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RESEARCH PAPER

Ultrasound-guided retrobulbar nerve block in horses: a cadaveric study

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Abstract

Objective To develop an ultrasound-guided technique for retrobulbar nerve block in horses, and to compare the distribution of three different volumes of injected contrast medium (CM) (4, 8 and 12 mL), with the hypothesis that successful placement of the needle within the retractor bulbi muscle cone would lead to the most effective dispersal of CM towards the nerves leaving the orbital fissure.

Study design Prospective experimental cadaver study.

Animals Twenty equine cadavers.

Methods Ultrasound-guided retrobulbar injections were performed in 40 cadaver orbits. Ultrasound visualization of needle placement within the retractor bulbi muscle cone and spread of injected CM towards the orbital fissure were scored. Needle position and destination of CM were then assessed using computerized tomography (CT), and comparisons performed between ultrasonographic visualization of orbital structures and success rate of injections (intraconal needle placement, CM reaching the orbital fissure).

Results Higher scores for ultrasound visualization resulted in a higher success rate for intraconal CM injection, as documented on the CT images. Successful intraconal placement of the needle (22/34 orbits) resulted in CM always reaching the orbital fissure. CM also reached the orbital fissure in six orbits where needle placement was extraconal. With 4, 8 and 12 mL CM, the orbital fissure was reached in 16/34, 23/34 and 28/34 injections, respectively.

Conclusion and clinical relevance The present study demonstrates the use of ultrasound for visualization of anatomical structures and needle placement during retrobulbar injections in equine orbits. However, this approach needs to be repeated in controlled clinical trials to assess practicability and effectiveness in clinical practice.

Keywords horse, local anaesthesia, nerve block, retrobulbar, ultrasonography.

Introduction

Retrobulbar nerve block (RNB), commonly used in cattle, has become increasingly popular in equine medicine. Akinesia and anaesthesia of the eyeball are achieved by blockade of the optic, oculomotor, abducens and trochlear nerves, and the maxillary and ophthalmic branches of the trigeminal nerve (Miller Michau 2005). Benefits during ocular surgeries include impedance of enophthalmus, reduced anaesthetic requirement, and prevention of the oculocardiac reflex during eye manipulation (Raffe et al. 1986). The use of RNB for standing procedures is therefore recommended by some authors to avoid unnecessary general anaesthesia in horses (Gilger & Davidson 2002; Tóth et al. 2008).

Several techniques for the retrobulbar administration of local anaesthetics have been described in horses, including the four-point block, direct injection into the orbital muscle cone above or below the zygomatic arch, and the modified Peterson block (Miller Michau 2005; Brooks 2006). In each case, a needle is blindly inserted into the orbital cavity behind the globe. Complications include penetration of the eyeball (which may be deleterious for procedures other than enucleation), orbital haemorrhage, direct damage to the optic nerve, and intrameningeal injection of local anaesthetic, leading to epidural or subarachnoid anaesthesia (Robertson 2004; Skarda & Tranquilli 2007). Real-time visualization of both needle passage and local anaesthetic spread may improve the safety of these techniques.

Ultrasound-guided nerve blocks have been used with increasing frequency in humans (Eichenberger et al. 2006; Luyet et al. 2008, 2009) and small animals (Bagshaw et al. 2009; Costa-Farre et al. 2009; Echeverry et al. 2009). Ultrasound (US) guidance might improve the quality and safety of RNB in horses by visualizing the position of the needle and injected fluid. If the pattern of spread of the injected fluid is inappropriate for RNB, the needle can be repositioned until the ideal site of injection is located. Placing the needle tip for optimal spread of local anaesthetic to the orbital fissure, where the nerves exit the skull, may reduce the total volume of injected agent required for successful local anaesthesia.

For these reasons, the first aim of the current study was to develop and describe an US-guided technique for RNB in horses. Based on preliminary investigations, we hypothesized that positioning of the needle tip within the cone formed by the retractor bulbi muscle (=intraconal position) would produce the most effective spread of fluid towards the orbital fissure and around the nerves that exit the skull in this region. As a second aim, the spread of three different injection volumes of contrast medium (CM) (4, 8 and 12 mL) towards the orbital fissure were compared by computerized tomography (CT) imaging, to determine the most appropriate volume for this technique.

Materials and methods

Twenty Warmblood horses recently euthanized by either lethal injection or bolt shot and exsanguination were used for this study. Heads were removed from the trunk immediately after death and cooled for an average of 24 hours (20–31 hours) until the retrobulbar injections were performed.

Where the eye was collapsed, intraocular pressure was restored prior to US examination by injecting water into the eyeball; this injection was performed using a 20 gauge needle inserted underneath the third eyelid, until the globe felt plump to palpation.

The examination and injections were always performed by the same investigator (UM). US was performed using a Sonosite Turbo ultrasound machine (SonoSite Inc, WA) with an 8–5 MHz, 11 mm, broadband, curved array transducer (C11x; Sonosite Inc), positioned on the closed upper eyelid. First, visualization of the optic nerve was attempted in horizontal and vertical US planes. Next, a 21 gauge × 100 mm SonoPlex Stim cannula (Pajunk Medizintechnologie GmbH, Germany) was inserted at the rostral end of the supraorbital fossa, caudomedially to the posterior aspect of the zygomatic process, in a slightly craniomedial direction. The needle was advanced under US visualization, with the aim being to place its tip just behind the eyeball in the craniocentral part of the cone formed by the retractor bulbi muscle, as shown in Fig. 1. Whenever possible, the needle tip was positioned such that the needle and optic nerve could be visualized simultaneously within the same US image. A CT scan was then performed to record the initial position of the needle. Thereafter, CM (Telebrix 30M; Guerbet, Germany) was injected in 4 mL aliquots, up to a final volume of 12 mL in each orbit. To avoid movement of the cannula during syringe attachment, the contrast medium was injected through extension tubing connected to the needle before skin penetration. After each 4 mL injection CT scans were performed to assess the spread of CM. The investigator performing the ultrasound guided retrobulbar injection (URI) was unaware of the CT results.

US visualization of the optic nerve and direction of CM dispersal were scored according to the methods shown in Tables 1 & 2. If the spread during the first injection was considered unsatisfactory, the investigator had the option to interrupt the initial 4 mL injection and reposition the needle under US guidance. At this time, an additional CT

 40, 205–211