

EFFECTS OF DETOMIDINE AND BUTORPHANOL ON INTRAOCULAR PRESSURE IN CLINICALLY HEALTHY HORSES DURING SEDATION FOR OPHTHALMOLOGIC EXAMINATIONS WITHOUT HEAD SUPPORT ABOVE THE LEVEL OF THE HEART

EPECTELE DETOMIDINEI ȘI BUTORFANOLULUI ASUPRA PRESIUNII INTRAOCULARE LA CAI CLINIC SĂNĂTOȘI ÎN TIMPUL SEDĂRII PENTRU EXAMINĂRI OFTALMOLOGICE FĂRĂ SUSȚINEREA CAPULUI DEASUPRA NIVELULUI INIMII

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ABSTRACT | REZUMAT

Intraocular pressure (IOP) is determined by the balance between the production and drainage of aqueous humour. Any imbalance can lead to an increase in IOP, affecting ocular perfusion and favouring the development of glaucoma. In horses, normal IOP values range from 15 to 30 mmHg, and exceeding the threshold of 35 mmHg is considered indicative of glaucoma. Factors influencing IOP include anaesthetic agents, head position and restraint methods. Detomidine, an alpha-2 adrenergic agonist commonly used in horses, has an ocular hypotensive effect by reducing aqueous humour production and improving drainage. In contrast, positioning the head below the level of the heart can cause a significant increase in IOP, most likely due to changes in intracranial pressure and episcleral venous pressure. The present study investigated the effects of detomidine and butorphanol on IOP in relation to head position by measurements at 10-, 25-, and 40-minutes post-sedation. The results showed a significant increase in IOP at 25 minutes post-sedation, when the head was below the level of the heart, followed by a return to baseline values at 40 minutes. These findings emphasise the importance of monitoring head position during veterinary procedures to prevent pathological increases in IOP and optimise ophthalmologic management in horses.

Keywords: equine intraocular pressure, glaucoma, standing sedation, head position in horses

Presiunea intraoculară (PIO) este determinată de balanța dintre producția și drenajul umoarei apoase. Orice dezechilibru poate duce la creșterea PIO, afectând perfuzia oculară și favorizând apariția glaucomului. La cai, valorile normale ale PIO sunt cuprinse între 15-30 mmHg, iar depășirea pragului de 35 mmHg este considerată indicativă pentru glaucom. Factorii care influențează PIO includ agenții anesteziici, poziția capului și metodele de contenție. Detomidina, un agonist alfa-2 adrenergic utilizat frecvent la cai, are efect hipotensiv ocular prin reducerea producției de umoare apoasă și îmbunătățirea drenajului. În schimb, poziționarea capului sub nivelul inimii poate determina o creștere semnificativă a PIO, cel mai probabil din cauza modificărilor presiunii intracraniene și a presiunii venoase episclerale. Studiul de față a investigat efectele detomidinei și butorfanolului asupra PIO, în raport cu poziția capului, prin măsurători efectuate la 10, 25 și 40 de minute post-sedare. Rezultatele au indicat o creștere semnificativă a PIO la 25 de minute post-sedare, când capul era sub nivelul inimii, urmată de o revenire la valorile inițiale la 40 de minute. Aceste constatări subliniază importanța monitorizării poziției capului în timpul procedurilor veterinare pentru a preveni creșteri patologice ale PIO și a optimiza managementul oftalmologic la cai.

Cuvinte cheie: presiune intraoculara cabaline, glaucom, sedare in picioare, poziția capului la cai

Numerous studies have shown that during sedation in horses, not only substances can influence intraocular pressure (IOP) but also head position (1; 9; 13; 19). Ocular examinations in these animals are often challenging due to their reticence and the muscular conformation of the eyelids, which do not allow them to be easily opened manually to facilitate the clinical and paraclinical tests required for ophthalmologic diagnosis. Sedation for ophthalmologic examination is

necessary in most cases. Most of the time, the lack of ancillary staff in Romania forces the attending physician to perform the examination without additional help. During sedation, the horses remain in the quadrupedal position, but the head drops below the level of the heart. Important to note, and part of the object of this study, is that the head position in the horse influences intraocular pressure by considerably increasing it. Because of this, measurements may be erroneous in clinically healthy horses, and in horses with glaucoma, this may lead to secondary iatrogenic complications. Experimental studies in mice have demonstrated that rapid increases in IOP produce significant

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retinal ganglion cell damage (20). Furthermore, during standing sedation, various ophthalmologic procedures can be performed, and intraocular pressure should be taken into account. For example, in the case of a deep ulcer or corneal wound, a sudden increase in IOP can result in complications such as corneal perforation (9). Head position is a significant factor in IOP fluctuations. In sedated horses, when the head is positioned below the level of the heart, IOP increases markedly, most likely as a result of increased intracranial pressure, changes in cerebral perfusion and increased episcleral venous pressure (1).

