In some types of refractory drug uncontrollable uveitis, inflammatory cells are exuded into the vitreous cavity. Ocular inflammation induces retinal gliosis and the activation of pigment epithelial cells, which sometimes causes subsequent proliferative vitreoretinopathy (PVR) which is directly related to the loss of vision in patients with uveitis. In such cases, a pars plana vitrectomy (PPV) is the only way to maintain the visual functions. Owing to advances in the technical development of pars plana vitrectomy (PPV), the indications for a PPV in uveitis has continued to increase.

In general, PPV in uveits is more difficult to perform than in other diseases. Postoperative complications, such as cataract, high ocular pressure, and recurrence of PVR, are frequently induced by prolonged ocular inflammation. In fact, infiltrating macrophages have been shown to play a major role in the formation of the epiretinal membrane in an animal study. It is therefore important to establish an effective way to prevent and manage postoperative ocular inflammation in patients with uveitis. Although various surgical techniques and instruments have been developed in PPV, the removal of the residual vitreous cortex remains an uncertain procedure because of the transparency of the vitreous and also because inappropriate procedures can sometimes result in severe complications.

Triamcinolone acetonide (TA) is a water insoluble steroid that inhibits various inflammatory reactions. Peyman et al originally described the intravitreous injection of TA during a vitrectomy. TA granules twine around the vitreous body and thus allow the transparent vitreous to be visualised and therefore helps surgeons to achieve a complete removal of the vitreous from the retina. We previously reported that TA assisted vitrectomy did not have any apparent adverse effects on postoperative findings or visual outcome.

In the present study, we performed TA assisted PPV for the treatment of several kinds of refractory uveitis and examined the postoperative outcome. In some cases, 4 mg of TA was intentionally left after a vitrectomy to reduce the degree of postoperative inflammation.

**PATIENTS AND METHODS**

**Patient selection**

The patients with uveitis were included in the present study, which was carried out with the approval of the appropriate institutional review board and was performed in accordance with the ethical standards laid down in the 1989 Declaration of Helsinki. The possible merits and risks of the present treatment were explained to the patients before surgery and informed consent was obtained from all patients.

Patients who underwent TA assisted PPV at Kyushu University Hospital from April 2000 to June 2001 were enrolled in this study. All cases were examined postoperatively for 2 months or longer.

**Surgical procedures**

A TA aqueous suspension was left standing for 30 minutes and the vehicle of TA (Kenakol-A, Bristol Pharmaceuticals KK, Tokyo, Japan) was discarded according to a previously described method. The remaining TA (40 mg) suspension was mixed with 5 ml balanced salt solution (BSS, Santen, Osaka, Japan) and this procedure was repeated twice. Thereafter, the final suspension was used for the following procedure as a TA suspension.

Firstly, the standard phacoemulsification was performed when needed. The standard PPV using three scleromies,
removing the vitreous up to the vitreous base, was performed and the following procedures were added. A core vitrectomy was performed and 0.5–1.0 ml of TA solution was injected with a 27 gauge needle into the mid-vitreous cavity. The TA granules were trapped in the gel structure of the vitreous. Thereafter, the posterior cortical vitreous appeared as a white gel and a break of the posterior hyaloid cortex appeared on the retinal surface. After the vitrectomy was sufficiently performed, the residual vitreous cortex which trapped TA was removed either by a silicone tipped needle or ILM forceps. Some eyes underwent retinal endolaser photocoagulation when needed. Finally, an intraocular lens was inserted and silicone oil tamponade was performed in some cases. After the conjunctiva was closed, gentamicin was injected subconjunctivally.

In addition, aciclovir (40 mg/ml) was dissolved in the infusion solution during PPV and silicone oil tamponade was performed in case 5.

### Intentional TA leaving

Basically, we remove the TA granules from the eye using a silicone tipped needle after PPV. A small amount of TA granules was usually left on the inferior retina; however, the exact amount of TA left in the eye was not measured. To control ocular inflammation post-surgery, four of six patients had 4 mg of TA intentionally left in the vitreous cavity after the complete removal of the vitreous.

