Clinical case of the secondary glaucoma treatment in a dog by transscleral cyclophotocoagulation

Sergey Kartashov\textsuperscript{1,*}, Maria Oboeva\textsuperscript{1}, Evgenia Kartashova\textsuperscript{2}, Alexandr Butenkov\textsuperscript{1,2}, Anastasia Rakityanskaya\textsuperscript{1}, Marina Petrova, and Maria Sultanova\textsuperscript{1}

\textsuperscript{1}Don State Technical University, 344000, Rostov-on-Don, Russian Federation
\textsuperscript{2}Limiter Liability Company “VITAVET”, Russian Federation

Abstract. Glaucoma is a common disease in animals, often leading to blindness. Nowadays, there are several treatments for glaucoma. One of promising techniques is transscleral cyclophotocoagulation. This article presents a clinical case of treating a dog with bilateral secondary glaucoma complicated by optic atrophy and blindness of the right eye. Thanks to the combination of drug therapy and surgical treatment, a steady decrease in intraocular pressure was achieved.

1 Introduction

Glaucoma is one of the most unpleasant eye diseases for veterinarians and owners. The first signs of glaucoma can be nonspecific and are characterized by redness of the conjunctiva of one or both eyes, soreness, eyes manifesting by squinting, as well as clouding of the cornea of any severity. The only way to diagnose glaucoma is to measure intraocular pressure using tonometers such as “Tonoopen”, “TonoVet”, or “Schiotz”. All these tonometers are convenient to use and give reliable and comparable measurement results [1, 2, 3, 4].

The authors are quite unanimous in assessing intraocular pressure, which should be considered a diagnostic criterion for glaucoma in dogs - intraocular pressure above 25 mmHg [5, 6, 7].

For the proper management of glaucoma, it is important to find out whether the glaucoma is acute or chronic, and whether the disease is primary or secondary. If the animal is diagnosed with chronic glaucoma, then in most of these cases, the affected eye will be irreparably blind, and there will be no talk of restoring visual function. Eyes with acute glaucoma will be temporarily blind due to increased intraocular pressure and the effect of pressure on the optic nerve. In such cases, vision may return after normalization of intraocular pressure. An anamnesis is very important for determining the temporal characteristics of the disease, but according to many authors, owners tend to underestimate the duration of the disease course, which makes it difficult to diagnose correctly. The authors indicate that eye size is the most useful factor in determining the duration of an

* Corresponding author: vera.murgul@mail.ru
illness. Chronic glaucoma is the only reason for the increase in the eyeball in size and the development of buphthalmia [8, 9, 10, 11]. In almost all cases, the enlarged eye is irreparably blind. However, there is evidence that there are several exceptions to this rule, firstly, these are young animals, and secondly, some breeds in which the eye will easily change its size due to the particular structure of the connective tissue - these are Core Terriers, Shar-Pei and Chow-Chow.

However, if an adult animal of a different breed has an enlarged eye, it is very likely that the eye is irreparably blind. Ophthalmoscopy and examination of the optic disk also provides useful information on damage to the optic nerve from increased intraocular pressure. Both the size of the eye and the characteristics of the fundus are evaluated in comparative terms with a healthy eye, if the latter is healthy. It is always possible to restore vision in a dog with an eye that is not noticeably enlarged and whose optic nerve is clearly intact [3, 4].

In assessing glaucoma, the question of whether it is a primary process (genetic) or a secondary one is also important. Glaucoma is hereditary in many dog breeds, including Cocker Spaniels, Basset Hounds, Siberian Husky and many others. Causes of secondary glaucoma include lens dislocation (often found in Terriers), uveitis, and intraocular tumors. A thorough ophthalmic examination should help to determine if the case is primary or secondary. If the patient has a lens dislocation, this will affect on the prognosis and choice of treatment, lens extraction will be necessary for successful state management [8, 9]. The diagnosis of lens dislocation is based on the study of the anterior segment, for its visualization using a slit lamp, in addition, visualization of the lens using ultrasound examination of the eye is possible [8, 10, 11].

With uveitis, concomitant to glaucoma, its full control is required. The basis for the diagnosis of uveitis is the study of the anterior part of the eye with a slit lamp, while there is a “fog ray” passing through the (normally completely transparent) anterior chamber. Finally, the visible mass in the eye or the darkly pigmented thickened iris suggests neoplasia of the eye [6, 7].

