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Assessment of intraocular pressure in chinchillas of different age groups using rebound tonometry

Pressão intraocular em chinchilas de diferentes faixas etárias utilizando tonômetro de rebote

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ABSTRACT

The aim of this research was to measure the intraocular pressure (IOP) of normal chinchilla eyes using the rebound tonometer. A further aim was to assess whether there were differences in the values of intraocular pressure in relation to animals age, gender and time of day. Thirty-six chinchillas were divided into three groups of 12 chinchillas each, by age: Group I (2-6-month-old), Group II (20 and 34 months) and Group III (37 and 135 months). Ophthalmic examination was performed previously by Schirmer tear test, slit lamp biomicroscopy, indirect ophthalmoscopy and fluorescein test in all chinchillas. Three measurements of intraocular pressure were assessed on the same day (7, 12 and 19h). Tonometry was performed on both eyes using the rebound tonometer after calibration in "p" mode. Statistical analysis was performed with SigmaPlot for Windows. The mean IOP for groups I, II and III were 2.47±0.581mmHg, 2.47±0.581mmHg and 2.51±0.531mmHg, respectively. No significant differences were reported between age and IOP and no significant differences were reported between the time of day and IOP. The IOP in chinchillas did not differ significantly between genders or ages of the animals, and did not change with time of day.

Key words: *Chinchillas, **Chinchilla lanigera**, intraocular pressure, tonometry, TonoVet.*

RESUMO

Objetivou-se aferir a pressão intraocular (PIO) em olhos saudáveis de chinchilas usando o tonômetro de rebote. Além disso, pretende-se verificar se existem diferenças nos valores de pressão intraocular em relação à idade e ao sexo dos animais e o período do dia. Trinta e seis chinchilas foram divididas em três grupos com 12 animais cada, considerando as idades, designados por GI (2-6 meses), GII (20-34 meses) e GIII (37-135 meses). Previamente, foi realizado exame oftalmológico, incluindo teste da lágrima de Schirmer, biomicroscopia com lâmpada de fenda, oftalmoscopia indireta e teste de fluoresceína em todas as chinchilas. Foram realizadas três aferições da pressão intraocular num mesmo dia (7, 12 e 19 horas). A tonometria foi realizada em ambos os olhos, usando o tonômetro de rebote calibrado no modo "p". Análise estatística foi realizada com o programa SigmaPlot para Windows a fim de analisar os dados. A média da PIO para o G I, G II e G III foi de 2,47±0,581mmHg, 2,47±0,581mmHg e G III de 2,51±0,531mmHg, respectivamente. Não houve diferenças significativas entre a idade e a PIO e não houve diferenças significativas entre as horas do dia e a PIO. Os valores da PIO em chinchilas não sofreram alterações decorrentes do sexo e da idade dos animais e não foram significativamente diferentes em distintas horas do dia.

Palavras-chave: *Chinchilas, **Chinchilla lanigera**, pressão intraocular, tonometria, TonoVet.*

INTRODUCTION

The evaluation of intraocular pressure (IOP) is essential in an ocular examination and permits the diagnosis of eye diseases, such as uveitis and glaucoma (GELATT & MACKAY, 1998). Currently, IOP is measured by portable tonometry in animals, including applanation and rebound tonometry (PEREIRA et al., 2011). Rebound tonometer does not require the use of topical anesthesia (REUTER et al., 2010).

Portable tonometers are especially useful, mainly during the determination of the daily curve of intraocular pressure (PEREIRA et al.,

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2011). Changes in IOP have been studied; it may change according to the model, skill of the examiner, species, age of the animal, and time of day at which the intraocular pressure is measured (WHITTKER et al., 1995; MUGHANNAM et al., 2004; JEONG et al., 2007; LYNCH et al., 2007; LIMA et al., 2010; LIU et al., 2011; ANDRADE et al., 2012). Anaesthetic procedures (JIA et al., 2000; KIM et al., 2013) and scheduled feeding (LIU et al., 2011) also cause changes in IOP.

Chinchillas are bred for the fur trade, employed as a model in ophthalmic research and produced increasingly as pets (PEIFFER & JOHNSON, 1980; WILLIAMS, 2007; MÜLLER et al., 2010, MÜLLER & EULE, 2014). Moreover, studies describing ophthalmic parameters in chinchillas are scarce (PEIFFER & JOHNSON, 1980; LIMA et al., 2010; MÜLLER et al., 2010; BERCHT et al., 2015). Other features that make this animal desirable for model research include its small size and ease handling (PEIFFER & JOHNSON, 1980; MÜLLER et al., 2010). The aim of this research was to measure the IOP of normal chinchilla eyes using the rebound tonometer. Furthermore, it aimed to assess whether there were differences in the values of intraocular pressure in relation to animals age, gender and time of day.

