able to position for at least several days, as a technically perfect procedure will surely fail without effective positioning of the gas bubble.

**Retina Selection**

A careful 360° scleral depressed exam must be performed to ensure the location of all breaks in detached retina, the presence of any other breaks in attached retina, and any areas of lattice or other potential sites of weakness or traction. In our practice, breaks in the superior half of the fundus (6 clock-hours) are ideal candidates for a pneumatic retinopexy. In the case of multiple breaks in detached retina, the greater the distance between the breaks, the less ideal the candidate. All breaks in attached retina must be treated with cryo- or laser retinopexy prior to performing pneumatic retinopexy. Areas of lattice degeneration in attached retina can be observed, but we recommend treating it prophylactically with cryo- or laser retinopexy. Although earlier studies reported better success in phakic patients compared to pseudophakic patients, presumed secondary to

---

**Figure 1.** A patient prepares for an intravitreal gas injection. While supine, have the patient oriented in this position, making the inferior limbus the highest point of the eye.
the presence of small, almost undetectable, pseudophakic breaks, recent reports suggest no difference in anatomic or visual outcomes. In our institution, inferior retinal breaks and persistent vitreous traction on a retinal tear are features ultimately predicting pneumatic retinopexy failure.

**PROCEDURAL PEARLS**

Almost universally, we perform cryoretinopexy and then pneumatic injection in sequence at the same setting.

**Patient Comfort and Positioning**

Allowing the patient to lay flat in a comfortable position with pillows to support the neck and legs helps to alleviate some of the anticipated anxiety. After applying topical anesthetic drops and several drops of povidone iodine 5%, we inject subconjunctival 2% lidocaine hydrochloride to both the areas of anticipated cryoretinopexy and intravitreal gas injection.

**Art of Cryoretinopexy**

Gentle cryoretinopexy treatment should be applied to the borders of each retinal break, with careful attention to the lateral horns. Treatment directly over the open bed of retinal pigment epithelial cells should be avoided in an effort to minimize liberation of pigment.

In cases of bullous detachments with marked subretinal fluid, it can be difficult to obtain cryoretinopexy uptake to retinal breaks. These situations can be approached in one of two ways. One can apply cryoretinopexy to the anticipated area of retinal pigment epithelium under the tear so that the tear will fall onto the treated area once the retina flattens. The second option is to consider a staged procedure, in which the paracentesis and pneumatic injection are performed first, followed within the next several days by application of cryoretinopexy or laser treatment.

It can be challenging to find retinal breaks once the retina flattens. Techniques to help find the flattened break include marking the site of the retinal break by

---

Figure 2. Five days after pneumatic retinopexy, a small, new retinal break was discovered temporally surrounded by fluid and was subsequently lasered. Five months postoperatively, the patient remains attached and is doing well.
at the ora serrata with laser prior to the injection of the gas bubble, careful depression with the cryoretinopexy probe (or a scleral depressor if using laser indirect ophthalmoscopy), and following a detailed drawing or wide-angle photograph from the preoperative visit.

**Always Tap First**

To avoid potentially dangerous elevations in intraocular pressure (IOP), we elect to perform an anterior chamber paracentesis prior to gas injection. We use a 30-gauge needle attached to a sterile 1.0 cc syringe with the plunger removed. Lens status determines how best to approach the paracentesis. In pseudophakic patients, we enter temporally, just anterior to the limbus. The needle is inserted bevel-up and advanced slightly toward the center of the anterior chamber. In phakic patients, we adopt an inferotemporal approach and advance the needle, bevel-up, over the iris toward the inferior angle. Using a sterile cotton tip to apply counter pressure to the limbus, we remove roughly 0.20 cc to 0.30 cc of aqueous.

**Injection of Gas**

A single, large gas bubble, best achieved by injecting at the highest point of the eye, is essential for obtaining ideal tamponade of the targeted retinal break(s). Almost all of our gas injections are done at the 6:00 position because the inferior retina is typically attached, minimizing the chance of penetrating detached retina. To make the inferior limbus the highest point of the eye, have the patient, while lying supine, lift his/her chin upward and roll his/her eyes toward the back of the head (Figure 1). The 30-gauge needle should be introduced into the vitreous cavity and pulled back slightly so that only a little more than the tip is inserted into the eye. Push initially with moderate force on the plunger, creating a small gas bubble at the tip of the needle. Complete the injection with slightly increased speed and force, injecting the remaining gas directly into the bubble. This should be completed in one smooth motion.