In some cases, corneal edema prevents visualization of the anterior chamber. In these cases, they rely on statistical data, for example, a young Terrier with glaucoma is more likely to have a lens dislocation, and dogs after infectious diseases have uveitis. In doubtful cases, we conduct an ultrasound examination.

The treatment protocol in cases of acute glaucoma, when there is hope for a restoration of vision, is fairly standardized. For dogs, in the absence of a lens dislocation, it begins with eye drops containing xalatan (prostaglandin). In most dogs with acute uveitis, xalatan in mono mode can stabilize intraocular pressure. If intraocular pressure does not normalize within an hour, they add a local carbonic anhydrase inhibitor such as dorzolamide or brinzolamide itimolol. With poor control of pressure, it is necessary to use mannitol in complex therapy. Mannitol is an effective emergency aid for glaucoma, and is used to save vision [3, 4].

If the above topical preparations normalize intraocular pressure, they continue their administration. If the pressure control is poor, the anterior chamber centration through the corneal limb using a 27 or 30 needle is carried out to bring the intraocular pressure to values below 24 mmHg. After normalization of intraocular pressure, the use of all of the above drugs is continued, under the supervision of an ophthalmologist for at least another 24 hours. However, one can never guarantee that intraocular pressure will not increase again or that vision will return if it has already been lost. Relapse, or poor control of the disease, is always likely.

Some cases of glaucoma in small animals respond well to drug therapy for a long time, in other cases it is impossible to achieve a lasting effect. There are many surgical interventions for glaucoma, and none of them has been properly introduced into clinical
practice. However, surgery is a reasonable option for cases where drug therapy does not control intraocular pressure. A discussion of all various glaucoma surgeries is beyond the scope of this article. When the eye is irreparably blind, a permanent procedure should always be considered to alleviate the pain and discomfort of glaucoma. Enucleation (removal of the eye) and prosthetics (placement of the prosthesis inside the cornea and sclera) are quite acceptable options, as well as transscleral cyclophotocoagulation. Some authors also recommend intravitreal injections of gentamicin for the pharmacological removal of the ciliary body, which is a source of aqueous humor. This procedure is based on the epithelial toxicity of aminoglycosides. In the vast majority of cases, a single injection leads to a permanent decrease in the production of aqueous humor. The final appearance of the eye is unstable - some are hyperemic, in most cataracts develop, and some are irreversibly reduced in size. This procedure is indicated only for blind canine eyes, since gentamicin also destroys the retina. Pharmacological ablation of the ciliary body is contraindicated in cats, due to the risk of ocular sarcoma formation. Too often, dogs with glaucoma lose their vision in both eyes, despite proper treatment [5, 6, 7].

Thus, glaucoma is a complex group of serious eye diseases. Primary and secondary glaucoma are distinguished, in which impaired dynamics of aqueous humor is a consequence of previous diseases (uveitis, lens luxation, cataract, etc.) [1, 2, 3, 4]. Due to the abrasion of the clinical picture, the absence of pathognomonic symptoms in the early stages, and the lack of alertness in this pathology by veterinarians, this disease is often diagnosed late and complicated by buphthalmus, lens luxation, perforation of the cornea, which requires radical surgical treatment in the form of enucleation [5, 6, 7]. In the absence of relief of an acute attack of glaucoma during the day, as a rule, irreversible loss of vision occurs due to damage to the retina, compression of the optic nerve and, subsequently, its atrophy. Both primary and secondary glaucoma is difficult to diagnose and requires an individual approach to the choice of therapeutic tactics, which determined the relevance of our work [8, 9, 10, 11].

Since it is not always possible to achieve a stable normotensive effect of the glaucomatous eye, polypharmacy of standard therapy, as well as the difficulty of using prostaglandins for uveitis, veterinary medicine continues to search for more effective ways to control intraocular pressure. In humane medicine, an operation has been developed - transscleral cyclophotocoagulation, which gives encouraging results, but this technique has not been introduced in veterinary medicine. In the literature available to us, we did not find data about applying of laser transscleral cyclophotocoagulation using the “Lakhta-Milon” laser apparatus, which determined the purpose of our study.

2 Materials and methods

Ophthalmological examination was carried out using a Magnifier QC Lab binocular ophthalmic magnifier, while paying attention to the closure completeness of the palpebral fissure, the presence of exophthalmos or enophthalmos, the position and presence of lacrimal openings, the state of the lacrimal sac area; cranial reflexes of V pair of cranial nerves (touching the cornea), VII pair of cranial nerves (patting on the temple) were determined.

