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RESEARCH PAPER

Ultrasound-assisted periconal ocular blockade in rabbits

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Abstract

Objective This study aimed to evaluate the benefit and specifically the feasibility of using ultrasound in ophthalmologic periconal block, and the occurrence of complications.

Study design Prospective experimental study.

Animals Ten healthy New Zealand White rabbits (6–8 months of age), weighing 2.0–3.5 kg.

Methods Rabbits were anesthetized by intramuscular injection of acepromazine (1 mg kg^{-1}), ketamine (30 mg kg^{-1}) and xylazine (3 mg kg^{-1}). Ultrasound-assisted periconal block with lidocaine was performed on 18 eyes. Intraocular pressure was measured by applanation tonometry whereas corneal sensitivity was assessed using an esthesiometer, before and after each periconal anesthesia.

Results In all 18 eyes, it was possible to adequately visualize the needle shaft within the periconal space, as well as muscular cone, optic nerve and local anesthetic solution spread. Lidocaine 2% without epinephrine (0.79 ± 0.19 mL) was injected into the periconal space. There was no statistical difference between the intraocular pressure (mean ± SD) measured before (10.9 ± 2.9 mmHg) and after (11.9 ± 3.8 mmHg) the periconal anesthesia ($p = 0.38$). The effectiveness of the ultrasound-assisted technique was shown according to the values for corneal sensitivity, assessed before and after periconal anesthesia ($p < 0.0001$). Complications were not observed in this study.

Conclusions Eye ultrasonography allowed visualization of all anatomic structures necessary to perform a periconal block, as well as the needle insertion and anesthetic spread in real time. Further studies are required to prove the real potential of ultrasound for reducing the incidence of complications associated with ophthalmic blocks, especially when anatomic disorders of the eye could potentially increase the risk.

Clinical relevance Ultrasonography is a painless, noninvasive tool that may improve safety of ophthalmic regional blocks, potentially by reducing the prevalence of globe perforation or penetration of the optic nerve associated with the needle-based techniques.

Keywords anesthesia, eye, periconal blockade, rabbits, ultrasound.

Introduction

Regional anesthesia is the standard procedure for most ophthalmic surgeries in human adults. In addition to the use of topical anesthesia, some surgeons may request complete akinesia (absence of ocular movement) that is achieved with the use of needle-based techniques for some specific

procedures, such as extracapsular cataract extraction, trabeculectomy, vitreoretinal surgery, strabismus surgery, and retinal detachment (Kumar & Dowd 2008). Retrobulbar and peribulbar anesthesia have long been chosen techniques to ensure globe akinesia for ophthalmic surgery in adults (Accola et al. 2006; Benhamou & Ripart 2012).

In general, ophthalmic blocks are named according to their position in relation to the eyeball structures. Retrobulbar, or intraconal, block consists of injecting local anesthetic solution inside the muscular cone. Complications of retrobulbar anesthesia, such as perforation of the globe (Ramsay & Knobloch 1978; Wearne et al. 1998), damage to the optic nerve (Pautler et al. 1986) and persistent diplopia by direct injection of the anesthetic into the muscle (Golnik et al. 2000; Johnson 2001; Gomez-Arnau et al. 2003) have been described. Also, potentially fatal consequences of local anesthetic agents on the central nervous system (Rosenblatt et al. 1980; Brookshire et al. 1986; Javitt et al. 1987) have been reported (Luyet et al. 2008). Consequently, many anesthesiologists have turned to peribulbar anesthesia (Ripart et al. 2001, 2007).

Peribulbar, or extraconal, anesthesia is achieved by introducing a needle outside the muscular cone. The local anesthetic solution injected into the extraconal space must spread to the intraconal space to provide adequate anesthesia and akinesia of the globe (Ripart et al. 2001). A more efficient variation of the peribulbar block is the periconal block, in which the local anesthetic solution is deposited with a longer needle, behind the eye and outside the muscle cone (Vanetti 2006). The posterior periconal anesthesia was first described by Davis & Mandel (1986) as an alternative to retrobulbar anesthesia for ophthalmic surgery in human adults (Van den Berg 2004).

In all the techniques described above, the needle is blindly introduced into the orbital cavity. Complications arising from the insertion are rare, however, inadvertent globe perforation and rupture are the most devastating complications of retrobulbar and peribulbar anesthesia (Nouvellon et al. 2010). Human adult patients with an axial length of ≥26 mm (highly myopic eye) are susceptible to globe perforation (Kumar 2006).

Currently, ultrasound-assisted regional anesthesia is widely used mainly to perform peripheral nerve blocks in humans. However, there are few reports about ophthalmologic blocks assisted by ultrasound. The eye is easily accessible, its geometry and surrounding elements are relatively straightforward, and the tissue contents of the orbit lack gas-filled or bony structures, making this an ideal area for ultrasonic image (Gayer & Kumar 2008). Ultrasonography may improve the safety of ophthalmic regional blocks, particularly by reducing the incidence of globe perforation or penetration associated with the needle-based techniques; techniques that may be necessary as topical anesthesia does not provide complete akinesia.

This study aimed to evaluate the benefit of ultrasound (US) as a guide in periconal blocks with regard to the feasibility and occurrence of complications. A pilot study involving the performance of US-assisted periconal blockade in rabbits was developed as a preface to evaluation of the technique in human patients. The rabbit was chosen based on the anatomical similarities of its ocular region with that of the human eye (Berry & Easty 1993; Palte et al. 2012). The hypothesis of the study was that the needle could be visualized, advanced and positioned in rabbits without complications using assistance of US.

Materials and methods

Upon the approval of the Institutional Animal Care Committee (Protocol Number FMB-PE-60/2010), ten New Zealand White rabbits (*Oryctolagus cuniculus*), five males and five females, aged 6–8 months, weighing 2.0–3.5 kg (2.88 ± 0.41 kg), were included in this study. The animals were selected after clinical examination and observation of physiological variables within the normal range for the species, such as heart rate (HR), respiratory rate (f_R), temperature, mucosal coloration and capillary refill time. In addition, the rabbit eyes were evaluated by using an artificial light source for the presence of normal direct and consensual photomotor reflexes. Rabbits were provided by the Animal Resources Department of the Institution.

The animals were premedicated by intramuscular (IM) injection of acepromazine (1 mg kg^{-1}; Acepram 0.2%; Univet S/A Ind. Veterinária, Brazil). Fifteen minutes later, baseline measurements including intraocular pressure (IOP) measured by applanation tonometry (Tono-Pen XL; Medtronic, Brazil) and corneal sensitivity assessed by using an esthesiometer (Luneau Cochet-Bonnet esthesiometer; Western Ophthalmics Corporation, WA, USA), were recorded. Rabbits were monitored with pulse oximetry (hemoglobin oxygen saturation, SpO_2) and