



## Severe Intra-Ocular Pressure Rise After Uneventful Pars Plan Vitrectomy with Gas Tamponade due to a Technical Mistake

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### Abstract

**Introduction:** To describe an important technical mistake in gas dilution procedure with air to use as tamponade after vitrectomy.

**Patient and Clinical Findings:** This case series reports severely increased intra-ocular pressure (IOP) after three uneventful 23 gauge pars plana vitrectomy (PPvitx) and gas tamponade.

**Diagnosis, Intervention, and Outcomes:** After long hours of thinking, speaking, checking the instruments and checking different steps of gas preparation for exchange, we concluded that there was a problem with method of dilution of gas in these three cases by the same surgical aid. In all three cases, a subtle technical mistake in gas preparation concluded in high concentration of introduced gas in to eye. All cases showed dramatic final outcomes due to severely increased IOP in first pre-operative days.

**Conclusion:** Very higher concentration of gas (near 100% concentration) was introduced to eye when syringe was first filled with air and then with gas. This subtle technical point seems to be very important and all retinal surgical aids should be informed and warned about serious complications of missing it.

**Keywords:** IOP Rise; Gas Tamponade; Vitrectomy; SF6; C3F8; Dilution Technique

### Introduction

We decided to use the opportunity to describe an important point in gas dilution procedure with air to use as tamponade after vitrectomy. A technical mistake that happened in our center with dramatic consequences is described here to make other surgeons and surgical technicians notice the importance of it to avoid similar problems. This case series reports severely increased intra-ocular pressure (IOP) after three uneventful 23 gauge pars plana vitrectomy (PPvitx) and gas tamponade due to a technical mistake in gas preparation.

### Patient consent statement

This manuscript does not include any identifying information from the patients. The study adhered to the tenets of the Declaration of Helsinki.

### Case Presentation

#### First case

First case was a 50 year old female with rhegmatogenous retinal detachment (RRD) who underwent pars plana vitrectomy (PPVitx) with 13% perfluoropropane (C3F8) as tamponade. Air was re-

placed with C3F8 at the end of surgery using a 20 ml syringe filled with 13% C3F8 from inflow port after removing one trocar and leaving the other for air exit. The morning after surgery IOP was normal but one day later patient returned with severe eye pain and nausea due to elevated IOP up to 50 mmHg. At the operation room 1.5 ml gas was removed from the globe with 27 gauge needle, 3mm from the limbus slowly in about 4 minutes to relieve her high IOP. To our surprise, patient returned the following day with elevated IOP (about 50 mmHg) and gas was removed from vitreous cavity in the same manner. At the table, his tactile IOP reached to about 10 mmHg. Unfortunately, the next day IOP was high again and we repeated the same procedure. This course leaved us frustrated and worried about the risk of redetachment due to tamponade removal.

In follow up visits even after 6 months, retina remained attached but unfortunately, we were faced with an atrophic optic disk due to IOP rises. One of known complications of C3F8 gas tamponade is elevated IOP, but this much IOP rise needing multiple gas removal was insane and we had never such an experience before. In our center perfluoropropane (C3F8) and Sulfur hexafluoride (SF6) are commonly used as tomponade after Pars Plana vitrectomy (PPvitr) with few cases of subtle IOP rise managed by topical anti glaucoma. Greatly to our surprise we had another patient with IOP rise after SF6 tamponed in a few days.

### Second case

Second case was a 61 year old woman with macular hole that underwent pars plana vitrectomy, internal limiting membrane peeling and 20% SF6 gas tamponade. The morning after surgery everything was almost normal but the following day we noticed a severe IOP rise and anterior chamber was flat. We removed gas as mentioned before. After total 3 times of gas removal, at the end of first month of surgery patient had severe iris atrophy, corneal edema due to endothelial cell loss and hypotonia due to ciliary body shut down after severe IOP rises. Macular hole was closed but with optic disk atrophy and this dramatic clinical picture.

### Third case

Third case was a 56 year old female RRD in same pattern of the first case, but the patient home town was so far from our center, so she returned with one week delay after her eye pain and nausea. C3F8 was used for this patient and after multiple gas removal

in first 2 weeks, IOP was about 35 mmHg that three topical anti glaucoma medications were needed for IOP control. Interestingly even 60 days after surgery, gas remained in almost 90% of vitreous cavity.

### Discussion and Conclusion

We started to investigate the cause of this problem in our center. After long hours of thinking, speaking with technicians and operating room staff, checking the instruments and checking different steps of gas preparation for exchange, we concluded that there was a problem with method of dilution of gas in these three cases by the same surgical aid. Our routine way to dilute C3F8 with air is filling 2.6 ml of a 20 ml syringe with C3F8 and then diluting remaining syringe space with air that leaves 13% concentration C3F8 ready for exchange. The similar approach is used for SF6 dilution. Filling 4 ml of a 20 ml syringe with SF6 and then filling the remaining space of 20 ml syringe with air producing 20% concentration of SF6. As a routine, always gas was introduced to the syringe firstly and afterward it was diluted with air.

After searching for the reason and asking the operation room staff, it cleared that sometimes air was introduced to the syringe firstly. In the case of C3F8, first 17.4 ml of syringe was filled with air and then the remaining was filled with C3F8. C3F8 is introduced to syringe using a maintainer capsule of 100% C3F8. At first glance, everything seems right because the percentage of gas is the same but the problem is introducing gas after air to the syringe can cause near total replacement of 20 ml syringe space with 100% gas due to high positive pressure of gas. In other words high pressure C3F8 in capsule compresses air in the syringe, so more than anticipated gas is introduced to syringe leaving our syringe with higher concentration of gas (near 100%) that expands in the following days and causes severe IOP rise. Air does not have this active positive pressure and because of this, it seems critical to dilute gas by air and introduction of air should always be "after" gas.

It was interesting that after first gas removal of near 1.5 ml, we needed to repeat gas removal up to 3 times in all of cases. The reason was that there was a near 100% concentration of gas in their globes and the remaining part of gas expanded constantly. It has been shown that 100% C3F8 can expand up to near four times of its initial volume over 4 days and can be present even after 35 days. 100% SF6 also can expand up to near 2 - 2.5 times its initial volume over 2 days [1,2]. The most common cause of postsurgical

IOP elevation is high gas concentrations. Other possible risk factors include decreased ocular elasticity due to advanced patient age or concomitant circumferential scleral buckling. Decreased outflow by increased episcleral venous pressure can be another mechanism in patients with scleral buckling [3]. Fang, *et al.* in a recent study have shown patients whose tamponade was provided by C3F8 or silicone oil can experience an elevated IOP more than 3 months after their PPVtx (even up to one year after surgery) [4].

As conclusion, very higher concentration of gas was introduced to eye when syringe was first filled with air and then with gas. This subtle technical point seems to be very important and all surgical aids should be informed and warned about serious complications of missing it. Another possible solution could be to encourage companies to make pre-prepared concentrations of these tamponade gases.

## Value Statement

### What was known

- Vitreoretinal surgeons commonly admit to have problems with exact gas concentration.
- During PPVtx, we need to dilute expandable gases before injecting into the eye ball to avoid IOP rise.

### What this paper adds

- High pressure gases in the capsule compresses air in the syringe, so more than anticipated gas is introduced to syringe leaving the syringe with higher concentration of gas (near 100%) that expands in the following days and causes severe IOP rise.
- Air does not have this active positive pressure.
- It seems critical to dilute gas by air and introduction of air should always be “after” gas.

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