Tonometry was performed with an ophthalmic tonometer "TonoVet". The following tests were carried out: Schirmer I test, Norn lacrimal film rupture test, Jones I test, fluorescein test, if a fluorescein test was negative, than a lissamine test was performed.

When examining the skin of the eyelids, attention was paid to the condition of the eyelid edge, the presence of dystrichia, ectopic eyelashes, the state of the ducts of the meibomian glands and the nature of the discharge from them; when examining the
conjunctiva, attention was paid to discharge from the eyes, conjunctival edema, type of conjunctival hyperemia, type of scleral hyperemia, if necessary, a test was performed with irifrin; the presence of trichiasis of the lacrimal meatus region was noted.

Examination of the cornea was performed using a ShinNippon XL-1 slit lamp, the state of the corneal surface, its transparency, the presence of defects, thickenings, overlays were noted; the thickness of the precorneal lacrimal film was determined.

Examination of the iris was performed with a ShinNippon XL-1 slit lamp for the presence of synechia, an inversion of the pigment leaf of the iris, the state of the vascular apparatus of the iris were noted.

Examination of the anterior chamber of the eye was performed with a ShinNippon XL-1 slit lamp, the state of fluid in the anterior chamber of the eye, the depth of the anterior chamber, the presence of foreign objects, pus, blood in the anterior chamber were determined.

Examination of the pupil and pupil-motor reactions were determined for white, blue and red colors, and the rate of pupil reaction to mydriatic was noted.

Examination of the lens was performed with a Shin Nippon XL-1 slit lamp.

Fundus examination (ophthalmoscopy) was performed with a Smartscope m-5 fundus camera for the presence of hyperreflective and hyporeflective zones, the presence of hemorrhages, retinal detachments, retinal edema, signs of its dysplasia: the state of the fundus vessels, their tortuosity, perivascular edema, hemorrhages and proliferative processes were noted; examination of the optic nerve disk was carried out with a Smartscope m-5 fundus camera.

Ultrasound examination was performed on a DC-N6 ultrasound scanner using a linear sensor with a frequency of 14 MHz. The anteroposterior size of the eyeball, the thickness of the cornea were determined; the integrity of the cornea, inclusions or foreign objects in the cornea, the anteroposterior size of the anterior chamber of the eye, the contents of the anterior chamber of the eye, the state of the iris and the region of the corneoscleral junction, the state of the ciliary body, topography, shape, transparency and anteroposterior lens size, damage to the lens capsule were determined.

Transscleral cyclophotocoagulation was carried out by a laser, programmable device “Lakhta-Milon” - an ophthalmologic device developed by the closed joint stock company “Milon Laser” - St. Petersburg, with a wavelength of 810 nm, operating in a pulse-periodic mode, with an output power of 0.1 up to 1.5 watts.

3 Purpose of the study

Find out the possibility of using laser transscleral cyclophotocoagulation for the treatment of glaucoma in dogs, determine the operating parameters of the “Lakhta-Milon” laser apparatus during surgery, and clarify possible complications.

4 Results and discussions

In October 2018, a patient was admitted to the VITA Veterinary Clinic in Rostov-on-Don: dog, male, 2 years old, Jack Russell Terrier breed with complaints from owners about an increase and redness of the right eye, clouding of the cornea, lacrimation, loss of appetite and activity.

Anamnesis: grew and developed according to age, according to the owners there are no concomitant diseases, vaccinated in time, treated for ectoparasites and helminths, home content with a walk. Premium wet feed.
Anamnesismorbi: about a year ago, owners began to report periodic conjunctival hyperemia, used local NSAIDs. In September 2018, they went to another clinic for conjunctivitis, and it was diagnosed with glaucoma. Prescribed treatment: eye drops “Tobradex” (tobramycin, dexamethasone), “Cosopt” (dorzolamide, timolol), “Xalatamax” (latanoprost).

Physical examination: clear consciousness, the nature of growth and development corresponds to age, the position of the body is natural, average fatness. Body temperature is 38.2. Visible mucous membranes are pink. Capillary filling rate is 2 sec. Turgor of tissues: the skin fold straightens for about 2 seconds. Auscultation: vesicular breathing, no wheezing. Respiratory rate is 25/min. Palpation: the abdominal wall is soft, painless on palpation. Lymph nodes are not enlarged, mobile, are not fused with surrounding tissues. Arterial pressure is 149/88 mmHg, heart rate is 133/min. The amplitude of the pulse on the thigh is normal and easily palpated. The hair is shaped. Urination is free, painless, urine is straw-yellow.