### Postoperative examination

The patients were clinically examined for more than 4 months after surgery. Postoperatively, we carefully checked the best corrected visual acuity, while also identifying any elevation or symptoms of intraocular pressure (IOP), ocular inflammation, infection, or a need for reoperation. Ocular inflammation was scored based on the number of cells in the anterior chamber and partial tractional retinal detachment occurred. A patient with Behçet’s disease underwent PPV because of retinal detachment induced by the traction of proliferative tissues in the vitreous that was confirmed by the examination of B-mode ultrasound examination (case 4). A patient with Vogt-Koyanagi-Harada (VKH) disease (case 5) underwent PPV because of her rhegmatogenous retinal detachment. Although the correlation between VKH and the retinal detachment was not clear, she actually had prolonged ocular inflammation due to a relapse of VKH disease when she had PPV. Another patient (case 6) had acute retinal necrosis induced by an infection of herpes simplex virus type 1 (HSV-1), which was diagnosed based on virus DNA amplifications by polymerase chain reaction (PCR) in the aqueous humour. At the time of PPV, the peripheral retina became necrotic and multiple retinal holes existed at the necrotic portion.

### Postoperative evaluation

At the end of the follow up period, the retina was attached in all six cases. No eye required additional PPV, filtrating surgery, or cataract surgery. After surgery, the intentionally left TA gradually disappeared within a month in the vitreous cavity (Fig 2).

In five of six cases, the visual acuities were improved after TA assisted PPV (Table 1). Case 4 did not show an improvement in the visual acuity. Her optic disc had been seriously damaged by Behçet’s disease, and we could not even observe her fundus before operation because of a dense cataract.

As shown in Table 2, ocular inflammation in both the anterior chamber and anterior vitreous cavity was reduced in all cases post-TA assisted PPV. This tendency became apparent in the vitreous cavity compared to the inflammations in the anterior chamber. To confirm the conditions of posterior segment of the eye, fluorescein angiography (FAG) was performed after TA assisted PPV. In all six cases, the condition of the retinal vessels was generally fair. Figure 3 showed the representative photographs of FAG (cases 3, 4, and 6). There were

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**Figure 1** Intraoperative findings regarding the removal of the residual vitreous cortex (case 1). (A) A thin hyaloid membrane (arrow) is left on the posterior retina even after the surgical posterior hyaloid separation. The edge of this hyaloid is held with a surgical forceps (arrow). (B) The membrane is gradually removed. (C) The macular area (arrow) is then free from the residual vitreous cortex.

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Table 1: Postoperative examination and vitreous cavity under slit lamp microscopy as described previously.

Table 2: Postoperative examination and vitreous cavity under slit lamp microscopy as described previously.

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no inflamed lesions such as a severe hyperfluorescein area, non-perfusion area because of vessel occlusion or oedema. Collectively, we can conclude that the TA used during PPV reduced the degree of postoperative ocular inflammation effectively.

An IOP elevation is a common complication of treatment involving ocular TA injection. In a previous study, 25% of the eyes with an intraocular injection of TA experienced an IOP elevation and as much as 4 mg of triamcinolone was injected into the eyes of the patients. One patient transiently showed an elevated IOP after surgery (case 4). However, she also had partial goniosynechia and complete posterior synechia of the iris as a result of Behçet’s disease, thus her IOP was elevated (45 mm Hg) and uncontrollable by topical and systemic antiglaucoma drugs by the time she was referred to our clinic. We assume that her postoperative IOP elevation was due to the pre-existing goniosynechia rather than to the side effects of TA.

The intraoperative use of steroids might also increase the risk of postoperative infection. In this series of examinations,

<table>
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<th>Patient No</th>
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<th>Age (years)</th>
<th>Kind of uveitis</th>
<th>Preoperative visual acuity</th>
<th>Postoperative visual acuity</th>
<th>Combined surgery</th>
<th>TA leave</th>
<th>Follow up (month)</th>
<th>Complication</th>
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<td>PEA</td>
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HM = hand movement, PEA = phacoemulsification and aspiration, IOL = intraocular lens.