MATERIALS AND METHODS

This is a prospective, non-randomised study that took place between June 2024 and December 2024 on a herd of 15 clinically healthy horses, 9 males and 6 females aged 7-14 years, from the Bucharest-Ilfov area. The horses come from sport horse breeds: 5 Dutch Warmbloods, 6 Holsteiners, and 4 Standardbreds. The objective of this study was to determine the effects on intraocular pressure following sedation with detomidine and butorphanol in horses with a head position below the level of the heart. The anaesthetic protocol used was selected to provide moderate standing sedation with 0.02 mg/kg detomidine and 0.1 mg/kg butorphanol administered intravenously. The effects of sedation were observed 2-5 minutes post-administration with the head down. Intraocular pressure was determined using a "rebound" tonometer (Tono-vet), equipped with an option for the species setting, equine in this case (Fig. 1).



Fig. 1. IOP determination with the Tonovet device

Determination and monitoring of intraocular pressure in clinically healthy horses was performed 10 minutes after sedation with the head supported above the level of the heart, 25 minutes post-sedation with the head below the level of the heart (Fig. 2) and 40 minutes post-sedation with the head above the level of the heart. Each measurement was repeated 3 consecutive times: the differences between values were not significant.

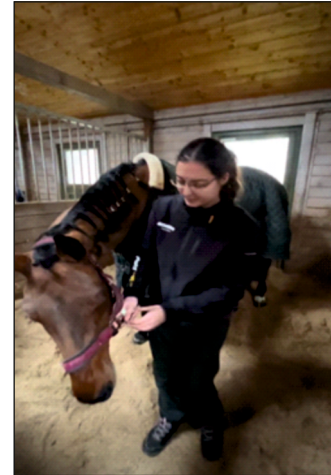


Fig. 2. Position of the head below heart level

RESULTS AND DISCUSSIONS

Intraocular pressure (IOP) is regulated by maintaining a balance between the production and drainage of aqueous humour in the ciliary body. Any disturbance of this balance can lead to increased IOP, compromised ocular perfusion and, in the long term, ischaemia and degeneration of the retina and optic nerve, favouring the onset of glaucoma. In horses, normal IOP values range from 15 to 30 mmHg, and exceeding 35 mmHg is associated with the diagnosis of glaucoma. The specific anatomy of the equine eye influences the production and drainage of aqueous humour, the fluid being removed by both the conventional trabecular meshwork and the unconventional uveoscleral route. Results of determinations at each interval are shown in Fig. 3.

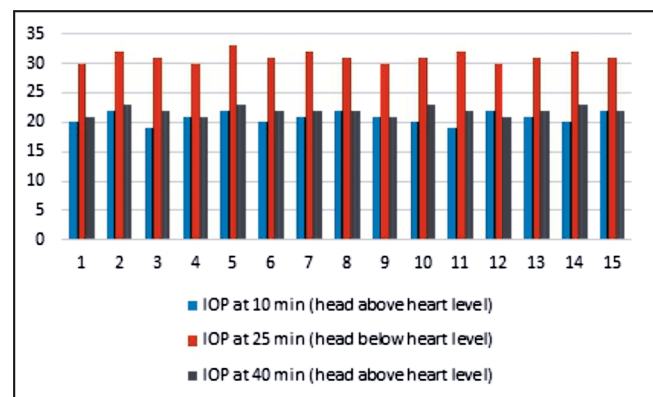


Fig. 3. Graphical representation of the values of each case

Many factors can influence IOP, including the anaesthetics administered, head position and restraint methods used. Previous studies have shown that anaesthetics such as propofol, ketamine and opioids can cause changes in IOP. In contrast, detomidine, an alpha-2 adrenergic agonist commonly used in horses, has been associated with decreased IOP by reducing

aqueous humour production and improving ocular drainage. Anaesthetic administration may influence IOP, but data on the effects of combinations of detomidine and opioids are limited. Previous studies have shown the following effects on IOP:

- Opioids increase IOP in rabbits (2, 10).
- Propofol increases IOP in dogs (8).
- Ketamine causes an increase in IOP, but the association with midazolam stabilises intraocular pressure (6).
- Detomidine reduces IOP by decreasing aqueous humour production and facilitating drainage (9).
- Butorphanol has hypotensive effects on the eye in some studies in dogs and rabbits (7).

