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CORRELATION BETWEEN DURATION OF GAS ANESTHESIA WITH ISOFLURANE AND THE REDUCTION OF TEAR PRODUCTION IN GERIATRIC PATIENTS

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Abstract

This study was performed in order to investigate the correlation between duration of gas anaesthesia with isoflurane and the reduction of tear production in geriatric patients. The study was conducted on 15 dogs (8 males and 7 females, ages between 9 and 14 years old) that were presented at the Faculty of Veterinary Medicine of Bucharest between September – October 2016. Preanesthetic examination was performed according to ASA status (American Society of Anesthesiologists). Patients premedication was made with Midazolam 0.2 mg/kg and Butorphanol 0.2 mg/kg injected intramuscularly (IM) or intravenously (IV). All dogs were intubated, induction was made with Propofol 4-6 mg/kg IV and maintenance was performed with Isoflurane. All patients had Schirmer Tear Test (STT) readings taken prior to intubation and immediately after the isoflurane was turned off. All dogs that were under isoflurane anaesthesia for less than 30 minutes had a slight reduction of tear production compared with those that exceeded 30 minutes in which it was noticed a drastic decrease in tear production. From the total of 15 dogs: 3 dogs that were under isoflurane anaesthesia for less than 30 minutes had a final STT of 15 mm/min +/- 3 mm/min compared with those in which anaesthesia time exceeded 30-40 minutes where the final STT was 5 +/- 3 mm/min.

Key words: *Geriatric patients, Isoflurane, Schirmer Tear Test, tear production.*

INTRODUCTION

The precorneal tear film (PTF) is extremely important for the maintenance of the ocular surface health.

Its functions include primary oxygen source to the avascular cornea, removal of debris and exfoliated cells through drainage, lubricant between the eye lids and a source of protective antimicrobial proteins.

The PTF is described as a three structurally and functionally unique layers consisting of lipid, aqueous and mucin components.

The cornea is extremely vulnerable to injury during general anesthesia when the palpebral reflex and the corneal reflex cannot protect the eye from drying, from corneal abrasions or from other corneal injuries.

Dry corneal epithelium may be easily desquamated and removed by the normal movement of the eyelids that can cause painful postanesthetic ulcers of the cornea (Gelatt, 2013).

The objective of this study was to investigate the correlation between the duration of gas anesthesia with isoflurane and the reduction of tear production in geriatric patients. The hypothesis was that longer the anesthetic duration would cause a lower postanesthetic tear production.

MATERIALS AND METHODS

The study was conducted on 15 canine patients of different ages, belonging to different breeds.

The patients were anesthetized for different surgical procedures: ovariohysterectomy, castration, mammectomy, cistotomy (Table 1).

Physical examination, complete blood count and ophthalmic examination on both eyes were performed.

Patients did not receive any ocular medication and had no abnormalities during examination.

Aqueous tear production was measured in millimetres per minute by use of the Schirmer Tear Test (STT) by placing the tear test strip in the ventral conjunctival fornix approximately one-third of the distance from the lateral to medial canthus (Fig. 1).

Table 1. Breed, age and gender particularities of all geriatric dogs submitted to the study

Crt. No.	BREED	AGE	GENDER ♂/♀
1	Poodle	14 years	♂
2	Pekinese	13 years	♂
3	Half breed	13 years	♀
4	Golden Retriever	12 years	♀
5	Poodle	12 years	♂
6	Maltese Bichon	12 years	♀
7	Bichon	11 years	♀
8	Great Dane	11 years	♂
9	Cocker	11 years	♂
10	Mini Schnautzer	10 years	♂
11	Schitzu	10 years	♀
12	Cross breed	10 years	♀
13	Cross breed	10 years	♂
14	Bichon	9 years	♀
15	Cross breed	9 years	♂

