Air Pump for Retinal Detachment With Macular Hole

Chiaki Takenaka, MD  
Hidenao Ideta, MD  
Ken Watanabe, MD  
Junji Nakatake, MD  
Kouichi Shinagawa, MD  
Seiji Demizu, MD

ABSTRACT
From 1984 to 1992, 128 eyes with substantial retinal detachment due to macular hole underwent vitrectomy at the Ideta Eye Hospital. In the first 76 eyes treated, air was injected by syringe after removal of the vitreous (group A); in the subsequent 52 eyes, air was injected by a pump while subretinal fluid was aspirated through the macular hole (group B). The rates of retinal reattachment after the first surgery were 63.2% in group A and 82.7% in group B (P < .05). Thus, using the air pump was more effective than air injection.

Treatment of retinal detachment with macular hole has changed greatly in the past decade. Macular buckle had been the main technique before 1982; in that year, Gonvers and Machemer described using vitrectomy for the condition.1 In 1984, Ideta et al first reported a technique involving neither macular buckle nor vitreotomy: namely, air injection following external drainage of the subretinal fluid and external thermal retinopexy.2 In 1984, Miyake reported simple gas injection with or without drainage and without thermal retinopexy.3,4 In the same year, Blodi and Folk described a similar technique, involving anterior chamber paracentesis.5 Since then, gas tamponade with or without vitrectomy has become the most popular technique for the treatment of retinal detachment due to macular hole.6-9

In our hospital, vitrectomy has been the standard treatment for this condition since 1984. We adopted this policy, since placing a macular buckle at the posterior pole is difficult, and suturing a thin, staphylomatous sclera is risky. During the first 6 years in which we performed vitreous surgery, we simply injected air into the vitreous cavity with a syringe after removing the vitreous gel. But over the past 3 years, to reattach the retina during the operation, we have positively drained the subretinal fluid through the macular hole using an air pump. The present study was done to determine which procedure affords better reattachment.

MATERIALS AND METHODS
From 1984 to 1992, 128 eyes with substantial retinal detachment due to macular hole underwent vitrectomy at Ideta Eye Hospital. Cases of age-related macular hole with a narrow collarette of detachment around the hole were not included. Also excluded were eyes with a history of eye surgery and eyes with retinal vascular diseases, uveitis, trauma, and other peripheral breaks.

We compared two groups. The first group comprised 76 eyes (seven men and 69 women) that underwent vitrectomy between 1984 and 1989. The average age of the patients was 64.2 years (range, 45 to 86 years) (group A). The second group comprised 52 eyes (three men and 49 women) that underwent vitrectomy between 1990 and 1992. The average age was 61.9 years (range, 35 to 82 years) (group B).

In the first group, after removal of the vitreous gel and cortex, minimum endodiathermy was applied at the macular hole edge. Then, through a syringe attached to

From Ideta Eye Hospital, Kumamoto, Japan.
Presented at the Scheepens International Society Meeting, “Recent Advances in the Research and Management of Vitreoretinal Disorders,” March 30 to April 2, 1993, Hong Kong.
Reprint requests should be addressed to Chiaki Takenaka, MD, Ideta Eye Hospital, 1-35 Gofuku-machi, Kumamoto City, 860, Japan.
the infusion tube, 2 to 3 mL of air was simply injected into the vitreous cavity while the vitreous fluid was aspirated with a cutting probe (Fig 1).

With this procedure, retinal detachment remained at the end of surgery. However, if the patient kept a prone position, in most cases, the retina reattached within 1 day after surgery. In the second group, after removal of the vitreous gel and cortex and the application of endodiathermy at the hole edge, the subretinal fluid was actively drained through the hole with an extrusion needle, while air was pumped in at a pressure of 30 to 35 mm Hg. With this procedure, retinal reattachment was usually obtained at the end of the operation (Fig 2). After both procedures, the patients were kept in a prone position for 1 hour at least six times a day for 5 to 7 days.

