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Пневморетинопексия: клиническое исполнение и осложнения

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Pneumatıc Retınopexy; Clınıcal Management and Complıcatıons

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РЕФЕРАТ

Пневморетинопексия (ПР) – малоинвазивная, безоперационная процедура для восстановления отслойки сетчатки. Данная процедура включает в себя введение расширяющегося газа и применение криотерапии или лазерной фотокоагуляции для закрытия разрывов сетчатки. Это важный инструмент в арсенале витреоретинального хирурга, дающий хорошие результаты. Относительная простота, дешевизна, благоприятные показатели анатомического успеха и низкая частота осложнений побудили авторов выступить за использование ПР в отдельных случаях отслойки сетчатки. ПР была впервые описана Хилтоном и Гриззардом более 30 лет назад и на сегодняшний день широко распространена для лечения отслойки сетчатки в большинстве стран мира. В статье подробно рассмотрены показания, противопоказания, преимущества, недостатки и техника выполнения ПР.

Ключевые слова: *пневморетинопексия, отслойка сетчатки, минимально инвазиная процедура.* ■

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ABSTRACT

Pneumatic retinopexy (PR) is a minimally invasive, non-incisional procedure for repairing retinal detachment. It consists of injecting an expandable gas and applying retinal cryotherapy or laser photocoagulation to seal retinal breaks. It is an important tool in the armamentarium of the vitreoretinal surgeon, yielding good results in carefully selected patients. The relative simplicity, costeffective, favorable anatomic success rates, and low complication profile let the authors to advocate use of PR in selected RRD cases. PR was described first by Hilton and Grizzard more than 30 years ago and now represents commonly performed intervention for RRD in most parts of the world.In this review, contraindications, advantages, disadvantages and surgical procedure of PR are discussed in detail.

Key words: *pneumaticretinopexy; retinal detachment; minimally invasive procedure.* ■

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INTRODUCTION

Pneumatic retinopexy (PR) is a minimally invasive procedure for repairingrhegmatogenous retinal detachment (RRD) [1]. This technique tends to inject an expandable gas and applying retinal cryotherapy or laser photocoagulation to seal retinal breaks [1]. This surgery remains a useful officebased procedure for treating certain types of primary RRDs and has single-surgery success rates ranging from 45-90%, depending on the surgeon and cases selected [2-4].

Surgical options available for regmatogenous retinal detachment include pars plana vitrectomy (PPV), scleral buckling and pneumatic retinopexy as a stand-alone procedure or with one or more other combinations [5]. Each of these three techniques has its own advantages and disadvantages. Scleral buckling is a best surgery technique for retinal breaks in the same meridian and multiple quadrants, especially the inferior quadrants. Its main complications are chronic persistent diplopia, conjunctival scars and inductive refractive disorders. With the advent of sutureless microincisional PPV, many of these issues are avoided [4]. PPV is mostly preferred when the retinal breaks are large, posterior and generally located in the multiple quadrants. It is a good option in pseudophakic patients, as it often leads to the development of cataracts. Unlike PPV, cataract formation after pneumatic retinopexy is rarely observed [5, 6]. PR can avoid all of these complications and still successfully reattach a detached retina with a good final visual results for selected patients.

PR was first described by Hilton and Grizzard in 1986 and has subsequently been well studied as a primary treatment, as well as a rescue treatment in patients with failed primary RD surgery [7]. In fact, in 1982, Linkoff applied the Xenon gas, which was rapidly absorbed for the first time, intravitreally, and published that the sub-retinal fluid

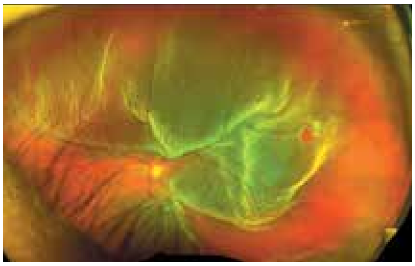

Fig 1. Uncomplicated RD with retinal breaks in the 8 clock hours and sufficiently clear media

was absorbed and the detachment subsided with the appropriate position [8].

