Investigation of fellow eye of unilateral retinal detachment in Shih-Tzu

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Abstract

Objective To investigate disease in the fellow eye, and consider the relation to rhegmatogenous retinal detachment (RRD) in Shih-Tzus.

Animals studied The fellow eyes of 49 Shih-Tzus (27 male, 22 female; median age: 6.8 years) with unilateral RRD diagnosed by funduscopy or ultrasonography at Rakuno Gakuen University Teaching Animal Hospital were assessed in this study.

Procedures Ophthalmic examinations (including menace response, pupillary light reflex, slit-lamp biomicroscopy, and funduscopy) were performed in the subjects. Electroretinography was performed in 12 eyes that developed retinal degeneration. Maximum follow-up period was 42 months.

Results Cataracts and vitreous opacity were observed in 26 (53%) and 32 eyes (65%), respectively, by slit-lamp biomicroscopy. Retinal degeneration with various degrees of hyper-reflectivity of the tapetal fundus and/or attenuation of retinal vessels was observed in 35 eyes (71%) on funduscopy. A reduction of amplitude in rod, standard combined and 30 Hz flicker electroretingram was detected in 5 (42%), 10 (83%), and 6 eyes (50%), respectively. During the follow-up period, RRD was detected in six eyes.

Conclusion Retinal degeneration was frequently detected by funduscopy and electroretinograms in the fellow eye in Shih-Tzu with RRD. In our subjects, vitreous degeneration was also observed frequently. It has been reported that peripheral retinal degeneration is one of the causes of RRD associated with vitreous degeneration in humans. We assume that primary retinal degeneration with secondary vitreous degeneration is one of the causes of RRD in Shih-Tzu.

Key Words: electroretinogram, fellow eye, retinal degeneration, retinal detachment, Shih-Tzu, vitreous degeneration

INTRODUCTION

Retinal detachment (RD) is one of the major ocular diseases in Shih-Tzus.1,2 Acquired RD in dogs is classified into two types in terms of pathophysiology, and is divided into three detailed types.3 Rhegmatogenous RD (RRD) is caused by tears in the neurosensory retina, allowing fluid to enter the potential subretinal space.3,4 Nonrheumatogenous RD is divided into exudative RD, which is caused by choroidal inflammatory and vascular disease, and tractional RD, which occurs when bands composed of inflammatory and fibrotic tissue form within the vitreous and subsequently exert anterior traction force on the neurosensory retina.3,4

The most common cause of RRD is cataract surgery in dogs,1 especially when surgery is complicated by tearing of the posterior lens capsule, vitreous loss, retained lens fragments, or intraocular hemorrhage.1,2 Dogs with excessive vitreous degeneration, mainly Shih-Tzu, Boston Terrier, Poodle, etc., are prime candidates for RRD.1,5 In previous reports, a giant retinal tear occurred in conjunction with vitreous degeneration and liquefaction in Shih-Tzu.6

We have often seen retinal degeneration in the fellow eye in Shih-Tzu with unilateral RRD at Rakuno Gakuen University Veterinary Teaching Animal Hospital. In this study, we investigated disease in the fellow eye, and considered the relationship to RRD.
MATERIALS AND METHODS

Animals
The fellow eyes (49 eyes) of 49 Shih-Tzus (27 male and 22 female; 1–14 years old; median age: 6.8 years old) with unilateral idiopathic RRD diagnosed by funduscopy or ultrasonography at Rakuno Gakuen University Teaching Animal Hospital from 2002 to 2005 were assessed in this study.