MATERIALS AND METHODS

Thirty six male and female chinchillas of different ages were examined at the Colégio Politécnico of the Universidade Federal Santa Maria. This research was approved by the Animal Use Ethics Committee of the Universidade Federal do Rio Grande do Sul (CEUA-UFRGS). The research was conducted according to the Association for Research in Vision and Ophthalmology (ARVO) statement for the use of animals in ophthalmic and visual research. Ophthalmic examination was performed previously, using the Schirmer tear test (Teste Lacrimal de Schirmer, Ophthalmos, SP, Brazil), slit lamp biomicroscopy (SL15, Kowa, Japan), fluorescein test (Fluorescein strips, Ophthalmos, SP, Brazil) and indirect ophthalmoscopy. Only healthy animals with no ocular findings were used.

Tonometry was performed throughout the same day (7, 12 and 19h) by the same examiner. Rebound Tonometry was performed using the TonoVet® (Tiolat, Helsinki, Finland) after calibration in "p" mode on both eyes. The animals were divided into three groups, of 12 chinchillas each, according to age as follows: Group I (2-6-month-old), Group II (20-34-month-old) and Group III (37-135- month-old). Three sets of measurements were obtained and the average value was recorded.

Statistical analysis was performed using SigmaPlot for Windows version 11.0 (copyright© 2008 Systat Software, Inc. Germany). To verify the distribution of the data, it was used the Shapiro-Wilk test. Non-parametric tests were used: Kruskal-Wallis ANOVA was used to compare ages and distinguish between hours of the day to determine times at which differences in IOP occurred. Spearman correlation coefficient was used to correlate ages and the time of day in IOP. The Mann-Whitney U Statistic was used to determine gender differences in IOP in chinchillas. A P value <0.05 was considered significant.

RESULTS

All chinchillas were considered healthy based on ophthalmic and physical examination findings and the results of blood tests, which were within reference ranges reported for the species. Rebound tonometry allowed measurement of IOP in all chinchillas and was easy to handle. The mean IOP of the whole group of 72 eyes was 2.49±0.56mmHg (range 2-4mmHg). The mean IOP values for group I, II and III were 2.47±0.58mmHg, 2.47±0.58mmHg and 2.51±0.53mmHg, respectively. The mean IOP did not vary significantly with age in chinchillas (P=0.756).

No significant differences were reported between IOP values in group I (P=0.415), group II (P=0.329) or group III (P=0.188). No correlation was reported in IOP values between ages and time of day (Spearman correlation coefficient, $P>0.05$). No significant differences between mean IOP of male and female chinchillas were freported: 2.48±0.54mmHg and 2.50±0.57mmHg, respectively (P=0.857). No ocular problems have been observed in these chinchillas since data collection.

DISCUSSION

Nowadays, to evaluate IOP in animals, applanation and rebound tonometers are most frequently used (GOLDBLUM et al., 2002; LEIVA, et al., 2006; JEONG et al., 2007; PEREIRA et al., 2011; ANDRADE et al., 2012; SPIESSEN et al., 2015). Normal IOP values measured using a rebound tonometer have been appointed in several species of domestic and wild animals (BROADWATER et al., 2007; LYNCH et al., 2007; PRASHAR et al., 2007; BLACKWOOD et al., 2010; MERCADO et al., 2010; REUTER et

al., 2010; RUSANEN et al., 2010; PEREIRA et al., 2011; LABELLE et al., 2012; WANG et al., 2013).

Values of intraocular pressure can be altered by numerous factors, including model of the device, the examiner's experience, species studied, stress and the period of day when the pressure is evaluated, among others (BROADWATER et al., 2007). In the present research, all measurements were evaluated by the same examiner, and to reduce stress, the measurements were performed on site and the same auxiliary properly restrained the animals with minimal pressure in the neck and eyelids for a short time.

A study on raptors obtained values of 6.3mmHg to 11.7mmHg (LABELLE et al., 2012). Goats were reported to have values of 7.9±1.7mmHg (BROADWATER et al., 2007). A mean value of 9.51±2.62mmHg has been reported in rabbits (PEREIRA et al., 2011). A rebound tonometer in calibration mode d (dog/cat) was also used for owls; the mean IOP value reported was 11±1.9mmHg (HARRIS et al., 2008). The IOP of penguins oscillated between 31 and 27mmHg (MERCADO et al., 2010); in goats, the mean IOP was 11.8±1.5mmHg (BROADWATER et al., 2007), and fishes have been reported to have an average value of 4.9mmHg (LYNCH et al., 2007). In chickens, the mean value was 17.51±0.13mmHg (PRASHAR et al., 2007). In research in monkeys, the average IOP was f reported to be 29.3±0.9mmHg (LIU et al., 2011), demonstrating that the IOP varies according to the tonometer and species among other factors. All of these studies demonstrated the importance of establishing reference values for different species of animal. Nevertheless, as previously reported, IOP shows great interspecies variation, and extrapolation among species with normal pressures is not possible (PIGATTO et al., 2011).