There are many studies on the possible indications and relative contraindications for PR [9, 10]. Ideal case selection typically includes uncomplicated RDs with retinal breaks in the superior 8 clock hours or multiple superior breaks confined to a single clockhour of the retina and sufficiently clear media *(Fig. 1)*. Patients are required to be positioned after the procedure. Discomfort is minimal, diplopia does not occur at any stage, and cataract formation is not one of its common complications. Its other main advantage over scleral buckling and PPV is that it can be performed as an office procedure, just like any intravitreal injection that retinal surgeons commonly administer in the treatment of macular degeneration [3, 4, 11].

In the literature, 40% of all rhegmatogenous retinal detachments can be repaired using pneumatic retinopexy [12-14]. The reasons for underutilization of pneumatic retinopexy include the belief that it does not relieve vitreoretinal traction, the need for skillful use of indirect ophthalmoscopy in retinal break detection and that more preoperative time is required for thorough examination of the retina to find retinal breaks and to prepare and educate patients. However, PR is a well tolerated, effective, and less invasive way to reattach the retina than traditional surgery. PR is more economical than scleral buckle or vitrectomy and avoids complications associate with scleral buckling or vitrectomy procedures. Case selection for pneumatic retinopexy is important in achieving good outcomes, and the procedure works best for detachments with small retinal breaks located in superior quadrants.

Clinical indications and patient selections

The ideal patients are those with the following: one break or a group of breaks within 1 clock hour and retinal breaks involving the superior 8 clock hours of the fundus without severe PVR. Phakic patients undergoing pneumatic retinopexy tend to do better than those who are pseudophakic or aphakic [3, 15, 16]. Chan et al. supported that phakic patients have a single operation success rate of between 71% and 84%, whereas pseudophakic patients have a success rate of 41%–67% [1]. The outcomes of phakic patients undergoing PR are more satisfying because of aphakic and pseudophakic eyes are more prone to tiny large retinal breaks in the far periphery, or in multiple quadrants [4, 17]. On the other hand, one-year results from the PIVOT trial showed that there was no statistically signifcant difference in outcomes between phakic and pseudophakic eyes, with both groups achieving a final reattachment rate of 99% after further vitrectomy or scleral buckling surgery [9].

Pneumatic retinopexy is a desirable procedure in certain patients who would be unsuitable for placement of a scleral buckle. Patients with a single break under the superior rectus would be at risk of iatrogenic vertical diplopia following placement of a segmental buckle [18]. Pneumatic retinopexy would obviate this risk. Patients with comprised conjunctival or scleral integrity may also be better candidates for pneumatic retinopexy than scleral buckle. This includes patients who have previouslyhad a glaucoma fltering procedure, thin sclera, previous strabismus surgery or pre-existing conjunctival scarring.

A relatively new indication is the use of pneumatic retinopexy following recurrent retinal detachment after scleral buckling or PPV [19]. Successful retinal reattachment with pneumatic retinopexy in eight out of 10 such reported cases showed that an office procedure can salvage a successful retinal reattachment outcome and thus avoid the need for more extensive subsequent surgery such as scleral buckling revision or PPV. Other 'expanded' indications for pneumatic retinopexy now include cases with retinal breaks in the inferior 4 clock-hours large retinal breaks between 2,5 and 6 clockhours in size and even giant retinal tears or dialysis [14, 20]. A novel approach that combined pneumatic retinopexy with the temporary insertion of a removable scleral explant for retinal detachment caused by inferior retinal breaks showed retinal reattachment in 87,9% [21].

