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Case Report
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Urrets-Zavalia syndrome following cataract surgery in dogs: A case series

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Abstract

Background: In human medicine, Urrets-Zavalia syndrome (UZS) is a well-recognized but uncommon postoperative complication characterized by a fixed dilated pupil, accompanied by iris atrophy and glaucoma. Although it was originally reported in 1963 after penetrating keratoplasty surgery for keratoconus, it has been associated with various ophthalmic procedures such as cataract surgery. The condition has not been previously published in the veterinary literature.

Case Description: Three client-owned diabetic dogs that developed UZS´s triad after cataract surgery are described. Despite uneventful phacoemulsification in the six eyes, five developed moderate-to-severe postoperative ocular hypertension. Although intraocular pressure (IOP) spikes were initially controlled, fixed dilated pupils accompanied by iris atrophy and chronic ocular hypertension were seen in the five affected eyes. Aggressive medical and surgical management maintained vision in three of those eyes. In one eye, uncontrolled IOP led to blindness.

Conclusion: This is the first published description of UZS in dogs, occurring after phacoemulsification. Although no exact, demonstrable causative element could be determined, we believe that should be considered a triggering condition for this syndrome, as it directly affects the ocular blood flow autoregulation and intrinsic uveal tissue integrity. Until the contrary is proved, diabetes mellitus might be considered as a risk factor for developing this syndrome after cataract surgery in dogs.

Keywords: Iris atrophy, Mydriasis, Ocular hypertension, Phacoemulsification, Postoperative complication.

Introduction

In 1963, an Argentinian ophthalmologist named Alberto Urrets-Zavalia described a fixed and dilated pupil syndrome, accompanied by iris atrophy and glaucoma, as a complication of penetrating keratoplasty for keratoconus (Urrets-Zavalia, 1963). At that time, the author associated the uncommon postoperative complication with the use of topical mydriatic agents (atropine). Later on, this syndrome was described in association with other surgical procedures, such as different methods of keratoplasty (Maurino *et al.*, 2002; Minasian and Ayliffe, 2002; Srinivasan and Patnaik, 2004; Fournié *et al.*, 2009; Anwar *et al.*, 2012; Bozkurt *et al.*, 2012; Foroutan *et al.*, 2016), intracameral gas injection for the treatment of corneal hydrops (Aralikatti *et al.* 2008), trabeculectomy (Jain *et al.*, 2000), goniotomy (Chelnis *et al.*, 2012; Walton, 2013), intraocular lens implantation (Yuzbasioglu *et al.*, 2006; Park *et al.*, 2008; Pérez-Cambrodí *et al.*, 2013; Narang *et al.* 2017), cataract surgery (Monson *et al.*, 1992), argon laser retinal photocoagulation (Lifshitz and Yassur, 1988), 360-degree peripheral iridoplasty (Espana *et al.*, 2007), and anterior chamber foreign body removal (Totuk *et al.*, 2018). The exact mechanism of Urrets-Zavalia syndrome (UZS) is still unknown. The dilated pupils do not seem to respond to pilocarpine, sympatholytic agents, or to alpha-adrenergic blockers. Hence, the treatment in human patients is directed toward the symptomatic control of glare, intraocular pressure (IOP), and photophobia with concealment of anisocoria with cosmetic contact lenses (Narang *et al.*, 2017) or corneal micro pigmentation (Reed, 1994; Alio *et al.*, 2012).

In the veterinary literature, apart from a case report recently presented at the European College of Veterinary Ophthalmologists meeting (Bilotta and Busse, 2021), no descriptions of UZS have been published, so far. Herein, we describe three cases of UZS in diabetic dogs occurring after cataract surgery and discuss the etiological mechanisms for this syndrome.

Case Details

The medical records of three client-owned dogs that developed clinical signs compatible with UZS after bilateral cataract surgery at the Veterinary Teaching Hospital of the Autonomous University of Barcelona (VTH-UAB) from 2020 to 2021 were retrospectively reviewed. In the short-term postoperative period of uneventful phacoemulsification, the syndrome was suspected when an acute, fixed and dilated pupil,

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accompanied with clinical iris atrophy and glaucoma were detected.