In the current research, the mean IOP in the investigated chinchillas measured by the rebound tonometer was 2.49±0.56mmHg. The average IOP value was smaller than that which was previously estimated by applanation tonometer in chinchillas (PEIFFER & JOHNSON, 1980; LIMA et al., 2010). Because differences have been observed between applanation tonometry and rebound tonometry, the results of one method cannot be applied to another. Nevertheless, the values obtained in this research are much the same as those estimated in chinchillas using the rebound tonometer (2.9±1.8mmHg) (MÜLLER et al., 2010). This small difference may be justified by fluctuations in IOP throughout the day and differences in physical constraint. Authors did not report in the study at what time of day the measurements were taken. Furthermore, in the present research, the rebound tonometer was calibrated in "p" and the "d" mode was used (MÜLLER et al., 2010).

The aim of the present research was to determine whether differences existed in the intraocular pressure values of chinchillas during those times of the day when measurements were taken. An additional aim was to check for differences in the values of intraocular pressure between genders and between different age groups of chinchillas. Age-related differences in IOP have been reported (GELATT & MACKAY, 1998; NOMURA et al., 1999; RIBEIRO et al., 2010). In the present research, no significant differences were found in IOP between genders as reported in literature (GELATT & MACKAY, 1998; MERCADO et al., 2010; RUSANEN et al., 2010; PEREIRA et al., 2011). In one other study, gender-based differences in IOP were reported in lions (OFRI et al., 1998). Previous studies establishing the relationship between age and IOP reported controversial results (SHIOSE et al., 1984; NOMURA et al., 1999). In lions, increases occurred up to 20 months of age (OFRI et al., 2008). Likewise, in marmosets, the IOP increased from childhood until the eye was completely developed (NICKLA et al., 2002). On the other hand, other studies showed decreases in IOP with increasing age (GELATT & MACKAY, 1998). The present research found no significant relation between age and IOP. This information is much the same as that reported in the literature (MERCADO et al., 2010; RUSANEN et al., 2010; PEREIRA et al., 2011).

The β-adrenergic system and circadian rhythms influence the regulation and formation of aqueous humour and thus it has been demonstrated that they also regulated intraocular pressure (BROMBERG et al., 1980; MCCANNEL et al., 1992). The daily curve is among the methods used to evaluate IOP throughout the day (AIHARA et al., 2003). Previous studies evaluating IOP in various species throughout the day have shown that the evaluation of IOP at different times of the day may produce variation. There is no consensus on the influence of circadian rhythm on the values of IOP in animals (NICKLA et al., 2002; PEREIRA et al, 2011; WANG et al., 2013). In a study conducted in rabbits, it was reported that during the daylight period (7 a.m. to 7 p.m.), IOP was slightly lower than that during the dark period (8 p.m. to 6 a.m.) (WANG et al., 2013). In monkeys, during the circadian cycle, lower IOP values were seen in

the morning than at noon (LIU et al., 2011). In marmosets, it was observed that IOP was greatest during the unlighted phase and lower during the light phase (NICKLA et al., 2002). However, in another study conducted in rabbits, IOP was reported to be higher in the morning (PEREIRA et al., 2011). When rats were exposed to 12h each of light and darkness, IOP decreased in the morning up to 12:00, and then increased incrementally from the early evening up to 21:00 (AIHARA et al., 2003). In contrast, the intraocular pressure in rats exposed to constant light was different than that of mice, showing multiple fluctuations between the highest and the lowest points over a period of 24h. In this research, the average IOPs at different times of the day were not significantly different. The animals showed no discomfort during assessments of IOP. These results are compatible with rebound tonometry outcomes of earlier studies (PEREIRA et al., 2011).

CONCLUSION

The outcome of this research shows that rebound tonometry appears to be a safe, repeatable and well-tolerated method for the evaluation of IOP in chinchillas. The results obtained in this research showed that the IOP in chinchillas is unchanged regardless of age and gender, and there is no influence of the circadian rhythm on IOP in chinchillas. The data presented in this research will help in the identification and control of eye disorders in chinchillas.

BIOETHICS AND BIOSSECURITY COMMITTEE APPROVAL

This research was accepted by the ethical review committee (protocol number 23465CEUA-UFRGS approved on September 17, 2012) and followed the ethical norms of the Association for Research in Vision and Ophthalmology (ARVO) statement for the use of animals in ophthalmic and visual research.

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