Examination findings and Outcomes

Important biomicroscopic examination findings must be checked include conjunctival integrity in the area to be used for gas injection, clarity on the visual axis (to obtain the number, size, and location of all the retinal breaks), anterior chamber depth (to permit safe paracentesis for pressure control), and lens or intraocular lens status. The full extent of subretinal fluid accumulation, and the presence of retinal breaks or lattice degeneration in areas of attached retina must be evaluated and these areas should be treated with laser before intraocular gas injection. Macular pucker, fixed retinal folds, subretinal scar tissue complexes should be diagnosed before PR, because cases with PVR are much less likely to succeed with pneumatic retinopexy [22].

A review of 81 studies including 4138 eyes undergoing primary PR revealed a single operation success rate of 74,4% in phakic and pseudophakic patients and a final success rate of 96,1% after further scleral buckling or vitrectomy procedures [1]. Superior visual acuity outcomes may still be achieved in cases with expanded indications for pneumatic retinopexy, although modifcation of the standard technique may be required [23, 24]. Tornambe et al. compared PR and scleral buckling revealed that postoperative visual acuity through 6 months and they observed that visual acuity of 20/50 or better was achieved in 80% of PR cases versus 56% of scleral buckle procedures [14]. Visual rehabilitation was also signifcantly faster in the pneumatic retinopexy group. In the PIVOT trial, patients who underwent PR had gained 4.9 more ETDRS letters at 1 year than vitrectomized eyes. They supported that PR should be considered the first line treatment for RRD in selected cases and PR offers superior visual acuity, less vertical metamorphopsia, and reduced morbidity when compared with PPV [9].

Pneumatic retinopexy techniques and intraoperative complications

Initiallythe anesthetic eye drops were dropped and 2–5 min after then subconjunctival lidocaine injection were done. An eyelid speculum is inserted and a drop of povidone 5% is then instilled into the conjunctival sac, especially over the area of the intended injection site. There are a number of alternative methods of achieving anesthesia and asepsis. For control of intraocular pressure before gas injection, anterior chamber paracentesis is performed with a 27-gauge needle. A safe location is at the inferotemporallimbus because this allows a long distance for the needle to enter the anterior chamber and still be protected from puncturing the lens or iris. Some retinal specialists measure the amount of aqueous removed and aim for about 0,2–0,3 ml. Once the globe becomes noticeably soft, the paracentesis needle is withdrawn. This step of softening the globe before injection of gas also serves to increase the likelihood of injecting a single gas bubble.

The choice of where to make the gas injection varies. We prefer injecting the gas at the 6 o'clock position 4 mm posterior to the limbus in phakic patients and 3,5 mm posterior to the limbus in pseudophakia. The patient then looks up and the 30-guage needle passes through conjunctiva and sclera and about 2–3 mm into the vitreous cavity. The injection is made using a slow continuous movement on the syringe plunger so that a gas bubble develops at the tip of the needle in the vitreous cavity and the needle remains in the bubble as it expands with more gas generally and avoids «fish-egg» gas bubbles. This ensures that a single bubble is obtained. An alternative site commonly used is the infero-temporal quadrant, away from the most bullous portion of the retinal detachment so that accidental injection of gas into the subretinal space is avoided. The needle remains in the eye for a few seconds after the gas has been injected. The needle and syringe are removed in a quick movement to allow the external puncture opening to self-seal and thus prevent any gas from escaping from the vitreous cavity. Some surgeons use a sterile cotton-tipped applicator to immediately massage the puncture site and avoid gas leakage.