Signalment, clinical findings, and preoperative evaluation

There were two spayed females [a mix breed dog (case 1) and an Ibizan Warren Hound (IWH; case 2)] and a neutered male [Yorkshire Terrier (YT; case 3)], of ages between 9 and 10 years and 4–15 kg. All the animals were diagnosed with diabetes mellitus 2–5 months prior to presentation. Owners reported that the dogs have gone blind within a very short period after the diagnosis of diabetes (1–3 months). Apart from hypothyroidism in case 2, no other concurrent systemic diseases were detected, and complete physical examinations at presentation were unremarkable.

Ocular findings at the first presentation are summarized in Table 1. In three dogs, initial ophthalmic examination revealed absent menace response in both eyes (OU) with no other relevant findings in the neuro-ophthalmological examination. Schirmer Tear Test 1 (MSD Animal Health, Madison, NJ) and tonometric values (TonoVet®, Icare Finland Oy, Helsinki, Finland) were within normal limits. Biomicroscopic examination (Kowa SL17®, Kowa Company Ltd., Tokyo, Japan) revealed intumescent cataracts OU, impairing fundus examination. Although mild senile iris atrophy was bilaterally seen in cases 1 and 2, pupillary light reflexes (PLRs) were not affected. Fluorescein test was negative in all the eyes.

Abnormalities of the preoperative complete blood count and serum biochemistry studies for each dog are summarized in Table 2. In all the eyes, the preoperative gonioscopic evaluation revealed an open iridocorneal angle (ICA) with no pectinate ligament dysplasia. In addition, ocular ultrasound examination was unremarkable, with biometric measurements of the crystalline lens diameter varying between 12.9 and 14.3 mm, and short-protocol electroretinography revealed regular retinal activity in all the eyes.

Preoperative treatment and surgical procedure

All the dogs were treated 5–6 hours before surgery with flunixin-meglumine (0.5 mg/kg IV; Nixyvet 50mg/ml®, Divasa-Farmavic, S.A. Group, Barcelona, Spain), and at anesthesia induction with cefazolin (25 mg/kg IV; Cefazolina Normon, Laboratorios Normon S.A., Madrid, Spain). In addition, topical tropicamide (Colircusí Tropicamida®, Alcon Healthcare, Barcelona, Spain), 1% phenylephrine (Colircusí Fenilefrina®, Alcon Healthcare, Barcelona, Spain), 0.1% nepafenac (Nevanac 1 mg/ml®, Alcon Healthcare, Barcelona, Spain), and ciprofloxacin (Oftacilox®, Alcon Healthcare, Barcelona, Spain), were applied every 30 minutes for 2 hours.

Cataract surgery consisted of a routine one-handed divided-and-conquer phacoemulsification procedure using a peristaltic pump (Alcon Infinity Vision System®, Alcon Healthcare, Barcelona, Spain). Intracameral fluids used along the surgery included: balanced salt solution, refrigerated Ringer´s solution, 2.2% sodium hyaluronate viscoelastic (An-bfh 2.2%®, an-vision, Hennigsdorf, Germany), and intracameral tissue plasminogen activator (0.25 µg/0.1 ml). In all the eyes, and acrylic lens of the appropriate size was inserted in the capsular bag (MD8®, an-vision, Hennigsdorf, Germany). All surgeries were uneventful, and sodium hyaluronate was removed using the automated irrigation/aspiration system following placement of the IOL. For all the eyes, 45º mini-flared Kelman tips were used, and phacoemulsification metrics were recorded (Table 3). The corneal incision was closed by 3–4 simple interrupted sutures (Dafilon 9/0®, B Braun, Melsungen, Germany), resulting in a watertight seal. Recovery from general anesthesia was uneventful.

