Glucoma is defined as an elevation of intraocular pressure (IOP) that induces degeneration of the optic nerve and retina with subsequent blindness [5, 8]. Appropriate treatments should be instituted after making a diagnosis based on the possible cause (etiolog), gonioscopic findings of the iridocorneal angle, and stage of the disease [2, 4, 5]. Treatments to control IOP falls into two categories : medical therapies using osmotic diuretics, miotics, adrenergic agents, and/or carbonic anhydrase inhibitors, and surgical treatments including filtering procedures, cycloclysis, cycloclyosurgery, and laser cyclophotocoaglation [1, 4, 5]. Medical treatments are initially attempted in animals with glaucoma, though with medication alone it is generally difficult to maintain acceptable IOP in the glaucomatous eye over a long period [5, 8]. This report deals with a glaucomatous patient in which lower IOP was maintained with medical therapy alone for 1973 days.

An 8-year-old, 2.0 kg male Yorkshire terrier was presented to the Veterinary Teaching Hospital, Faculty of Agriculture, Miyazaki University for abrupt anorexia, depression, and trembling from the previous day. The case had the history of progressive retinal atrophy (PRA) and its related decreased vision, or being apt to bump into objects, bilateral uveitis, corneal injuries and/or ulcers associated with decreased vision, cystitis, skin neoplasia (intracranial cornifying epithelioma), and cryptorchidism. The neuro-ophthalmic evaluations revealed weak menace and direct or consensual pupillary light reflexes, and dilated pupils (4/6) were observed bilaterally in photopic condition at the time of making the diagnosis of PRA. Injection of the conjunctiva and sclera, and mydriasis (5/6) were found in the right eye on physical examination. Slit lamp examination revealed the presence of a small amount of fibrin and 1+ of flare in the anterior chamber of both eyes, pigmentation of the right anterior lens capsula, and bilateral mild lens opacity. IOP of the right and left eyes, which was measured with tomo пен XL (Bio Rad, CA, U.S.A.), was 40 mmHg and 19 mmHg, respectively. The iridocorneal angle was examined with a koepp goniolens. In both eyes, an open iridocorneal angle was seen, and there were no detectable abnormalities on the iridocorneal angle including the base of the irises, pectinate ligaments, and filtration angles. All retinal vessels were attenuated and the tapetum was hyperreflective, bilaterally. The optic disc appeared pale in the right eye. There were no differences between previous conditions and the onset of glaucoma on the visual examinations. In hematology and chemistry profile, only increased plasma ALT (116 U/l) was detected. The case was diagnosed as acute open angle glaucoma associated with uveitis.

The dog was initially treated with dichlorphenamide (DCPA, 3 mg/kg, po, tid (three times a day)), 0.5% timolol maleate (topical medication, tid), and 0.1% diclofenac sodium (topical medication, tid). The next day, IOP of the right and left eyes was 15 mmHg and 16 mmHg, respectively, and clinical signs were improved. Since IOP of the right eye was controlled by the medical therapy described above, the frequency of the treatment was reduced from tid to bid (twice per day) on day 21. In addition, topical medication of diclofenac sodium was discontinued, because fibrin and flare were not detected in the anterior chamber of both eyes. Lower IOP of the right eye was maintained by the medical therapy with DCPA and timolol maleate for 344 days (Fig. 1). On day 366, the case was brought back to the hospital for depression, anorexia, mild hyperemia of conjunctiva and sclera, and pain in the right eye from the previous day. Increased IOP of the right eye (30 mmHg) was again detected. IOP of the left eye was within the normal range.
Abnormalities of the iridocorneal angle were not found in either eye. Mannitol at a dose of 1.5 g/kg was administered intravenously, and frequency of the administration of DCPA and timolol maleate was increased from bid to tid (Fig. 1). The next day, IOP of the right eye was reduced to 24 mmHg. Clinical signs were improved. Thereafter, IOP of both eyes was maintained within the reference range (15–25 mmHg) by extended medical therapy for 32 days. Hence, frequency of the medication was decreased from tid to bid. On day 472, enarapril, which is an angiotensin converting enzyme inhibitor (ACEI), was administered, because mitral insufficiency (MI) was found in the case. Topical treatment of timolol maleate was discontinued on day 825, and lower IOP of the right eye was maintained with the administration of DCPA alone (Fig. 1).

