BILATERAL SUBCUTANEOUS EMPHYSEMA FROM PRESSURIZED INFUSION DURING PARS PLANA VITRECTOMY: A CASE REPORT

Baseer U. Ahmad, MD,* Mark R. Barakat, MD,* Marc Feldman, MD,† Rishi P. Singh, MD*

Objectives: To report a case of extensive subcutaneous emphysema introduced during vitrectomy while using an advanced feedback-controlled pressurized infusion system.

Methods: Clinical case report of a 56-year-old woman undergoing pars plana vitrectomy for rhegmatogenous retinal detachment of the left eye. The clinical and radiologic findings of the patient’s eyes were documented. The mechanisms of feedback-controlled pressurized infusion devices were reviewed to explain the adverse events. A search of PubMed was conducted to look for any similar cases and/or discussion.

Results: In this surgical case, vitrectomy was completed with air–fluid exchange and a formed anterior chamber was observed with an estimated pressure of high teens to low 20s by the surgeon. After the undraping, the patient was noted to have severe facial crepitus extending to the clavicles. Immediate chest X-ray was done, followed by computed tomography, confirming orbital and subcutaneous emphysema, as well as the presence of perfluoro-N-octane in the left orbit.

Conclusion: Integrated pressurized infusion devices using feedback sensors allow for a sophisticated method of maintaining intraocular pressure and globe formation. However, inadvertent or occult globe rupture may lead to disruption of feedback control and subsequent high rates of infusion. As the infused substances exit the site of rupture, they can lead to extensive extraocular gas or fluid accumulation, and we report a case of severe bilateral subcutaneous emphysema as a result.


From the *Department of Ophthalmology, Cole Eye Institute, Cleveland, Ohio; and †Department of Anesthesiology, Cleveland Clinic Foundation, Cleveland, Ohio

Case Report

A 56-year-old woman with no significant medical or ocular history presented with sudden onset of new floaters in the left eye and was found to have a superior retinal detachment involving the macula. A retrobulbar anesthetic block was performed, and she was taken to the operating room with the intention of performing pars plana vitrectomy, endolaser, external cryotherapy, and C3F8 16% gas injection.

Initially, the retinal tear was identified, and as the overlying vitreous was removed, a large amount of hemorrhage began and filled the vitreous cavity. The vitrectomy ports were plugged, and infusion pressure was increased to 60 mmHg for 2 minutes. Ports were then removed, and blood was noted in the anterior chamber. A corneal incision was made, blood was removed, and the posterior pole was reentered with replacement of the perfluoro-N-octane (PFO) and 59 spots of endolaser before the hemorrhage again became too dense. External cryotherapy was done followed by air–fluid exchange and C3F8 16% gas injection. Sclerotomies and overlying conjunctiva were closed. A formed anterior chamber was noted at this point.

On removal of the surgical drape, significant swelling of the skin overlying the bilateral orbits, face, neck, and chest was seen. In addition, severe subcutaneous crepitus of the bilateral upper and lower lid, facial, and neck subcutaneous was noted (Figure 1). A stat chest X-ray was performed without evidence of pneumothorax or tracheal shift. Subsequent computed tomographic scan of the neck showed diffuse air within the fascial planes of the bilateral
face, bilateral, anterior, and posterior cervical neck, and pneumo-
mediastinum. Computed tomography of the orbits also showed left 
intracocular and extraocular PFO and air, as well as mixed fluid 
density throughout the fascial planes of the face (Figure 2).

She was admitted overnight at this point for observation and 
discharged the following day. At 2-month follow-up, the crepitus 
had resolved and subsequent phacoemulsification, intraocular lens 
placement, scleral buckle, pars plana vitrectomy, and tractional and 
proliferative vitreoretinopathy retinal detachment repair were done without complication. At 6-month follow-up, best-corrected visual 
acuity was restored to 20/400 in the left eye.

**Discussion**

The basic equipment required for pars plana 
vitrectomy includes a vitrectomy machine, a light 
source, an air pump, a lens viewing system, and an 
operating microscope. All vitrectomy machines 
share some basic components, including the focus of our case (the infusion system), which allows control 
of intraocular pressure (IOP) during surgery.

In the past, infusion systems used either gravity-
based or gas-forced infusion. In gravity systems, the instilled substance was introduced at a pressure dictated by the height of a bottle of balanced salt 
solution above the patient. More recent gas-forced infusion systems have used either an internal or external air pump with mechanical pressure measure-
ment to maintain IOP during surgery. In the newest 
systems, electronic feedback mechanisms are used to control infusion rate to maintain the specified target 
IOP. In the latter, IOP is a set target, whereas the 
infusion rate required to maintain the desired IOP is variable.

In the case we report, globe rupture clearly occurred as evidenced by the finding of characteristic radi-
opaque extraocular PFO. We propose several mech-
anisms, including globe perforation, rupture of 
a staphyloma, and ocular explosion. Despite the rare 
occurrence of globe perforation during retrobulbar anesthesia (<0.1%), it is a well-recognized adverse 
event and the most likely in our patient’s case given the increasing rarity of alternate explanations.

Such other possibilities include malfunction of the vitrectomy system pressure sensor with subsequent 
continued infusion until rupture of a posterior staph-
yloma or ocular explosion occurred. However, no 
evidence of staphyloma was seen on initial or 
subsequent dilated fundus examinations and therefore 
would be unlikely. Finally, an ocular explosion would be particularly unlikely as IOPs of >2,800 mmHg 
were found necessary before rupture occurred in an 
experimental series, and the infusion port would have 
become dislodged long before such a pressure could 
be attained.

In this case, after the undetected globe rupture, pars 
plana vitrectomy was done according to standard 
methods: removal of vitreous followed by infusion of 
PFO, laser application, air–fluid exchange, and finally

Fig. 1. Postsurgical photograph illustrating subcutaneous emphysema.

Fig. 2. Left intraocular and extraocular PFO on computed tomography of head.
air–gas exchange. We propose that the undetected globe rupture allowed an exit site for extraocular spread of each of the infused substances (PFO, air, and finally C$_3$F$_8$). Because the vitrectomy infusion system was designed to maintain the desired IOP, we believe that infusion was continued but unable to elevate the IOP to the desired set point because of exit from the rupture site. Consistent with our speculated mechanism, extensive subcutaneous emphysema was seen at the conclusion of surgery, confirmed by further computed tomographic imaging, and the presence of radiopaque orbital PFO was also observed at that time.

In summary, we propose that an inadvertent or occult globe rupture may lead to disruption of feedback control in integrated vitrectomy infusion systems with subsequent high rates of infusion. As the infused substances exit the site of rupture, they can lead to extensive extraocular gas or fluid accumulation. Subcutaneous and orbital emphysema generally follow a benign course, and intraorbital PFO is likely to be well tolerated as well given its benign nature within the eye. However, we think that this mechanism of accumulation represents a novel complication of vitrectomy of which the retinal surgeons should be aware. If such a complication is encountered or suspected, it is advisable to disengage automated IOP control, switch to gravity-based infusion, and then carefully examine and repair any rupture site in addition to the original surgical repair.

**Key words:** vitrectomy, emphysema, pressurized infusion, orbital, perfluoro-N-octane, PFO, complication.

**References**