Immediate and short-term postoperative management

Immediate postoperative management included buprenorphine (15 µg/kg IV; Buprex®, Indivior Europ Limited, Dublin, Ireland), topical 0.1% nepafenac q4h (Nevanac 1 mg/ml®, Alcon Healthcare, Barcelona, Spain), ciprofloxacin q4h (Oftacilox®, Alcon Healthcare, Barcelona, Spain), carbomer gel q4h (Viscotears®, Bausch & Lomb, Laval, CA) and tonometry every 2 hours for the first 24 hours. IOP spikes were treated accordingly to the "*VTH-UAB protocol for managing postoperative intraocular pressure spikes in dogs*," which includes topical carbonic anhydrase inhibitors, beta-blockers, synthetic prostaglandins, and anterior chamber decompression (ACD), depending on the IOP values (Table 4). Five out of the six eyes developed moderate-to-severe postoperative ocular hypertension (POH) (40–75 mmHg), requiring a combination of topical antiglaucoma drugs with ACD. The number of ACD needed to return the IOP to normal levels (≤20 mmHg) were as follows: case 1 (3 ACD OU), case 2 (2 ACD OU), and case 3 [1 ACD in the left eye (OS)].

Postoperative treatment at discharge consisted of topical 0.1% nepafenac q4h, ciprofloxacin q4h, carbomer gel q4h, and tropicamide q12h, as well as robenacoxib q24h (1 mg/kg, Onsior®, Elanco, IN). In addition, a combination of dorzolamide and timolol (Cosopt®, Santen Oy, Tampere, Finland) was added OU q6h in cases 1 and 2.

At first recheck, 1 week postoperatively, dogs seemed to cope well with medication; nevertheless, cases 2 and 3 showed signs of unilateral discomfort in the right and left eye, respectively. At the examination, menace response was present OU in dogs 2 and 3 while diminished in dog one. Five out of the six eyes showed dazzle reflex but absent PLRs with unresponsive mydriatic pupils. At that time, mydriasis was classified as severe in three eyes (case 1 OU and case 3 OS) and moderate in 2 (case 2 OU) (Fig. 1). IOPs values were as follow: case 1 [55 mmHg right eye (OD); 42 mmHg OS], case 2 (72 mmHg OD; 12 mmHg OS) and case 3 (5 mmHg OD; 57 mmHg OS). Biomicroscopic examination revealed different degrees of bulbar conjunctival congestion and diffuse corneal edema; all the eyes showed mild

Table 1. Ocular findings of dogs affected by UZS after cataract surgery. Findings at first presentation and last recheck are shown.

		First ophthalmic examination					Last ophthalmic examination					
		Vision			IOP (mmHg)	Inflammation =(Aqueous flare)	Vision			IOP (mmHg)	Inflammation (Aqueous flare)	IOL Position
		Menace	Dazzle	DPLR			Menace	Dazzle	DPLR			
Case 1	OD	-	+	+	17	-	-	NC	- (severe mydriasis)	7	Very mild	N
	OS	-	+	+	18	-	+	+	- (severe mydriasis)	7	Very mild	N
Case 2	OD	-	+	+	10	-	-	-	- (moderate mydriasis)	16	Very mild	N
	OS	-	+	+	9	-	+	+	- (moderate mydriasis)	6	-	N
Case 3	OD	-	+	+	13	-	+	+	+	7	Mild	N
	OS	-	+	+	15	-	+	+	- (moderate mydriasis)	22	Very mild	N

(NC): Non-conclusive; (N): Normal.

Table 2. Abnormalities of the preoperative complete blood count and serum biochemistry studies for three dogs affected by UZS.

	Complete blood count				Biochemistry			
	Parameter	Result	Reference range		Parameter	Result	Reference range	
Case 1 IWH	Erythrocytes	9.12	5.65–8.87	M/µl	Glucose	528	70–143	mg/dl
	RDW	22.7	13.6–21.7	%	Sodium	142	144–160	mmol/l
	Reticulocytes	156.9	10.0–110.0	K/µl	Chloride	106	109–122	mmol/l
	Lymphocytes	0.77	1.05–5.10	K/µl	Albumin	4.2	2.2–3.9	g/dl
	MPV	13.8	8.7–13.2	fl	ALT	188	10–125	U/l
					Total bilirubin	1.1	0.0–0.9	mg/dl
Case 2 Mixed	Monocytes	0.064	0.15–1.35	K/µl	Cholesterol	413.9	135–270	mg/dl
	Eosinophils	0	0.1–1.5	K/µl	ALT	157	21–102	UI/l
Case 3 YT					Fructosamine	488.9	192.6–357.4	µmol/l
					ALKP	290	20–156	UI/l
					Potassium	3.94	4.37–5.35	mmol/l
					Sodium	135.5	141–152	mmol/l
					Chlorine	99.1	105–115	mmol/l

(RDW): Red cell distribution width; (MPV): Medium platelet volume; (ALT): Alanine aminotransferase; (ALKP): Alkaline phosphatase.