Local status: occlusion of the palpebral fissure is complete. The eyelids fit well and contour the eyeball. Lacrimal openings, meibomian glands have no changes. There are no lesions, neoplasms, edema on the skin of the eyelids. The edges of the eyelids are unchanged. Ectopic eyelashes and dystrichia are absent. Anisocoria, the left eye is significantly larger in diameter than the right (OS> OD).

OD: conjunctival and scleral hyperemia, edema and hyperemia of the third eyelid, deep vascularization of the cornea. Buftalm. Endothelial edema of the cornea, Haab striae. Stagnation in the capillaries of the conjunctiva and episclera. The pupil does not respond to bright light.

OS: conjunctival and scleral hyperemia. The surface of the cornea is shiny and smooth, with no visible defects. The size of the pupil is within normal limits, it narrows well when illuminated with white, red, and blue light.

Eye reflexes: corneal and palpebral reflexes are positive on both sides, threat reflex (OD-negative, OS-positive) is unchanged.

Tonometry (TonoVet) OS - 28 mmHg, OD - 56 mmHg.

Schirmer-1 test: OS - more than 15 mm/min, OD - 12 mm/min. Schirmer-2 test (after a single instillation of incocaine): OS - 13 mm/min.

Test with irifrin (2.5% phenylephrine): negative, which indicates both superficial (conjunctival) and deep (episcleral and scleral) stagnation in the vessels.

Fluorescin test: positive, unexpressed corneal ulcer (OU).

Biomicroscopy (ShinNippon - XL 1 slit lamp): OS cornea is not thickened, the anterior chamber depth is unchanged, the fluid in the anterior chamber of the eye is transparent, foreign objects are not visible. OD is the increase in the anterior chamber of the eye. The examination of the lens and vitreous body was not carried out due to the presence of contraindications to the use of mydriatics.

Ophthalmoscopy (WelchAllynPanOptic and OptomedSmartscopem-5): OS - good visualization of the fundus. Absence of hypo- and hyperreflective sites. Tapetum of the fundus is granular. Absence of hemorrhages, edema and sites of retinal detachment. The vessels of the fundus are significantly attenuated, there is the pronounced tortuosity of the vessels of the retina. Optic disk is pink, swelling is noted. OD - the fundus is poorly visualized due to a decrease in the transparency of the eye. The vessels of the fundus are significantly attenuated, there is pronounced tortuosity of the vessels of the retina. Optic disk is gray, edematous (Figure 1-4).

Ultrasound of the eyeball: OS - the anteroposterior size of the eyeball (20.9 mm), the thickness of the cornea (0.5 mm), the size of the anterior chamber of the eye is within normal limits. The topography of the lens, the shape and anteroposterior size of the lens are unchanged, the contents are anechogenic. OD - corneal thickening (0.7 mm), an increase in
the anteroposterior size of the anterior chamber of the eye (5.8 mm), an increase in the anteroposterior size of the eye (24.6 mm). The topography, the shape and anteroposterior size of the crystalline lens are unchanged, the contents are anechogenic.

Based on the information received, a diagnosis was made: Bilateral anterior uveitis. Secondary Glaucoma OU.

Fig. 1. The state of the left eye at the time of the initial examination.

Fig. 2. The state of the right eye at the time of the initial examination.

Fig. 3. Fundus on the left. Marked vascular attenuation.

Fig. 4. Fundus on the right. Marked vascular attenuation. Edema of the optic disc. Opacities of the eye media.

The primary goal was the rapid reduction the intraocular pressure of less than 24 mmHg. For this, a loop diuretic was introduced, synthetic analogues of prostaglandins F2α (latanoprost), selective α2-adrenergic agonists (bromonidine), a combination of non-selective β-adrenergic receptor blocker (timolol) and carbonic anhydrase inhibitor (dorzolamide) were used. Despite this, the intraocular pressure decreased to OS – 14 mmHg and OD – 43 mmHg. Due to the low effectiveness of drug treatment, it was decided to carry out surgical treatment of glaucoma (transscleral cyclophotocoagulation) in order to partially destroy the ciliary body and, as a result, reduce the production of aqueous humor. To treat superficial corneal ulcers, local antibiotics (ofloxacin, fusidic acid 1% and
chloramphenicol), root protectors (dextrophanol 5%, sulfated glycosaminoglycans), and an anticollagenase drug (homologous serum) were added to the therapy. A course of the retinal repair stimulator (retinalamine) was prescribed for 10 days.