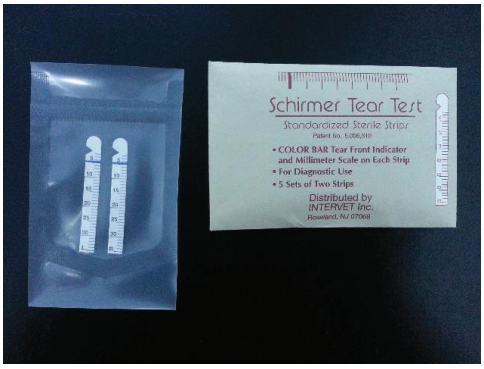

Figure 1. Schirmer Tear Test (original)

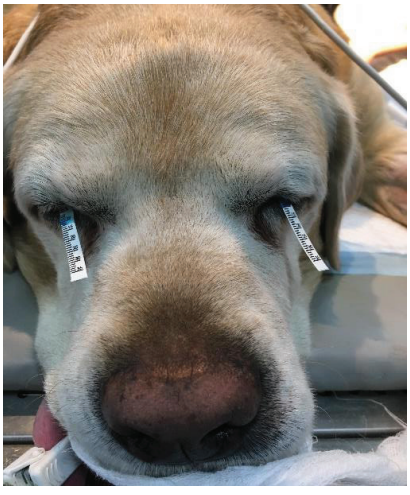

Figure 2. STT readings (original)

After the test strip was inserted, the eyelids were gently held closed for 1 minute, at which time the STT was read and recorded. Testing was performed bilateral (Fig. 2). Before each test was done, the inferior cul-de-sac was gently swabbed with a cotton- tipped applicator to remove accumulated tears and mucus.

Tear production was measured at baseline (before intubation) and immediately after the isoflurane was turned off.

Anesthesia was induced with Propofol (4-6 mg/kg IV). Intermittent positive-pressure ventilation (IPPV) was initiated by use of a volume-cycled ventilator delivering 12 breaths/minute to achieve a target end-tidal CO_2 of 35-45 mm/Hg. Oxygen flow was initially delivered at 2 L/minute with the vaporizer set to achieve an end-tidal concentration of 2.0% isoflurane within 10 minutes of induction (Costea, 2015).

After the target concentration was achieved, oxygen flow was decreased to (500+10/kg) L/minute. Crystalloid solutions were administered at 3-5 ml/kg/hour IV throughout anesthesia.

At the end of the surgery, the isoflurane was turned off and the Schirmer Tear Test was performed. Afterwards, the residual inhalant anesthetic was flushed from the breathing circuit.

IPPV was discontinued and patients were extubated when they began to breathe spontaneously and to reject the endotracheal tube (Costea, 2016). After STT was measured, an ocular lubricant was applied to each of the patient`s eyes to protect the cornea.

RESULTS AND DISCUSSIONS

Mean tear production for Schirmer Tear Test measurement in all patients at baseline for the right and the left eyes were 20 mm/min +/- 5 mm/min (Figure 2). From the total of 15 dogs: 3 dogs that were under isoflurane anesthesia for less than 30 minutes had a final STT of 15 mm/min +/- 3 mm/min compared with those in which anesthesia time exceeded 30-40 minutes where the final STT was 5 +/- 3 mm/min (Table 2). Aqueous tear production was reduced in patients during anesthesia and returned to baseline values immediately in the recovery period, for all the cases.

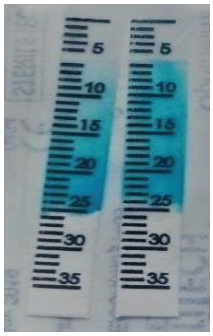

Figure 3. Schirmer Tear Test at baseline (original)

The decreased intra-anesthetic lacrimation observed in the present study may be attributable to vagolytic or sympathomimetic effects of the gas anesthetic (Ding, 2003). Because vagolytic and sympathetic activity were not measured in this study they cannot be definitively ruled out as factors.