Table 3. Metrics of the peristaltic phacoemulsification procedures of three dogs postoperatively affected by UZS.

	Eye	Time (minutes)	Power (%)	Energy (%-seg)	Fluids (ml)
Case 1	OD	3.27	28.70	93.80	229
	OS	3.55	29.50	104.72	210
Case 2	OD	4.01	26.70	106.80	194
	OS	3.55	31.50	111.82	208
Case 3	OD (non-affected)	3.03	34.50	104.53	149
	OS	3.04	36.50	110.96	158

Table 4. VTH-UAB protocol for managing postoperative IOP spikes in dogs.

< 20 mmHg	• Follow the prescribed traetment
20-30 mmHg	• NON-CARDIAC PATIENT: Apply one drop of dorzolamide + timolol • CARDIAC PATIENT: Apply one drop of dorzolamide • Recheck IOP in one hour
30-40 mmHg	• Apply one drop of latanoprost • Recheck IOP in one hour
> 40 mmHg	• Manual ACD through corneal incision (Hildebrand *et al*., 2003) • Recheck IOP in one hour

aqueous flare, centered intraocular lens (IOL), and normal fundus examination. The hypertensive eyes (n = 4) were treated with a drop of latanoprost (Xalatan®, Pfizer, New York, NY), and IOPs rechecked after 30 minutes. IOP dropped down to normal values; thus, latanoprost was added to the previous treatment, and tropicamide was discontinued. In the following rechecks, despite the use of latanoprost, mydriasis was still present in dogs one and two OU and in dog three OS. Based on the presence of the three classical signs (mydriasis, iris atrophy, and glaucoma), UZS was diagnosed in the three dogs, being initially classified as severe for case 1 OU and case 3 OS and moderate for case 2 OU.