Administration of the combination of opioids and detomidine in our study demonstrated a stable intraocular pressure in the first 10 minutes and at 40 minutes post-sedation when the head was positioned above the level of the heart, whereas at 25 min. post-sedation, IOP values were considerably higher (Fig. 4).

By analysing the mean intraocular pressure values at each determination interval (Table 1), a 10 mmHg increase in intraocular pressure can be observed at 25 minutes post-sedation, when the head was below the level of the heart, compared to the first determination (head above the level of the heart).

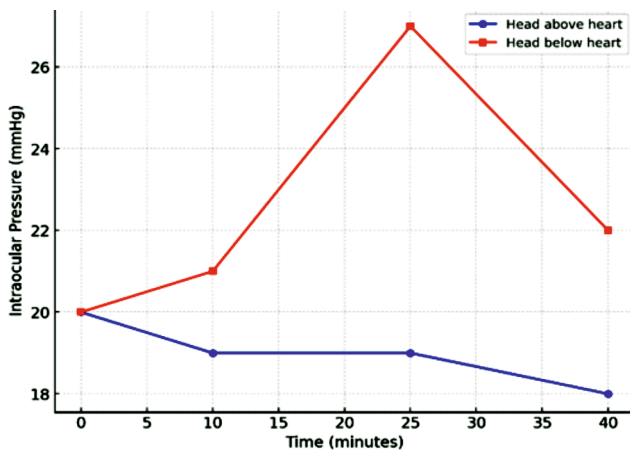


Fig. 4. IOP changes with time since sedation and head position

There is also a difference of 9 mmHg between the mean value at 25 minutes post-sedation (head below heart level) and the third determination at 40 minutes (head above heart level).

Table 1
Mean intraocular pressure values by head position

Post-sedation time	IOP (head above heart level)	IOP (head below heart level)
10 minutes	21 mmHg	
25 minutes		31 mmHg
40 minutes	22 mmHg	

This variation is attributed to the head position and not to the substances used for sedation, thus confirming the results of previous studies (9,19), which showed that head positioning below the level of the

heart causes a significant increase in IOP of up to 32 mmHg in horses under general inhalation anaesthesia and positioned head down, compared to baseline values of 17.5 mmHg. In cases of general anaesthesia, the increase in IOP is secondary to increased intracranial pressure and retrobulbar venous congestion (13, 15). The present study confirms that head positioning below the level of the heart causes an increase in IOP in horses. However, this increase of up to 10 mmHg results in values below the pathological threshold of 35 mmHg. Comparison with the existing literature suggests that detomidine in combination with butorphanol is a safe option for sedation of horses, even in the absence of head support. This aspect is particularly relevant to common veterinary practice in Romania, where ophthalmologic examinations are frequently performed without auxiliary equipment for head support. These findings are essential for establishing optimal sedation protocols and preventing the risk of ophthalmologic complications in horses.

CONCLUSIONS

According to the results obtained and in agreement with literature data, detomidine and opioids demonstrated ocular hypotensive effects. The increase in intraocular pressure observed following head positioning below the level of the heart was not clinically significant to indicate risks of iatrogenic complications. Therefore, the use of detomidine in combination with butorphanol is a viable therapeutic option for unattended ophthalmologic examinations since even in the absence of head support, intraocular pressure values remain within physiologic limits and do not pose major ophthalmologic risks.

Evaluation of the impact of head position on intraocular pressure is essential, particularly in the context of ophthalmologic examination of horses without external support. The results of this study provide veterinarians with useful information for tailoring clinical protocols, thereby helping to reduce the risk of iatrogenic complications in patients with pre-existing or incipient ocular disease.

A limitation of this study is the exclusive inclusion of clinically healthy horses with normal intraocular pressure. Future studies could also investigate the effects of these sedative agents on horses diagnosed with glaucoma or other pre-existing ocular pathologies.

The administration of detomidine in combination with butorphanol represents a safe and effective sedative protocol for ophthalmologic examinations in horses, even when the head position is below the level of the heart, thus offering an optimal alternative in veterinary practice.

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