Ophthalmic examinations
Ophthalmic examinations, including menace response, pupillary light reflex, applanation tonometry (Tono-Pen XL; Medtronic Solan, Jacksonville, FL, USA), slit-lamp biomicroscopy (SL-D7; Topcon, Tokyo, Japan), and funduscopy (TRC-50IX; Topcon, Tokyo, Japan) were carried out in all subjects. In 12 eyes, retinal degeneration was observed by funduscopy, and electroretinograms (ERGs) were recorded with a portable ERG LE-3000 (TOMEY, Aichi, Japan) and LED-electrode (H2000; Kyoto Contact Lens, Kyoto, Japan). ERG was performed under sedation by intravenous injection of a combination of 0.01 mg/kg medetomidine (Domitor; Meiji, Tokyo, Japan), 0.15 mg/kg midazolam (Dormicam; Astellas, Tokyo, Japan), and 0.025 mg/kg butorphanol (Stadol; Bristol-Meyers, Tokyo, Japan), and 0.01 mg/kg medetomidine (Domitor; Meiji, Tokyo, Japan), and 0.025 mg/kg butorphanol (Stadol; Bristol-Meyers, Tokyo, Japan), and funduscopy at Rakuno Gakuen University Teaching Animal Hospital from 2002 to 2005 were assessed in this study. 7

Follow-up
We could perform follow-up in 35 eyes, over a period of 2–42 months, during which ophthalmic examinations, except for ERG, were performed in the fellow eyes periodically.

RESULTS
Menace response was present in 48 eyes, and was absent in one eye because of a mature cataract. Pupillary light reflex was normal or diminished, and intraocular pressure was within the normal range in all eyes. Results of slit-lamp biomicroscopy and ultrasonography are shown in Table 1. Cataracts were observed in 26 eyes (53%); incipient: 24 eyes; immature: 1 eye; mature: 1 eye). Vitreous presentation in the anterior chamber and opacities were seen in 8 (16%) and 32 eyes (65%), respectively. In funduscopy, retinal degeneration with various degrees of attenuated retinal vessels (AVR), hyper-reflectivity in the tapetal fundus (HR), and/or optic disk atrophy (OA) was observed in 35 eyes (71%); AVR only: 15 eyes; AVR and HR: 14 eyes; AVR and OA: 2 eyes, ARV, HR and OA: 4 eyes).

Data of ERGs from 12 eyes are presented in Table 2. The amplitudes of rod, standard combined, and 30 Hz flicker ERG were decreased or nonrecordable in 5 (42%), 10 (83%), and 6 (50%) eyes, respectively, compared with age-matched control data in Shih-Tzus (Table 2). Fundus photographs and ERGs of three cases, case 2, 7, and 8, are shown in Figs 1–3.

During follow-up of 35 Shih-Tzus, RRD of the second eye occurred in six eyes (17%). In these six eyes, retinal degeneration and vitreous opacity had been detected in six (100%) and five eyes (83%), respectively. The time period between RRD of the first and second eye in these six cases was 2, 4, 6, 12, 15, and 30 months. These subjects included case 8, 10, and 11 in Table 2, and the period of RRD of the second eye was 30, 12, and 15 months, respectively.

DISCUSSION
In this study, we investigated factors in RRD in 49 Shih-Tzus with unilateral RRD. Ophthalmic examinations showed retinal degeneration and vitreous degeneration of various degrees in 71% and 65% of subjects, respectively. During the follow-up period, 17% of subjects showed RRD. From these results, we assume that retinal degeneration is also one of the factors in RRD in the Shih-Tzu, as for vitreous degeneration.

The causes of retinal degeneration include genetic factors, developmental abnormalities, and intraocular inflammation. 5, 8–16 However, there is no evidence that retinal degeneration itself causes RRD in dogs. In humans, a kind of

Table 1. Results of slit-lamp biomicroscopy, ultrasonography, and funduscopy in fellow eyes of 49 Shih-Tzus with unilateral retinal detachment