### TABLE

<table>
<thead>
<tr>
<th>Restachment Rate of Each Group</th>
<th>Group A (76 eyes)</th>
<th>Group B (52 eyes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial surgery</td>
<td>63.2%</td>
<td>82.7%*</td>
</tr>
<tr>
<td>Subsequent surgery</td>
<td>34.2%</td>
<td>13.5%</td>
</tr>
<tr>
<td>Final surgery</td>
<td>97.4%</td>
<td>96.2%</td>
</tr>
</tbody>
</table>

*chi-square; P < .05.

### RESULTS

The reattachment rate at more than 3 months after initial single surgery was 63.2% for group A and 82.7% for group B, a statistically significant difference (Table).

As for reoperation techniques, in group A, two eyes underwent vitrectomy to remove remaining vitreous gel or cortex; 10 eyes, air injection; 6 eyes, photocoagulation at the macular hole; 9 eyes, peripheral scleral buckle; 18 eyes, macular buckle; and 1 eye, silicon oil use. In group B, 2 eyes underwent vitrectomy; 4 eyes, air injection; 2 eyes, SF6 injection; 4 eyes, photocoagulation; 1 eye, peripheral scleral buckle; 2 eyes, macular buckle; and 1 eye, silicon oil use.

Reattachment was obtained in 26 (34.2%) of the eyes in group A, and in 7 (13.5%) eyes of group B. The mean number of operations was 1.61 for group A and 1.31 for group B. The retina was finally reattached in 97.4% of the eyes in group A and 96.2% of the eyes in group B.

The two eyes that failed to obtain reattachment in each group were: one eye with reattachment by silicon oil use, which we regarded as a failure; and one eye for which the patient refused further surgery.

The scatter diagram shows preoperative and postoperative visual acuities (Fig 3). In many cases, acuity increased, but in no case to more than 0.2; postoperative acuities under 0.01 were few.

### DISCUSSION

The purpose of vitrectomy in treating retinal detachment with macular hole is to remove the vitreous cortex and gel. If some vitreous cortex remains attached to the retina, reattachment is less likely. The 40- to 60-percent reattachment rate after gas injection agrees with the posterior vitreous detachment rate of 50% in retinal detachment with macular hole. If air could be injected in only those cases in which posterior vitreous detachment is present, better results might be obtained. However, since preoperative determination of the presence or absence of posterior vitreous detachment is difficult, especially in highly myopic eyes,
removing vitreous traction is the preferred procedure. Removing vitreous traction is also considered one of the reasons for the higher percentage of retinal reattachment following the initial operation.

Another reason for removal of the vitreous gel is to insufflate air in the vitreous cavity. A large amount of air improves the chances for closure of the macular hole and reduces the need for maintaining a strict prone position.

Our study suggests that air injected by pump offers a better reattachment rate (82.7%) than less air injected by syringe (63.2%). When a large amount of air is used, lying prone for 1 hour six times a day for 5 days is sufficient. The air usually disappears within 2 to 3 weeks, while gases such as SF₆ or C₃F₈ remain more than a month, an amount of time usually considered unnecessary.

Using endodiathermy is controversial. In Goyrons and Machemer's original method, macular coagulation was not done. Also, better central vision can be expected when diathermy is not used. However, since more recurrences occurred when we did not apply diathermy, we used minimum endodiathermy to obtain a secure adhesion. No case in our study obtained a visual acuity of 0.2 or more; however, vision of 0.01 or less was rare. The poor postoperative central vision may have been due to myopic chorioretinal atrophy, substantial preoperative retinal detachment, or macular coagulation. In any case, securing the greatest possible visual field should have priority in these cases.

We found that vitrectomy with endodiathermy, accompanied by the fluid-air exchange method with a pump, was effective in increasing the reattachment rate in retinal detachment with macular hole. Thus, we recommend this method of treatment.

REFERENCES