<table>
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<th>Preoperative visual acuity</th>
<th>Postoperative visual acuity</th>
<th>Combined surgery</th>
<th>TA leave</th>
<th>Follow up (month)</th>
<th>Complication</th>
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we did not see any infections even in the patient with acute retinal necrosis caused by an infection of HSV-1. In addition, cataract formation is another complication of ocular steroid treatment. All patients underwent lens extraction before PPV (case 5 had already undergone cataract surgery before PPV), and thus the effect of TA assisted PPV on cataracts could not be determined.

DISCUSSION

In this study, TA assisted PPV was performed in patients with refractory uveitis. TA actually improved the visibility of the vitreous body and residual vitreous cortex during PPV, which thus ensured the safety of the surgical manoeuvres. In addition, the TA assisted vitrectomy did not have any apparent adverse effects on the postoperative findings in uveitis patients. After surgery, the intentionally left TA gradually disappeared within a month in the vitreous cavity (Fig 2). Since the clearance time of triamcinolone in the vitreous is much longer than that of water soluble steroids, the anti-inflammatory effect lasts for a long time. The remaining TA effectively suppressed the postoperative intraocular inflammation that tends to be associated with uveitis (Table 2). On the other hand, we should be aware of the side effects caused by steroids and infection for approximately 1 month after surgery.

In uveitis patients, ocular inflammation after PPV tends to induce various complications. Inflammatory cells can secrete various chemical mediators and cytokines, which can induce the intravitreal migration of secondary inflammatory cells, such as glial cells and retinal pigment epithelial (RPE) cells. In the most serious cases, these cells can proliferate, produce an extracellular matrix, and contract the residual vitreous cortex, thus leading to secondary tractional retinal detachment. Therefore, reducing postoperative inflammation by the administration of TA appears to be an effective method of PPV for uveitis patients. In fact, the intravitreal injection of TA has been successfully shown to inhibit experimental PVR in rabbits and optic disc neovascularisation of pigs. In addition, in a clinical study, Jonas et al reported that the intravitreal inoculation of steroids clearly reduced the incidence of PVR after a vitrectomy. It is notable that we could achieve a complete removal of residual vitreous cortex safety and easily by the assistance of TA (Fig 1). The remnant vitreous on the retina can be a scaffold of pathological cells, such as hyalocytes and glial cells, which can eventually cause macular pucker or secondary retinal detachment. As shown in Figure 1, the TA visualised residual vitreous cortex was frequently left on the macula, because it is the thinnest area of vitreoretinal adhesion. It is therefore understandable that the remaining vitreous cortex tends to form macular oedema and a premacular membrane. The complete removal of the vitreous is effective for the treatment of macular oedema associated with refractory uveitis.

We did not experience any severe side effects caused by the administration of TA including infections in this study series. In previous clinical reports, the intraocular injection of TA has been applied in age related macular degeneration and as an adjuvant therapy of PPV for diabetic retinopathy. Although the toxicity of TA itself on the human retinal function has not yet been determined, several side effects of TA have been reported. It is true that TA assisted PPV can potentially increase the risk of ocular side effects and infections, especially in our series in which TA was intentionally left after surgery. However, the anti-inflammatory effects of TA are more important than its potentially harmful effects in patients with severe uveitis.

There are clear limitations in this study. It is a case series, not a case-controlled study. In addition, the number of patients and the follow up period are limited. However, there was a perceived benefit regarding the case in detecting and removing the attached posterior hyaloid during vitrectomy. Furthermore, we would like to emphasise that the anti-inflammatory effects of TA assisted vitrectomy were obvious (as shown in Table 2). Not only did our method improve the visibility during PPV, it had a great potential to reduce postoperative inflammation both in the anterior and posterior segment of the eye without any side effects. If future randomised studies can show the beneficial effects on visual and surgical outcome, TA assisted vitrectomy should thus become accepted as a new method for performing a vitrectomy in uveitis patients.

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Authors’ affiliations
K-H Sonoda, H Enaida, A Ueno, T Nakamura, Y-I Kowano, T Kubota, T Ishibashi, Department of Ophthalmology, Kyushu University Graduate School of Medicine, Fukuoka, Japan
T Sakamoto, Department of Ophthalmology, Kagoshima University, Kagoshima, Japan

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