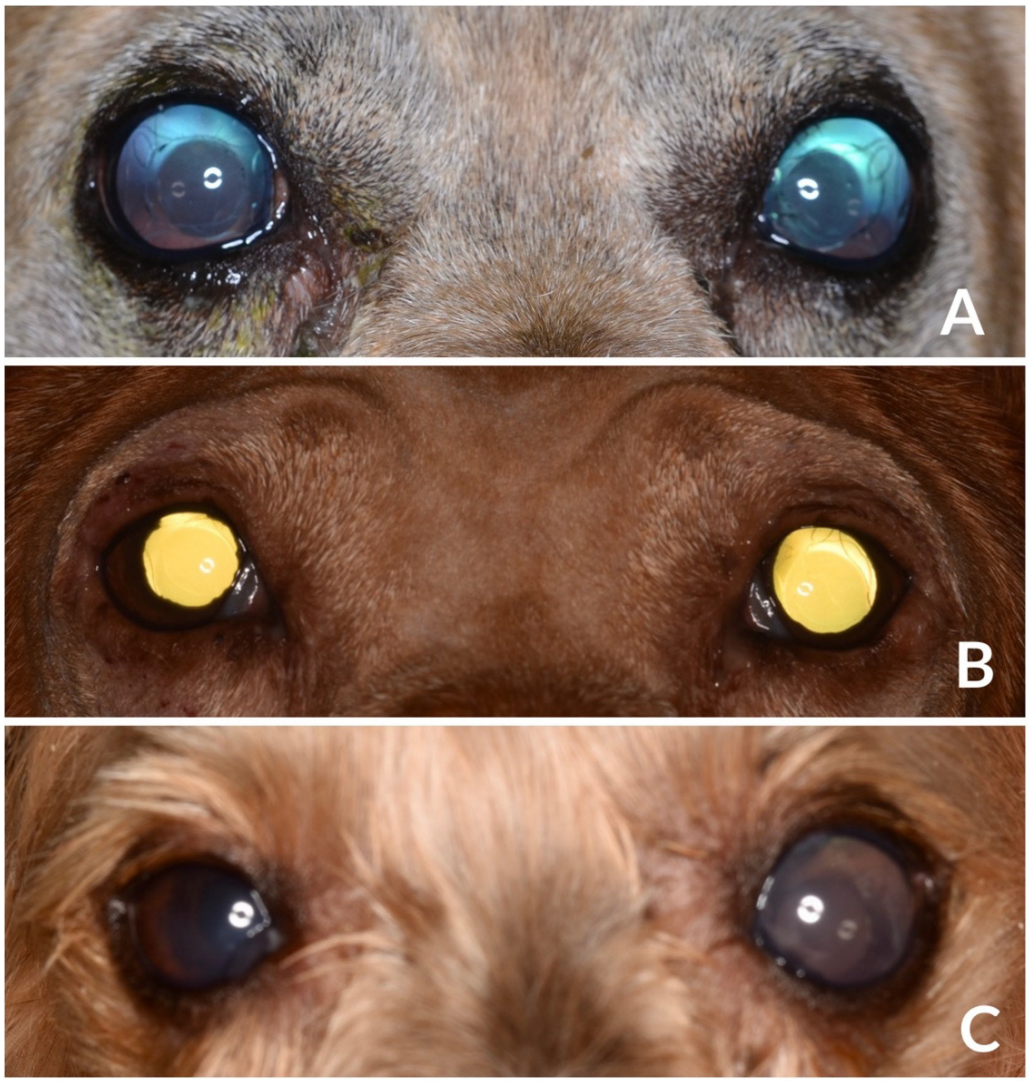

Fig. 1. Images of diabetic dogs affected by UZS. (A): Fixed, severely dilated pupils in a 9-year-old mixbreed dog, 1-week after bilateral cataract surgery. (B): Fixed moderately dilated pupils (OS>OD) in a IWH, 2-week after bilateral cataract surgery. (C): Fixed severely dilated left pupil in a YT dog, 1-week after bilateral cataract surgery. Dogs from figures A and B showed preoperative mild iris atrophy but normal PLRs.

Long-term postoperative treatment and outcome

Two weeks after the surgery, case 1 was rechecked due to a sudden episode of blindness. Menace response and dazzle reflex were absent, and pupils rested at the same severe mydriatic status. IOPs were 70 mmHg OD and 56 mmHg OS. Dynamic gonioscopy (17 mm Koeppe goniolens®, Ocular Instruments Inc., Washington, DC) confirmed the closure of the ICA due to a complete peripheral anterior synechia. Options were discussed with the owners, and an intraocular surgery was performed for breaking synechiae. Surgery occurred uneventfully, but although intracameral acetylcholine was injected in both eyes (Acetilcolina 10 mg/ml cusí®, Alcon Healthcare, Barcelona, Spain), no pupil movement was observed. Along with postoperative rechecks, pupils remained dilated, and IOP spikes in both eyes required further management with mannitol iv (Mannitol Mein 20%®, Fresenius SE&Co, Bad Homburg v.d.H., Germany) and topical combination of brinzolamide and brimonidine (Simbrinza®, Alcon Healthcare, Barcelona, Spain). At the time of writing this paper, menace response was only present OS with both pupils severely mydriatic and unresponsive to light. IOPs at that moment were 7 mmHg OU, and the dog was under topical medication with brinzolamide/brimonidine q6h and latanoprost q12h, as well as with systemic citicoline (15 mg/kg PO; Neuro-CPD®, Vetilea SL, Barcelona, Spain).

