

Effect of topical atropine on intraocular pressure and pupil diameter in the normal horse eye

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Abstract

The objective was to determine whether topically administered 1% atropine would alter intraocular pressure. The animals studied were four healthy adult horses. Intraocular pressure and pupil diameter were measured prior to and during a 2-day period of treatment with 1% atropine sulfate. No significant changes in intraocular pressure occurred as a result of the treatment with atropine. Pupil diameter increased significantly after atropine was applied. Available information on the outflow of aqueous humor from the horse eye suggests that atropine might reduce intraocular pressure in the horse by increasing uveoscleral outflow. This could prove beneficial in the treatment of equine glaucoma. We could not confirm a significant pressure-lowering effect of atropine. It is possible, however, that a longer treatment period may be required or that atropine may have a more profound effect on glaucomatous globes.

Key Words: atropine, glaucoma, horse, treatment

INTRODUCTION

Atropine is a parasympathetic blocking agent which is commonly administered to the eye in the treatment of uveitis. Its beneficial effects when given by this route include mydriasis and relief of iridocyclospasm. In addition, there is some evidence that it may help to re-establish a disrupted blood aqueous barrier.¹

Mydriatic agents generally are considered to be contraindicated in the treatment of glaucoma due to the tendency of the peripherally displaced folds of iris to reduce aqueous outflow through the drainage angle. It has been suggested, however, that atropine may be a potentially useful agent in the treatment of glaucoma in horses.^{2,3} The reasoning behind this lies in the extensive uveoscleral outflow network for the drainage of aqueous humor in the horse.⁴ It is believed that the mydriasis induced by atropine may improve access of the uveoscleral outflow tract in the horse, thus facilitating removal of aqueous humor.^{4,5} It has been shown that conventional miotic agents such as pilocarpine may actually impede uveoscleral outflow.⁴ The purpose of this study was to establish if atropine has any effect on intraocular pressure in the normal equine eye.

MATERIALS AND METHODS

For the sake of convenience, horses who were part of the resident population at the University of California Center

for Equine Health were used in this study. Four horses (eight eyes) were available. All were female and between 8 and 17-years old. The breeds were paint, quarterhorse, standardbred, thoroughbred. All had brown irides. None of the horses had historical evidence of previous ophthalmic problems. No abnormalities were found using biomicroscopy and direct ophthalmoscopy. The vertical pupil dimension was taken under similar barn lighting conditions using a Jamieson caliper. Estimation of intraocular pressure was made using an applanation tonometer (Tono-PenTM XL, Mentor O & O, Inc., Norwell, MA, USA). To facilitate this procedure, an auriculopalpebral block was done using lidocaine, and topical proparacaine was instilled. When the eyelids were parted to expose the cornea, care was taken not to apply pressure to the globe. When necessary, a chain lip twitch was applied for restraint.

On a given day, five measurements, at about the same time of day for each horse (08:00, 10:00, 12:00, 14:00 and 16:00 h), were taken for each parameter from each eye, no closer than 2 h apart. Measurements were taken on two consecutive days prior to treatment with atropine. Over the next 2 days, 1% atropine sulfate ophthalmic solution was applied to each eye prior to each measurement. Because we have previously observed that topically administered atropine results in maximal pupillary dilatation in normal horses within an hour after application, we made an assumption that increasing our treatment beyond 2 days would not have changed the results we might have obtained.

Repeated measures analysis of variance was used to examine the main effects of treatment (atropine vs. no treatment), day (two consecutive), side (left vs. right) and time of day (five distinct times of day), as well as their interactions, on intraocular pressure and vertical pupil dimension. Huynh-Feldt corrected *P*-values less than 0.05 were considered statistically significant.

RESULTS

There was no compelling statistical or medical evidence of an effect by day of week, eye side, and time of day on intraocular pressure (*P*-values = 0.23, 0.99, and 0.09, respectively). Minor differences in intraocular pressure were found when averaging over the 40 repeated measurements taken (16.5 mmHg prior to treatment, 14.8 mmHg after atropine treatment) (*P* = 0.075).

There was no evidence of any difference in pupil diameter by side (*P* = 0.19). However, differences were found between groups (prior to treatment or after) (*P* = 0.0004), time of day (*P* = 0.0008), and day of treatment (*P* = 0.0041). The mean pupil diameter prior to treatment was 8.64 mm, compared to a mean diameter of 16.26 after atropine treatment. In reality, however, the magnitude of these differences was dependent both on time of day and day of treatment (i.e. there was a statistical interaction) (*P* < 0.0001). In general, in horses given no treatment (i.e. prior to treatment), the pupil diameter remained constant across time and day. In contrast, horses given atropine had larger pupil diameters, had diameters that increased between the first and second atropine doses on the first day of atropine treatment, and had diameters that were larger on the second day of atropine treatment than on the first day.