<table>
<thead>
<tr>
<th>Slit-lamp biomicroscopy and ultrasonography</th>
</tr>
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<tbody>
<tr>
<td>Cataract</td>
</tr>
<tr>
<td>Incipient cataract</td>
</tr>
<tr>
<td>Immature cataract</td>
</tr>
<tr>
<td>Mature cataract</td>
</tr>
<tr>
<td>Vitreous presentation in anterior chamber</td>
</tr>
<tr>
<td>Vitreous opacity</td>
</tr>
<tr>
<td>Funduscopy</td>
</tr>
<tr>
<td>Retinal degeneration</td>
</tr>
<tr>
<td>ARV</td>
</tr>
<tr>
<td>ARV + HT</td>
</tr>
<tr>
<td>ARV + AO</td>
</tr>
<tr>
<td>ARV + HT + AO</td>
</tr>
</tbody>
</table>

ARV, attenuated retinal vessels; HT, hyper-reflectivity of tapetal fundus; AO, atrophy of optic disk.

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retinal degeneration is the cause of RRD. Thinning of degenerated retina and vitreous degeneration adjacent to retinal degeneration are factors in vitreoretinal traction and retinal tear. It is known that thinning of the retina is caused by retinal degeneration in dogs, but secondary vitreous degeneration has not been reported. Thus, we presume that retinal degeneration in the Shih-Tzu may cause vitreous degeneration, as in humans, and would be one of the factors in RRD.

Vitreous degeneration includes asteroid hyalosis, synchysis scintillans, and vitreous syneresis. These types of vitreous degeneration are caused by destabilization of the vitreous

Table 2. Amplitudes of ERGs recorded from 12 eyes of Shih-Tzus with retinal degeneration and 16 eyes of normal control Shih-Tzus

<table>
<thead>
<tr>
<th>Case number</th>
<th>Age (years)</th>
<th>Sex</th>
<th>ERG amplitude (µV)</th>
<th>Standard combined a-Wave</th>
<th>b-Wave</th>
<th>30 Hz flicker</th>
</tr>
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<tbody>
<tr>
<td>1*</td>
<td>4</td>
<td>Female</td>
<td>53.25</td>
<td>47.75</td>
<td>100.00</td>
<td>30.75</td>
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<tr>
<td>2*</td>
<td>5</td>
<td>Male</td>
<td>70.75</td>
<td>87.75</td>
<td>122.50</td>
<td>34.25</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>Female</td>
<td>90.25</td>
<td>157.25</td>
<td>338.00</td>
<td>96.75</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>Male</td>
<td>65.50</td>
<td>98.75</td>
<td>177.25</td>
<td>47.00</td>
</tr>
<tr>
<td>5*</td>
<td>9</td>
<td>Male</td>
<td>Non-rec.</td>
<td>33.00</td>
<td>45.00</td>
<td>18.00</td>
</tr>
<tr>
<td>6*</td>
<td>10</td>
<td>Male</td>
<td>80.50</td>
<td>114.38</td>
<td>126.31</td>
<td>51.25</td>
</tr>
<tr>
<td>7*</td>
<td>10</td>
<td>Male</td>
<td>24.25</td>
<td>56.25</td>
<td>74.50</td>
<td>32.75</td>
</tr>
<tr>
<td>8*</td>
<td>10</td>
<td>Female</td>
<td>40.00</td>
<td>87.00</td>
<td>79.75</td>
<td>48.30</td>
</tr>
<tr>
<td>9*</td>
<td>10</td>
<td>Female</td>
<td>Non-rec.</td>
<td>19.00</td>
<td>56.75</td>
<td>10.00</td>
</tr>
<tr>
<td>10*</td>
<td>11</td>
<td>Male</td>
<td>Non-rec.</td>
<td>44.67</td>
<td>58.83</td>
<td>37.50</td>
</tr>
<tr>
<td>11*</td>
<td>11</td>
<td>Female</td>
<td>Non-rec.</td>
<td>110.92</td>
<td>126.50</td>
<td>58.00</td>
</tr>
<tr>
<td>12*</td>
<td>12</td>
<td>Female</td>
<td>50.50</td>
<td>43.75</td>
<td>113.00</td>
<td>44.75</td>
</tr>
<tr>
<td>Normal control (mean)</td>
<td>7.0†</td>
<td></td>
<td>112.68</td>
<td>118.14</td>
<td>221.27</td>
<td>70.86</td>
</tr>
<tr>
<td>SD</td>
<td>2.1</td>
<td></td>
<td>39.13</td>
<td>58.82</td>
<td>133.95</td>
<td>39.26</td>
</tr>
<tr>
<td>Lower limit‡</td>
<td></td>
<td></td>
<td>3.97</td>
<td>58.82</td>
<td>133.95</td>
<td>39.26</td>
</tr>
</tbody>
</table>