Similarly, case 2 was reviewed 3 weeks after the surgery due to severe discomfort in the right eye. No menace response, dazzle reflex, nor PLRs were observed. OD and IOP were 65 mmHg. Due to the uncomplete response to the systemic medication with mannitol (2 g/kg iv) and the topical medication with latanoprost, brinzolamide, and brimonidine, persistent IOP spikes lead to a comfortable but blind eye OD. At last recheck before writing this manuscript, positive menace response and dazzle reflexes were present OS and absent OD, although the pupils remained moderately mydriatic and unresponsive to light. IOP was16 mmHg OD and 6 mmHg OS, and the dog were under a topical combination of brinzolamide and brimonidine OU q6h (Simbrinza®, Alcon Healthcare, Barcelona, Spain) and systemic citicoline.

At last recheck, case 3 showed menace response and dazzle reflex OU, had a moderately mydriatic and unresponsive left pupil, and the IOPs were 7 mmHg OD and 22 mmHg OS. The dog was under topical antiglaucoma medication OS (dorzolamide q8h and latanoprost q24h) and systemic citicoline.

Based on the outcome and the partial pupillary recovery of the left eye of case 3, severity was reestablished, being considered as severe in two eyes (case 1) and moderate in three eyes (case 2 and case 3).

Discussion

Phacoemulsification is considered as the gold-standard treatment for cataracts, being routinely performed by veterinary ophthalmologists (Michau, 2021). In the hands of experienced surgeons, surgical outcomes mirror the ones described in human´s ophthalmology, with a low incidence of complications reported (17.3%) (Klein *et al.*, 2011). Postoperative complications have decreased significantly over time due to factors such as improvement in the patient selection process, tissue handling, use of nondepolarizing neuromuscular blocking agents, adequate preoperative mydriasis, shortened surgical times, type of IOL, and use of ophthalmic viscosurgical devices (OVDs), among others. Immediate postoperative complications described in dogs so far include corneal incision dehiscence and infection, corneal ulceration, corneal endothelial decompensation and edema, intraocular hemorrhage, anterior uveitis, fibrin, toxic anterior chamber syndrome, and POH (Michau, 2021). Similarly, the most common long-term postoperative complications described are corneal lipidosis, degenerations and ulcerations, endophthalmitis, posterior and anterior capsule opacification, IOL decentration or luxation, glaucoma, retinal detachment, and peripheral ocular neuropathies (Michau, 2021). In addition, conversely to what has been widely described in human literature (Galiani and Aminlari, 2002), there are only two descriptions of the atonic pupil as a postoperative complication of phacoemulsification (Bilotta and Busse, 2021; Michau, 2021). Nevertheless, none of the above were associated with high IOPs.

UZS, although by no means frequent, has been a well-recognized, postoperative ocular complication in humans since 1963 (Urrets-Zavalia, 1963). Along the last decades, the syndrome, initially described by a fixed dilated pupil with iris atrophy and increased IOP, has englobed other clinical presentations, keeping fixed dilated pupils the main clinical sign (Spierer and Lazar, 2014). Nowadays, UZS has two well-known presentations with varying severity. The milder form is characterized by fixed mydriasis seen as a sole finding. The pupil dilation may diminish gradually in the next month or so until it returns to its normal size. As a rule, the slow process of recovery occurs spontaneously, leaving as a sequela diffuse atrophy of the anterior layers of the iris (Spierer and Lazar, 2014; Isac *et al.*, 2019). This form may easily go unnoticed based on the milder clinical findings and the mandatory use of postoperative topical mydriatics. A more severe form of UZS can be seen in less fortunate cases, showing marked fixed mydriasis is accompanied with iris atrophy and increased IOP. In most cases, mydriasis is irreversible and even exaggerated in parts, producing at the same time an ectropion of the pigment epithelium at the pupillary border and secondary dyscoria. Invariably, there is also a marked tendency toward the formation of synechiae. The clinical picture is much reminiscent of that encountered after a severe attack of high IOP (Magalhães *et al.*, 2016). Despite the five affected eyes of this case series showing the clinical appearance of iris atrophy and glaucoma, three were initially classified as severe forms of UZS based on their fixed severe mydriasis, and two as moderate forms. Along the postoperative period, one eye showed partial pupillary improvement, showing more moderate mydriasis, thus being re-classified as a moderate form.