We routinely useperfluoropropane (C3F8) for gas endotamponade followed by anterior chamber paracentesis. The gas bubble must be positioned correctly and should remain in the eye for long enough to close retinal breaks and facilitate resorption of subretinal fluid while chorioretinal adhesion occurs. Sulfur hexafluoride (SF6) and perfluoropropane (C3F8) are generally the preferred agents [25]. Filtered air is a non-expansile gas that is typicallyabsorbed after 3 days so, it may not be appropriate in some cases. The success rate for pneumatic retinopexy with fltered air has been reported as 85,7%–86,7% [26]. Air is readily accessible, cheap and may be less toxic than SF6 and C3F8 but anatomical succes rates are higher in expandile gasses [27]. The retinal breaks were treated with laser photocoagulation. Patients were instructed in the use of the steamroller maneuver, sent home for appropriate positioning, and returned in 1–2 days for follow-up evaluation. Cryo is often used in RRD cases by some retinal surgeons, Stewart et al. supported that cryopexy facilitates a one-step procedure and is well tolerated by patients. They argued that cryopexy is technically easier for peripheral breaks, especially for small or hardto-fnd breaks, compared to laser [28]. We prefer laser photocoagulation to achieve retinopexy because it avoids re-detachment. We performed laser retinopexy 24–48 hours after gas injection, when the neurosensory retina is apposed to the retinal pigment epithelium *(Fig. 2)*.

Intraoperative complications are usually linked to the IOP rising or misdirection of the injected gas. IOP falls toward baseline within 30–60 minutesof gas injection and typically does not rise again during the postoperative period [29]. Given the pressure spike during gas injection, it is important to visualize the optic nerve after gas injection and perform a paracentesis if the central retinal artery pulsation is absent.

The other essential and current intraocular complication is gas entrapment in pre-hyaloid space. Injected gas may track into the canal of Petit, which is the potential space between the anterior hyaloid, and the pars plana epithelium, creating the «sausage sign» [18, 30]. If there is a large amount of gas trapped, additional maneuvers are necessary to relocate the bubble. Facedown posturing within the frst 24 hours postoperatively should allow the expanding bubble to break through the anterior hyaloid face and move toward the posterior pole. Iatrogenic macular detachment can be induced if there is inferior displacement of subretinal fluid toward an attached macula or inferior breaks in attached retina. Tornambe described the steamroller maneuver, which can be used to prevent this complication [3].

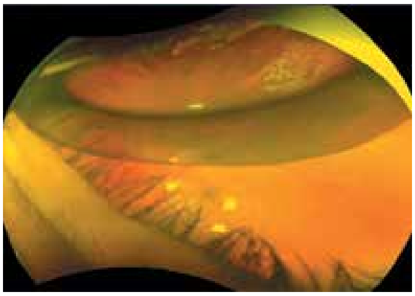

Fig. 2. Laser photocoagulation afterretinopexy (white spots), neurosensory retina is apposed to the retinal pigment epithelium

Postoperative complications

The most common complications after surgery are surgical failure, new or missed breaks, PVR, cataract, endophthalmitis, macular hole, cystoid macular edema (CME), gas under the retina, recurrent retinal detachment, epiretinal membrane, haze in vitreous, increased intraocular pressure, central retinal artery occlusion, suprachroidal gas, ischemic optic neuropathy. New or missed breaks can be observed after PR. In fact, it is important to distinguish between a new break and an missed break. If the retina has never attached and a break was detected in the detached area during reoperation, it has been more appropriate to call it 'missed break'. New breaks tend to be located in the superior retina, and approximately half are within 3 clock hours of the primary breaks [31]. Careful examination during the early postoperative follow-up period is necessary. In the literature, there are many cases showed that new retinal detachments may be managed successfully with repeat pneumatic retinopexy [32]. Giant retinal breaks have been reported following pneumatic retinopexy, but are rare [33]. Tornambe et al found that, for a series of 302 patients, the failure rate after a single operation was 32% [34]. In this group, factors predictive of failure included pseudophakia or aphakia, the extent of retinal detachment and the number of retinal breaks. Studies have found that the most common cause of re-detachment is the formation of a new break with associated subretinal fluid [35, 36]. New breaks tend to occur during the first postoperative month and are likely related to an evolving posterior vitreous detachment.