The most common complication from intraocular gas injection is the creation of “fish eggs,” or multiple small bubbles, which can interfere with visualization and sometimes migrate through a retinal break. If given appropriate time, these smaller bubbles will almost always coalesce. Position the patient either completely face-down or with the break toward the ground, so the gas floats away from the break for the first several hours. Then have the patient resume proper positioning for retinal tamponade.

Zonular weakness after cataract extraction, at times not visible at the slit-lamp, can also lead to migration of the gas bubble into the anterior chamber while the patient remains supine directly after injection. Often, immediate face-down positioning will allow the gas to return posteriorly to the vitreous cavity. If there is complete gas fill of the anterior chamber, causing pupillary block, an immediate anterior chamber tap is recommended to remove the anteriorly displaced gas. The insertion of a gas bubble can be reattempted with immediate upright or prone positioning after injection. In all such cases of zonular compromise, the patient should be warned of the signs and symptoms of pupillary block and the potential for elevated IOP.

Although both C3F8 and SF6 are available, our institution usually utilizes 100% SF6 with excellent results. Most frequently, we use 0.35 cc to 0.40 cc, or 0.1 cc more than the amount of aqueous removed during the anterior chamber paracentesis.
Post-Procedural Inspection

Upon completion of the procedure, one should ensure that the IOP is appropriate, the central retinal artery is perfused, and that the bubble is formed, and not fish-egged, in the vitreous cavity. If there are arterial pulsations at the optic nerve head, consider repeating an anterior chamber tap to lower the pressure.

POSTOPERATIVE GUIDANCE

Realistic Expectations

Patients should be informed that the first several hours are usually the most uncomfortable. Ocular surface irritation is best addressed with preservative-free artificial tears and an a lubricating ointment. Consider placing a patch for several hours. Also consider prescribing a topical steroid drop for patients undergoing cryoretinopexy.

Close Follow-Up

Postoperative examinations should continue to be meticulous, with close attention paid to the presence and location of residual subretinal fluid or any missed (or new) retinal breaks (Figure 2). When needed, an indirect laser ophthalmoscope allows for maximal manipulation of the gas bubble and easier application of laser treatment.

Most frequently, all of the subretinal fluid will be pumped out by the retinal pigment epithelium (RPE) within 24 hours to 72 hours, depending on how large and bullous the retinal detachment was at the time of pneumatic retinopexy. A combination of either thick subretinal fluid and/or a weak RPE pump can lead to persistent subretinal fluid despite closed retinal breaks. This persistent fluid can take days to weeks to resorb completely. It can be monitored for slow, steady improvement (Figure 3).

Don’t Hesitate to Rescue

Be prepared to head to the operating room earlier, rather than later, for a rescue procedure if the pneumatic retinopexy fails. A recent study from our institution found that the median time to failure was 6 days, with the majority of cases (80%) failing within the first month.7 Regarding which procedure to select after a pneumatic fails, this study also found a nonsignificant trend favoring buckle-vitrectomy over vitrectomy over repeat pneumatic.7

CONCLUSION

Used on appropriate candidates, pneumatic retinopexy can be an ideal means of reattaching the retina with excellent visual outcomes and quicker recovery than more invasive surgeries. We hope our recommendations will help the vitreoretinal surgeon avoid, and potentially manage, some pitfalls of pneumatic retinopexy.

REFERENCES


Michael N. Cohen, MD, can be reached at Ophthalmic Consultants of Boston, 50 Staniford Street; #600, Boston, MA 02114; or at the New England Eye Center at Tufts University School of Medicine, 800 Washington Street, #450, Boston, MA 02111; email: MichaelNCohenMD@gmail.com.

Howard F. Fine, MD, MHSc, can be reached at the Department of Ophthalmology, Rutgers University of Medicine and Dentistry of New Jersey; NJ Retina; 10 Plum Street, Suite 600; New Brunswick, NJ 08901; email: hfine@njretina.com.

Chirag P. Shah, MD, MPH, can be reached at Ophthalmic Consultants of Boston, 50 Staniford St., #600, Boston, MA 02114; email: cpshah@eyeboston.com.

Disclosure: Drs. Cohen and Shah report no relevant financial disclosures. Dr. Fine is a consultant and/or speaker for Alimera, Allergan, Genentech, Regeneron, and Spark Therapeutics and has equity/patent interests in Auris Surgical Robotics.