Although UZS has shown no predilection for age, gender, or systemic concomitant diseases in humans (Magalhães *et al.*, 2016), the three dogs reported in the present study were diabetic. The role diabetes mellitus may have played in the development of the condition is uncertain; however, considering that vasculitis is a relatively common complication in diabetic patients (Rask-Madsen and King, 2013), it could have helped in its development. Without a doubt, the relationship between diabetes mellitus and UZS requires further investigation.

In human literature, the clinical signs of UZS have been reported to appear between 1 and 21 days after the surgery (Totuk *et al.*, 2018; Kurtz and Fradkin, 2021). The exact time for the clinical signs to appear in the present study is unknown, as our first post-phacoemulsification recheck was performed 7 days after the surgery in all the cases. Even though the clinical signs were evidenced at the first recheck, they

could have shown before and gone unnoticed by the owner.

Although the exact mechanism of UZS is still unknown, two main etiologies have been historically considered overtime. The first, observed after intraocular or non-penetrating surgery, seems to be caused by an IOP spike and impairment of the vascular supply to the iris constrictor muscle, leading to iris atrophy with subsequent persistent pupil dilation (Tuft and Buckley, 1995). The IOP spike, if short, could induce the milder form of the presentation (with mydriasis as the sole clinical sign), while if maintained over time, it could induce the more severe form of the syndrome (mydriasis, iris atrophy, and glaucoma). The second etiology**,** observed after 360-degree laser procedures, would seem to be caused by impairment of the parasympathetic pathway to the iris constrictor muscle, related to direct laser damage to the short ciliary nerves that run radially from the posterior pole toward the iris sphincter muscle (Vieira *et al.*, 2017). This form does not involve iris atrophy or secondary glaucoma, and thus we believed we should avoid grouping all the cases of fixed and dilated pupils under the same syndrome, as they do not have neither the same signs nor the same etiology. Thus, we suggest another syndrome should be defined to cover the cases in which the fixed and dilated pupil was not caused by iris ischemia precipitated by an IOP spike but by the direct impairment of the parasympathetic pathway to the iris constrictor muscle. The five eyes reported in the present study showed moderate to severe immediate POH which could have triggered the syndrome. In fact, the eye with milder clinical signs of UZS was the one with lower POH values, needing just one ACD for reestablishing normal IOP.

Different mechanisms could induce IOP spikes during the intraoperative or immediate postoperative period. Intraoperatively, the IOP could inadvertently rise as a result of OVDs. Studies comparing the effect of various viscoelastic formulations on postoperative pressure in humans undergoing cataract surgery abound in the literature with various conclusions (Henry and Olander, 1996). Although significant pupil atrophy has not been reported after the widespread use of OVDs in cataract extraction surgery, the IOP increase related to the use of OVDs during intraocular surgery has been postulated as a reason for UZS (Tan and Humphry, 1993; Bourcier *et al.*, 2001). Apart from the mechanical vascular compression, OVDs may cause a toxic effect, resulting in ischemia and, consequently, fixed and dilated pupils. Another critical point for intraoperative IOP increase is the phacoemulsification fluidics. Studies have reported that the different phacoemulsification approaches, the influx of irrigation fluid into the eye, and the efflux of the fluid through the side port and corneal incision site influence the IOP (Wilbrandt and Wilbrandt, 1993; Kang *et al.*, 2015). In fact, it is generally believed that maintenance of some incision leakage during the procedure acts as a fluidics buffer, thus reducing the intraoperative IOP. In the five eyes here reported, a clear corneal incision of 2.8 mm width was performed, corresponding to the width required by the phacoemulsification needle and infusion sleeve. All the eyes underwent a one-handed divide-and-conquer technique with no significant difference regarding the phacoemulsification time, power, and volume of fluids used when compared to other cataracts of the same degree of maturity in the same institution.