Decreased intra-anesthetic lacrimation may be described as a blockade of trigeminal function associated with anesthetic depth. Lachrymal secretion is mostly dependent on afferent sensory function of the trigeminal nerve, followed by an efferent motor response by the facial nerve (Acosta et al., 2004).

The anesthetic depth may have abolished trigeminal sensory function in a way similar to the effect of inhalant anesthetics on other afferent input, thereby disabling a lachrymal response. Once the patient was able to stand, indicating the return of the afferent and efferent nerve function, sensory input from the trigeminal nerve was likely restored, resulting in normal tear production (Acosta et al., 2004).

Intra-anesthetic tear production may have also been caused by lagophthalmos. This is not the cause of decreased aqueous tear production but it is a condition that accelerates tear evaporation via decreased blinking.

Dogs with lagophthalmia may have a rapid evaporation of tear film from the corneal surface because of increased corneal exposure or decreased tear film quality (lipid or mucin). Tear evaporation was not evaluated during or immediately following anesthesia so, Schirmer Tear Test readings could not be correlated with tear film break-up time data (Tzubota, 1998).

Duration of anesthesia in the present study had a causal relationship with decreased postanesthetic tear production in geriatric dogs. This reveals that procedures longer than 30 minutes cause a decrease in tear production.

The hitch of lagophthalmos was not controlled in this present study; no effort was made to close the dogs' eyes during anesthesia. Future studies investigating the effect of lagophthalmos on intra-anesthetic aqueous tear production may include STT and tear film break-up time measurement in geriatric dogs with one eyelid taped closed and one eyelid left open during general anesthesia.

CONCLUSIONS

All geriatric dogs in this study had a decreased intra-anesthetic tear production during isoflurane anesthesia. Ocular lubricant or tear replacement should be used as a corneal protectant for patients that are going to be under gas anesthesia with isoflurane for more than 30 minutes.

Table 2. Schirmer Tear Test values at baseline and after isoflurane was turned off; OD- right (oculus dexter) eye, OS – left (oculus sinister) eye

Crt. No.	Anesthetic Duration (hour)	Baseline	STT after isoflurane was turned off
1	25 minutes	OD 15 mm/min OS 15 mm/min	OD 12 mm/min OS 12 mm/min
2	25 minutes	OD 20 mm/min OS 18 mm/min	OD 18 mm/min OS 15 mm/min
3	30 minutes	OD 20 mm/min OS 15 mm/min	OD 15 mm/min OS 15 mm/min
4	40 minutes	OD 15 mm/min OS 15 mm/min	OD 5 mm/min OS 5 mm/min
5	45 minutes	OD 15 mm/min OS 25 mm/min	OD 0 mm/min OS 10 mm/min
6	1 hour	OD 20 mm/min OS 15 mm/min	OD 0 mm/min OS 0 mm/min
7	1 hour	OD 15 mm/min OS 15 mm/min	OD 0 mm/min OS 0 mm/min
8	1 hour	OD 20 mm/min OS 25 mm/min	OD 10 mm/min OS 10 mm/min
9	1 hour	OD 20 mm/min OS 18 mm/min	OD 5 mm/min OS 5 mm/min
10	1 h 10 min	OD 18 mm/min OS 15 mm/min	OD 0 mm/min OS 0 mm/min
11	1 h 15 min	OD 15 mm/min OS 15 mm/min	OD 5 mm/min OS 5 mm/min
12	1 h 15 min	OD 15 mm/min OS 10 mm/min	OD 0 mm/min OS 0 mm/min
13	2 hours	OD 15 mm/min OS 15 mm/min	OD 5 mm/min OS 5 mm/min
14	2 hours	OD 15 mm/min OS 12 mm/min	OD 7 mm/min OS 5 mm/min
15	2 h 15 min	OD 15 mm/min OS 15 mm/min	OD 5 mm/min OS 0 mm/min

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