*The case has a significant abnormal value, compared with normal control data. †Median. ‡Lower limit of normal = mean value – 1.96 SD.

ERG, electroretinogram; non-rec., nonrecordable ERG; SD, standard deviation.

Figure 1. Fundus photograph and ERGs in 5-year-old male, case 2. Upper photograph is right fundus. Attenuation of retinal vessels, hyper-reflectivity in the tapetal fundus, optic disk atrophy, and vitreous opacity are observed. Lower photograph is left fundus with rhegmatogenous retinal detachment. ERGs recorded from right eye are shown; rod ERG, standard combined ERG, and 30 Hz flicker ERG from top to bottom, respectively.

Figure 2. Fundus photograph and ERGs in 10-year-old male, case 7. Upper photograph shows right fundus with rhegmatogenous retinal detachment. Lower photograph shows left fundus. Attenuation of retinal vessels and vitreous opacity are observed. ERGs recorded from the left eye are shown; rod ERG, standard combined ERG, and 30 Hz flicker ERG from top to bottom, respectively.
gel structure and vitreous liquefaction, and are one of the factors in RRD through loss of the function for retinal attachment. Certain breeds, the Shih-Tzu, Boston terrier, and poodle, have a pre-disposition to vitreous degeneration and this often leads to RRD. In our subjects, vitreous degeneration was frequently observed. No subject showed a hyper-mature cataract, although vitreous degeneration is common in eyes with a hyper-mature cataract. These cataracts may be induced by progressive retinal atrophy, which is known as canine inherited retinopathy, and this causes secondary cataract through the release of toxic substances from the degenerative retina. In humans, the relation between vitreous degeneration and RRD remains to be analyzed in detail. Foss and Wheeler reported a strong correlation between vitreous liquefaction and posterior vitreous detachment. Focal posterior vitreous detachment rapidly develops into total vitreous detachment, and traction is exerted at the area of vitreo-retinal adherence, separating the posterior vitreous cortex from the retina, with the development of a retinal tear and RRD. It is known that vitreous gel movement secondary to eye movement exerts strong traction on all areas of vitreoretinal adherence, with excessive vitreoretinal traction and RRD development and enlargement. In dogs, there are no reports about vitreous degeneration secondary to retinal degeneration, and the relation between posterior vitreous detachment and RRD. However, if the same phenomenon were to occur, it is consistent that dogs with vitreous degeneration would be candidates for RRD. Reports in human and rabbit also support our hypothesis that retinal degeneration is one of the factors in RRD.

Some reports show the utility of posterior vitrectomy in dogs. Vainisi reported that 72% of their cases of RRD recovered after surgery. However, the effects of surgery have not been confirmed, and the indications, complications, and durations for the surgery are unclear. There is no accepted preventive treatment of retinal degeneration. Prophylactic laser retinopexy has been performed recently as preventive treatment of RRD. If the risk of RRD is increased by retinal degeneration, we propose that prophylactic laser retinopexy should be performed in cases of retinal degeneration and unilateral RRD, as RRD is difficult to cure, once it develops.

In summary, retinal degeneration was frequently detected in the fellow eye of RRD by funduscopy and ERGs in Shih-Tzus. Retinal degeneration generally occurs bilaterally, so we consider that retinal degeneration was also present in the RD eye. In humans, it is reported that peripheral retinal degeneration is one of the causes of RRD. We suspect that retinal degeneration may be one of the causes of RRD also in Shih-Tzus.

REFERENCES


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