DISCUSSION

The values for intraocular pressure prior to treatment were similar to those found by others using similar instrumentation.⁶ We were unable to demonstrate a diurnal pattern for intraocular pressure in the horse, as has been found in other species.^{7,8} We did not find a statistically significant effect of atropine on intraocular pressure, although there was a tendency towards a lowering effect (see Fig. 1). Our results were different from those in another study of atropine and intraocular pressure in normal horses,⁹ in which a small, but statistically significant lowering effect was found. This effect was not seen until several days into the study.

Occasionally a chain lip twitch had been used for restraint in our horses. To our knowledge, there are no studies which bear on the effect of a lip twitch, if any, on intraocular pressure.

As expected,¹⁰ there was significant pupillary dilation after the administration of atropine. This began within 30 min after the initial instillation, appeared to be maximal between 2 and 4 h and lasted throughout the study period. We noticed no adverse effects from this reaction, such as

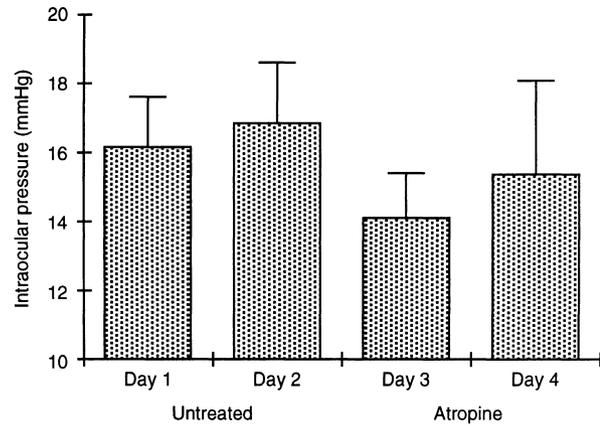


Figure 1. Mean intraocular pressure in mmHg for all eyes of all horses, with standard deviation. Although there is a tendency for a pressure-lowering effect of atropine, this was not statistically significant.

blepharospasm due to the inability to constrict pupils in the presence of light. The horses were housed in stalls which had access to sunlight and shade. Even when both eyes were maximally dilated, none of the horses appeared to favor the shaded portion of the stall.

In most species, pharmacologic mydriasis and cycloplegia are considered to be contraindicated in glaucoma. Mydriasis in particular may compromise the conventional aqueous outflow pathways (iridocorneal angle structures), thereby reducing aqueous outflow and exacerbating the glaucoma. Atropine, however, is known to improve uveoscleral outflow (aqueous outflow via structures other than the iridocorneal angle).⁴ This pathway appears to play a greater role in aqueous drainage in the horse than in other species.^{4,11} Atropine is thought to increase uveoscleral outflow in the horse by relaxing the iris sphincter and ciliary body musculature, thereby opening the supraciliary space and suprachoroidea.⁴ Furthermore, pilocarpine, which has effects opposite to atropine, including pupillary constriction and stimulation of the ciliary muscles, has been shown to decrease uveoscleral outflow in the horse.⁴

There is also the possibility that the effect of ocular instillation of atropine on intraocular pressure in general may be related more to the cycloplegia it causes than the mydriasis.¹² Although we did not evaluate cycloplegia in this study, it is not unreasonable to assume that atropine caused some degree of cycloplegia, especially because it was given many times each day. The effect of cycloplegia in the horse, however, may be negligible (C. J. Murphy, personal communication).

Despite all the theoretical advantages of using atropine in the treatment of equine glaucoma, several reports have documented an increase in intraocular pressure after ocular instillation in horses.^{3,9,13} Intraocular pressure returned to pretreatment values after atropine was discontinued.

Some have noted improvement in glaucoma with use of ocular instillation of corticosteroid and atropine, even without clinical evidence of uveitis.^{2,3} This raises the

question as to whether uveitis was present in some of these horses cited in previous studies, yet was not detected by standard examination techniques.¹⁴ Although strong experimental evidence is lacking, topical atropine is thought to help stabilize the blood-aqueous barrier.¹ This could be beneficial in treating uveitis. Thus, it would be difficult to precisely qualify any beneficial effect of atropine in a glaucomatous horse eye without further detailed studies on the effects of concurrent uveitis.

Based on results of this and other studies, it appears that atropine does not have a profound pressure-lowering effect in the normal horse eye. The effect on glaucomatous eyes, however, cannot be determined adequately from the available literature. It is possible that this may be substantially more than in the normal eye as has been found with other drugs.¹⁵ At least some horses have developed harmful increases in intraocular pressure with topically administered atropine.^{3,9,13} If atropine is to be used as treatment in glaucoma, it would therefore be prudent to carefully monitor intraocular pressure during the course of treatment.

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