Similarly, immediate postoperative spikes have been associated with different factors, such as OVDs retention in the anterior chamber angle, preexisting compromise of outflow facility, surgical trauma, hyphema, inflammation, and the skillfulness of the surgeon (Michau, 2021). In the present study, besides cohesive OVDs were routinely removed from the anterior chamber and lenticular bag, moderate-to-severe IOP spikes were detected in all the affected eyes throughout the first 24 postoperative hours. Surprisingly, those spikes were higher in the most severely affected eyes, requiring repeated ACD to return to normal IOP values. Postoperative IOP spikes have been previously associated with ocular blood flow dysregulation and tissue ischemia (Tranos *et al.*, 2013). Elevated and maintained IOP combined with a low systemic blood pressure has been shown to reduce the ocular perfusion pressure, thus inducing tissue ischemia (Costa *et al.*, 2014). Unfortunately, no blood pressure measurements were taken during the immediate postoperative period; thus, this hypothesis could not be confirmed.

The five ocular surgeries were uneventfully performed by experienced surgeons, and no preexisting compromise of outflow facility was detected by gonioscopy in none of the eyes. Several studies compare the outcomes of cataract surgery in relation to POH. A study on the use of ultrasound biomicroscopy to investigate angle and globe morphology before and after phacoemulsification in dogs concluded that dogs with larger ICA and AOD measurements before surgery were at greater risk of developing POH (Rose *et al.*, 2008). Another recent study revealed that eyes with abnormal gonioscopy findings are at an increased risk of postoperative glaucoma compared with eyes with normal gonioscopy findings (Sanders *et al.*, 2021). Therefore, gonioscopy is recommended as a part of the presurgical assessment in all dogs before phacoemulsification.

Although TASS has been reported to be a risk factor for developing UZS in humans (Nizamani *et al.*, 2013), the degree of postoperative intraocular inflammation seen in those eyes was considered as normal, with mild to moderate degree of aqueous flare that improved with medical treatment along the postoperative period.

Although the use of mydriatics, more specifically, atropine, has been classically postulated as an etiology for UZS, none of the dogs of this study were treated with topical atropine nor with intracameral phenylephrine. Mydriatic preoperative medication consisted of topical tropicamide and phenylephrine (1%).

Nowadays, there is no curative treatment for this condition. The use of topical parasympathetic (pilocarpine) and sympatholytic agents (dapiprazole and guanethidine) has been investigated. Although the majority of studies on the use of topical pilocarpine and guanethidine showed no improvement of the fixed and dilated pupils (Bonnet *et al.*, 1969; Bourcier *et al.*, 2001; Espana *et al.*, 2007; Kaeser and Kawasaki, 2010), when both combined, they were able to partially treat sympathetic spasm and induce miosis (Lagoutte *et al.*, 1983). Similarly, dapiprazole was successfully used for restoring pupil size in a patient with UZS after a keratoplasty procedure (Spadea *et al.*, 2008). In parallel, several reconstructive surgical treatments have been described in humans for symptomatic permanent mydriasis. These include keratopigmentation (Reed, 1994; Alio *et al.*, 2012), a black diaphragm intraocular lens (Sundmacher *et al.*, 1994), and pupilloplasties (Ogawa, 1998; Narang *et al.*, 2017). At the time of writing this report, three eyes remained still visual, all under topical antiglaucoma drugs. None of them responded to topical pilocarpine or latanoprost during the study period, maintaining mydriasis. No overt signs of photophobia were observed. To summarize, this is the first published description of UZS in dogs, occurring after phacoemulsification surgery. Even though no exact, demonstrable causative element could be determined, we believe that the use of ocular viscoelastic devices or topical tropicamide/phenylephrine was not directly associated with the onset of UZS. Conversely, POH should be considered a triggering condition for this syndrome, as it directly affects the blood flow autoregulation and intrinsic uveal tissue integrity. Until the contrary is proved, diabetes mellitus might be considered a risk factor for developing this syndrome after cataract surgery in dogs.

Conflict of interest

The authors declare that there is no conflict of interest.

Author contributions

Marta Leiva, Francisco Cantero, and Laura Gaztelu did the diagnosis, provide key information and analyzed the data. Francisco Cantero and Marta Leiva designed the manuscript, wrote the original draft, and revised it critically for important intellectual content. All the authors had direct patient contact, revised, edited the manuscript, and gave their final approval for the version to be published.

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