PVR is perhaps the most challenging complication in retinal detachment surgery. The reported incidence of PVR following pneumatic retinopexy ranges from 3% to 9,8% [14, 34, 37]. Re-detachment that is complicated by PVR typically warrants pars plana vitrectomy and membrane peeling. Gas migration into the anterior chamber has been reported in phakic eyes following pneumatic retinopexy, and this can cause elevated IOP [38, 39]. Zonular dehiscence is thought to allow pre-hyaloidal gas to track into the anterior chamber. Paracentesis can be performed to evacuate this gas.

The cataract is an uncommon complication of pneumatic retinopexy [14, 34, 40]. In Tornambe's multicenter randomized controlled trial of PR versus scleral buckling, looking at 198 eyes with at least 6 months follow-up, only 1 of the 103 eyes undergoing pneumatic retinopexy was noted to have developed cataract postoperatively. Two-year follow-up data for this cohort found progressive lens opacity in 19% in the pneumatic retinopexy group compared to 47% in the scleral buckle group, with 4% and 18% of eyes undergoing cataract surgery, respectively. A retrospective study of 193 eyes found a rate of cataract progression of 42% following small gauge pars plana vitrectomy, compared with 7% for pneumatic retinopexy [6]. Mougharbel et al. supported that no cataract progression were obtained during 24 months postoperative follow-up in a smaller prospective study [41].

After the PR, endophthalmitis is rare [37, 42]. Infection can be treated with intravitreal antibiotics, although persistent retinal detachment in the setting of endophthalmitis will likely require further PPV. The development of macular holes has been reported following PR and may occur in ~1% of cases [43]. It is thought that this occurs as a result of dynamic changes in pre-existing vitreomacular traction, triggered by intraocular gas injection. These macular holes can be successfully managed by PPV [44]. An observational study revealed CME to be angiographically evident in 11% of patients undergoing pneumatic retinopexy versus 29% of scleral buckle patients [11]. CME was more common in patients with a macula-off detachment and in those who were pseudophakic. The development of CME had a detrimental effect on the visual outcome.

Miscellaneous situations

Repeated PR is challenging situation in surgical failure. Vidne Hay et al. evaluated the visual and anatomical outcomes of reoperations following failure of PR and compare the different surgical techniques used in a current study.They found that in 79,8% eyes, the retina was reattached with one additional procedure. The success rate was significantly lower in eyes treated by repeated PR than by other surgical techniques (33% vs. 76–90%). PR failure was not associated with visual acuity loss, and the outcomes in 79,2% of cases that required only one additional surgery are comparable with those achieved with primary surgery [45].

PPV in young patients is challenging in these cases because of firm vitreoretinal adhesion of the posterior hyaloid, and poses a signifcant risk of presenile cataract. RRD in young patients is generally associated with trauma, myopia, aphakia and retinopathy of prematurity. A study of 19 eyes of 19 patients younger than 20 years of age revealed a primary success rate of 84% for pneumatic retinopexy, which is comparable to outcomes in adults [46]. In the literature, cases of bilateral PR were reported. Kerimoglu et al. have been reported that bilateral RRD can be treated with PR [47]. These patients can undergo simultaneous bilateral PR, and the possibility of faster visual rehabilitation may offer a particular advantage in these patients [48, 49].

PR may be a useful adjunct in cases of retinal detachment which are complicated by lower intraocular pressure and choroidal detachment [50]. Treatment of the hipotony and reduction of the extent of detachment facilitate sooner defnitive surgery than would usually be feasible.PR has been used to retinal detachments with several other retinal comorbidities such as choroidal coloboma [51].

CONCLUSION

In summary, PR is a minimally invasive and cost-effective technique for the initial management of RRD that provides rapid visual rehabilitation when used in appropriate cases. In cases where it is not successful, it is possible to increase the result success with additional surgeries performed early. Each patient should be evaluated according to his / her own characteristics and it should be remembered that when used, it has a great advantage for both the practitioner and the patient.

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