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Evaluation of the Effects of Medetomidine and Dexmedetomidine Use on Intraocular Pressure in Cats

Birkan Karslı[a*], Merve Bakıcı[b], Zeynep Pekcan[c]

Kırıkkale University, Faculty of Veterinary Medicine, Department of Surgery, Kırıkkale, Türkiye

[a]ORCID: 0000-0003-4208-3134; [b]ORCID: 0000-0001-8833-3499; [c]ORCID: 0000-0003-1047-5280

*Corresponding Author
E-mail: birkankarsli@gmail.com

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Abstract

In the present study, it was aimed to investigate the effects of α-2 agonists used for sedation in cats, namely medetomidine hydrochloride and dexmedetomidine, on intraocular pressure. Two study groups, each containing 17 animals, were formed. One of the groups was treated with 80 µg/kg medetomidine hydrochloride, and the other group with 40 µg/kg dexmedetomidine, via IM route. The animals underwent intraocular pressure measurement before sedative agent administration (T), at the time of vomiting (T1), after vomiting (T2), at 40th minute (T3), at 60th minute (T4), and 20 minutes after atipamezol administration (T5). There was no significant difference between intra-group intraocular pressure measurements taken at different times and inter-group IOP mesaurements taken at the same time points ($P>0.05$). A numerical increase occurred in intraocular pressure after vomiting, and intraocular pressure was found to be lower during sedation than at the baseline. In conclusion, it was determined that the administration of medetomidine hydrochloride and dexmedetomidine via intramuscular route for sedation reduced intraocular pressure but the levels remained within reference range.

Keywords: Anaesthesia, cat, intraocular pressure, tonometry.

INTRODUCTION

Intraocular pressure (IOP) measurement is an important diagnostic test because IOP levels are an important marker of ocular health and disease state. Intraocular pressure has a critical role on the road to success in the treatment and surgery of ophtalmological disorders (Broadwater et al., 2008; Gross and Pablo, 2015). A severe increase in intraocular pressure can damage the optic nerve or increase morbidity and worsen prognosis by causing the prolapse of ocular content in case of corneal and scleral instability. In patients undergoing corneal or intraocular surgery, excitement, coordination disorder, coughing, or gagging are undesired states in the early postoperative period. Therefore, it is desirable to achieve a balanced and multimodal anesthesia with agents that are capable of providing an unproblematic anesthetic recovery (Gross and Pablo, 2015; Bellini et al., 2017).

If sedation is needed for ocular examination or a more detailed ocular evaluation in animals, it is important to consider the effects of pharmacological agents. In veterinary medicine, most of the studies on the effects of different sedative/analgesic and anesthetic protocols on pupil diameter (PD) and IOP have been performed in dogs (Douet et al., 2018; Micieli et al., 2018). It is known that there is a limited number of studies examining the effects of sedatives and analgesics on intraocular pressure in cats (Malmasi and Ghaffari, 2015; Schroder et al., 2018). It is reported that the intraocular pressure is between 9 mmHg and 31 mmHg in a healthy eye in cats (Miller et al., 1991).

α-2 adrenoreceptor agonists are widely used as sedative agents, and are strong tranquilizer and analgesic drugs. Antagonizing their actions with atipamezol provides an advantage for their use. Medetomidine is the most commonly used α-2 adrenoreceptor agonist in small animals. It causes dose-dependent sedative effect 15-20 minutes after its intramuscular (IM) injection (Murrel JC, 2007). Dexmedetomidine is a α-2 adrenoreceptor agonist and a medetomidine isomer that is very similar to medetomidine with respect to pharmacokinetic properties. Previous studies have reported that α-2 adrenoreceptor agonists possess some ocular side effects (Aghababaei et al., 2021).

This study aimed to investigate the effects of the administration of medetomidine hydrochloride and dexmedetomidine via intramuscular route for anesthesia on IOP in cats, and to antagonize its effects with atipamezol.

MATERIALS AND METHODS

This study was approved by Kırıkkale University Animal Research Ethics Committee (AREC), and the owners of the animals were informed about the study. The study material consisted of 34 cats with healthy eyes, which required sedation for various interventions and examinations (mouth examination, radiological examination, bandage change). Animals that were found unsuitable for sedation with α-2 adrenoreceptor agonists due to the results of complete blood count and biochemical tests were excluded. The cats included in the study protocol were divided into two groups each

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containing 17 animals. One of the groups was administered 80 µg/kg medetomidine hydrochloride and the other 40 µg/kg dexmedetomidine via IM route. The animals underwent intraocular pressure measurement before the administration of the sedative agent (T0), at the time of vomiting (T1), after vomiting (T2), at 40th (T3) minute, and at 60th (T4) minute. Atipamezol was administered 60 minutes later, and the measurement was repeated 20 minutes after atipemazol (T5). Each measurement was repeated for three times, and the average level was recorded if there was no more than 5% difference between the measurements. All measurements were performed using the Tono-Pen Vet® aplanation tonometry device (Reichert, USA). The aplanation tonometry was calibrated before the measurements of each cat.

Statistical Analysis

SPSS v15 (SPSS Inc. Chicago, Illinois, America) statistical software package was used for the statistical analyses of the study data. The study data were tested for normality using the Shapiro–Wilk test and the results showed that they did not meet the parametric test assumptions. Therefore, a nonparametric test was used. Friedman test was used to analyze time-dependent differences within the groups, and Kruskal-Wallis nonparametric test to analyze the difference between the groups. $P<0.05$ was considered statistically significant.