Before the operation, an ultrasound of the heart, general clinical blood test and bioacoustic correction was performed.

Operation progress: Transscleral cyclophotocoagulation was carried out continuously, laser beam power 1.8 W, exposure 1 sec., energy 1 point 1.8 J. OS - 15 points dorsally, 6 points ventrally, OD - 30 points dorsally and 20 points ventrally, retreatting 2 mm from the limb and avoiding the area for 3 and 9 hours. The beam was perpendicular to the sclera. Intraoperatively, immediately after application of the laser, 0.05 ml of aqueous humor from the left eye and 0.1 ml of aqueous humor from the right were aspirated (Figure 5.6).

After the operation, the animal was left for 3 days in the intensive care unit hospital to monitor the intraocular pressure every 30 minutes. If necessary, drugs were used that reduce the intraocular pressure in the form of eye drops, and if they are ineffective, they aspirate the aqueous humor during the first day. After discharge from the hospital, intraocular pressure on the right eye was 34 mmHg (i.e., decreased by 22 mmHg from the initial one), on the left eye was 18 mmHg. (i.e., decreased by 10 mmHg from the initial). 3 weeks after the operation, an uncontrolled rise in intraocular pressure occurred (48 mmHg on the right eye, 29 mmHg on the left eye), and therefore a decision was made to enucleate the right eyeball, repeat the transscleral cyclophotocoagulation of the left eye. The operation was performed with the specified characteristics, dorsally-30 points, ventrally-20, avoiding the area for 3 and 9 hours. Intraoperatively aspirated 0.15 ml of aqueous humor. Intraocular pressure OS was 14 mmHg after the transscleral cyclophotocoagulation. After the operation, the animal remained under observation in the intensive care unit hospital for 3 days. In the early postoperative period, edema and hyperemia of the conjunctiva were observed, which resolved within 3 days against the background of the use of NSAIDs, root protectors and antibiotic therapy. After laser cyclophotocoagulation, a temporary depigmentation of the eyelid edges was observed. The patient was discharged with stable intraocular pressure. Repeated measurement of intraocular pressure in one month after surgery was 12 mmHg.

5 Results and conclusions
The primary goal of glaucoma management is the rapid reduction in intraocular pressure of less than 24 mmHg. For this, loop diuretics, synthetic analogs of prostaglandins F2α, selective α2-adrenergic agonists, as well as a combination of β-adrenergic receptor blockers and carbonic anhydrase inhibitors are recommended. In case of ineffective drug management of glaucoma, transscleral cyclophotocoagulation is carried out with the aim of partial destruction of the ciliary body, and a persistent decrease in intraocular pressure. In acute primary glaucoma, this operation saves the eyesight on the affected eye, in case of chronic glaucoma, the operation is an alternative to enucleation and is carried out in order to preserve the eye, a good cosmetic effect.

In secondary glaucoma, the prognosis for vision depends on the effective control of the underlying disease.

Transscleral cyclophotocoagulation is an effective method for persistently lowering intraocular pressure and preventing complications in dogs and cats associated with high intraocular pressure. It is an alternative to enucleation in severe glaucoma and can be used both to fully restore the function of the eye and acute glaucoma cure, and to save the eye, which irrecoverably lost its function in chronic glaucoma.

In each case, the mode, the number of points is selected individually depending on the initial value and target level of intraocular pressure, the stage of glaucoma. Experience with this treatment method shows that sometimes repeated intervention is required if it is not possible to achieve the proper values of intraocular pressure after the first procedure. With a stable increase in pressure above 20 mmHg, drawing of at least 30 points dorsally and 20 ventrally relative to the cornea is recommended, with preset values, since a smaller number of them leads to relapse. After transscleral cyclophotocoagulation, there is always a short-term increase in intraocular pressure, as a result of which, intraoperatively, immediately after the application of the laser, aqueous humor should be aspirated and the patient should be left in the intensive care unit for monitoring intraocular pressure until its completely stabilized.

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