Scleral injection associated with phacolysis caused by hypermature cataract was observed in both eyes on day 874. The dog was topically treated with dipotassium glycyrrhizinate (a non-steroid anti-inflammatory drug, tid), and clinical signs were again improved. The vision of the case decreased. The neuro-ophthalmic examinations included bilateral lack of menace reflex and the presence of dull direct or consensual pupillary light reflexes in both eyes. The pupils of the case dilated in photopic condition (6/6). On day 1149, uveitis and hyphema of unknown cause were found in the left eye, and prednisolone [1 mg/kg, po, sid (once per day)] and ampicillin (20 mg/kg, po, bid) were administered for 4 days. IOP of both eyes was within the normal range in those situations associated with uveitis. Abnormalities of the iridocorneal angle were not detected in either eye. Pulmonary edema related to MI was intermittently observed from day 1235, then the diuretic drug, furosemide (2 mg/kg, bid, po), was started. Aminophylline (10 mg/kg, bid, po) was also added to the previous medication of enarapril, DCPA, and furosemide from day 1264. From day 1603, the case received combined diuretic therapy using lower doses of furosemide (1 mg/kg, bid, po) and spironolactone (1 mg/kg, bid, po) due to the presence of hypokalemia (< 3.5 mEq/l). Since abnormal chemistry profiles included hypokalemia (3.0 mEq/l) and elevated levels of blood urea nitrogen (BUN, 267.9 mg/dl), creatinine (CRE, 4.8 mg/dl), and inorganic phosphorus (iP, 14.4 mg/dl) on day 1718, fluid therapy was begun to correct these abnormalities. Also, DCPA was discontinued due to anorexia and to prevent further hypokalemia. Elevated IOP of the right eye has not been detected since the discontinuation of DCPA to the end (1973 days from the onset of glaucoma). Since the case had hypermature cataracts and PRA in both eyes, the vision decreased markedly in latter course. However, the animal was conscious of light, and could take a walk in the daytime. Hence, we did not concluded the dog to be blind.
Choice of the glaucoma therapy depends upon the type and stage of the glaucoma. Although medical therapies are initially attempted for glaucoma patients, it is difficult to maintain lower IOP with medical therapy alone for a long period [5, 8], and surgical procedures or combination therapy with surgery and medication are frequently needed to control the proper IOP [1, 4, 5, 8]. Despite aggressive therapy, the prognosis of glaucoma in retaining vision is generally poor [5, 8]. The case presented here was diagnosed as acute open angle glaucoma, and treated successfully with medical therapy using DCPA systemically and timolol maleate topically, DCPA alone, or no-treatment for 1973 days. Since the dog had PRA, we did not conclude whether the vision was maintained by the glaucoma therapy. However, judging from examination of the pupillary light reflex and the owner’s verbal description of daily behavior of the case, the glaucomatous eye appeared to maintain acceptable conditions of the retina and optic nerve, suggesting that this medical therapy was useful in maintaining a good quality of life.

There were several factors involved in maintenance of the lower IOP of the glaucomatous eye in this case. First, the iridocorneal angle was intact in the eye affected. The open iridocorneal angle was found in both the outbreak of glaucoma and recurrence of the disease. Since Yorkshire terriers are not believed to have significant risk for open angle primary glaucoma [3, 8], it is probable that the flow of aqueous humor is driven through the filtration angle when the iridocorneal angle is not closed or narrow. Therefore, the medical therapy could successfully maintain a lower IOP of the glaucomatous eye for 1973 days. Second, abnormal signs associated with the elevation of IOP were recognized early by the owner, and treatment could be started before the advanced stage of the disease. Third, the owner was quite cooperative in treating the patient. If the owner had not recognized the slight changes of the case and had not cooperated in the glaucoma therapy, the glaucomatous eye might have fallen into a critical condition, and medical therapy might not have been effective. The experience of this case suggests that the veterinarian should educate the owner of a glaucomatous patient and make that individual a home assistant of the medical team. Tasks such as observation of the patient’s signs, applying medication regularly, and monitoring the response to the treatments should be assigned to the owner. This may be the key to successful management of the glaucoma patient.

The exact cause of glaucoma was not detected in this dog. The glaucoma observed might have been secondary open angle glaucoma associated with uveitis, because a small amount of fibrin and flare were seen in the anterior chamber on admission. The fibrin, cellular components, and large molecular proteins induced by uveitis hinder the outflow of the aqueous humor through the filtration angle [6, 7]. In addition, it is likely that uveitis can induce adhesions of the iris and the anterior lens capsule, thereby leading to pupil block (iris bombe) [6]. However, the dog was able to receive glaucoma therapy before reaching a critical condition. Since the uveitis was mild, inflammation of the uvea was completely resolved by the initial treatment, and there were no abnormalities of the iridocorneal angle, so that IOP could be regulated by the medical therapy. There is no definitive therapy in dogs with glaucoma [5, 8], though a good prognosis may be possible with early recognition of the disease and appropriate therapy based on accurate diagnosis in the dog with open angle glaucoma. The owner’s cooperation is required to achieve good results in controlling the disease.

REFERENCES