RESULTS

The age of the animals included in the study was 17.1±1.78 months, and their body weight was 3.79±0.96 kg (Mean ± SEM).

There was no significant difference between intra-group intraocular pressure measurements taken at different times and inter-group IOP mesaurements taken at the same time points ($P>0.05$) (Table 1). It was noticed that there occurred a numerical, albeit statistically non-significant, decrease in IOP levels after the administration of α-2 adrenoreceptor agonists, and that those levels were higher after atipamezol injection than those at baseline and during sedation. While some animals were noted to be fully sedated after the injections, some others completed the period with very mild sedation. Those animals also had lower IOP levels during sedation than those at baseline. Twenty-five animals showed an elevation in IOP level after vomiting whereas no IOP change was observed in 9 animals.

Table 1. Intraocular pressure levels of cats sedated with medetomidine hydrochloride and dexmedetomidine before sedative agent injection (T0), after vomiting induced by sedative agent injection (T1), at 20th (T2), 40th (T3), 60th (T4) minutes, and at 20 minutes after atipamezol administration (T5).

	T0	T1	T2	T3	T4	T5
Medetomidine	15.71 ± 2.36	16.12 ± 2.95	15.18 ± 2.43	15.12 ± 2.26	14.76 ± 2.06	16.29 ± 2.41
Dexmedetomidine	15.76 ± 2.01	16.53 ± 3.04	15.41 ± 2.98	15.82 ± 2.92	15.71 ± 2.68	16.82 ± 2.53

DISCUSSION AND CONCLUSION

It is known that α-2 adrenoreceptor agonists cause vomiting, bradycardia, hypotension, hypertension, and IOP changes after their use (Kanda et al., 2005). In general, α-2 adrenoreceptor agonists depress sympathetic tone and may reduce IOP by decreasing humor aqueous production. Studies on small animals have reported that α-2 adrenoreceptor agonists cause a significant decrease in IOP in dogs, while they show no effect in cats at all (Artigas et al., 2012; Micieli et al., 2018). α-2 adrenoreceptor agonists were also used in the present study, and caused no significant change compared with both the baseline IOP level and the reference intraocular pressure levels, and caused only a numerical decrease compared with the baseline level. This indicates that the use of α-2 adrenoreceptor agonists had no unfavorable effects on intraocular pressure in cats.

Reference intraocular pressure measurements made with aplanation tonometry are between 12 mmHg and 32 mmHg in healthy animals (Miller et al., 1991). It is reported that an animal should be followed up for glaucoma and treated as necessary when intraocular pressure exceeds 25 mmHg in dogs and 27 mmHg in cats (Miller, 2008). The present study also showed that the baseline and post-injection levels were within the reference range. This finding was considered to be related to the fact that the sedative agents used did not have an effect on intraocular pressure.

Vomiting is an act that increases intraocular pressure; it particularly worsens deep corneal ulcers, descemetocele, staphyloma, and glaucoma (Rauser et al., 2012; Kanda et al., 2015). This is an important side effect that should be taken into consideration when administering α-2 adrenoreceptor agonists. Although the novel α-2 adrenoreceptor agonists have less vomitory effect, studies have shown that the rate of vomiting in cats is around 20% (Lemke, 2004). A former study used α-2 adrenoreceptor agonists and investigated the effects of nausea and vomiting on IOP. The results of that study showed no positive correlation between vomiting and IOP, and the authors suggested that vomiting do not increase IOP or can increase it for a short time (Wolfran et al., 2022). In the present study, IOP was not measured at the time of vomiting but within 1-2 minutes after vomiting. Although there was no significant difference between the measurements, a small increase was evident after vomiting compared with the baseline level. This may suggest that vomiting can increase IOP.

Wolfran et al., (2022) reported that the use of 7.5 µg/kg dexmedetomidine had no effect on IOP while its use at a dose of 10 µg/kg significantly reduced IOP in cats. Malmasi and Ghaffari, (2015) reported that 100 µg/kg medetomidine caused no effect on IOP in cats. Kanda et al., (2019) reported that medetomidine hydrochloride used at a dose of 80 µg/kg significantly reduced tear production in cats. The present study used 40 µg/kg dexmedetomidine and 80 µg/kg medetomidine; although a very small numerical decrease occurred from the baseline level, this change was statistically non-significant; additionally, all levels were within the

reference range. Regarding medetomidine, the results of this study are in accordance with the study reported by Malmasi and Ghaffari, (2015) but show differences from that reported by Wolfran et al., (2022). The animals used in the study were neutered animals, and this is thought to be possibly related to the higher intraocular pressure due to hormonal effects in non-neutered animals (Ofri et al., 2002).

It is reported that atipemazol use reverses the effects of α-2 adrenoreceptor agonists and reduces IOP to baseline levels (Wolfran et al., 2022). In the present study was in accordance with the results of the study reported by Wolfran et al., (2022).

In conclusion, this study showed that medetomidine hydrochloride and dexmedetomidine administered via intramuscular route decreased intraocular pressure but the levels were within the reference range.

Conflict of Interest

The authors declare that they have no competing interests.

Authorship contributions

Concept: B.K., Design: B.K., Data Collection or Processing: M.B. and Z.P, Analysis or Interpretation: B.K. and Z.P, Literature Search: B.K. and M.B., Writing: B.K.

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