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SCIENTIFIC ARTICLE

Peribulbar block combined with general anesthesia in babies undergoing laser treatment for retinopathy of prematurity: a retrospective analysis

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KEYWORDS

Retinopathy of prematurity;
Peribulbar block;
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Abstract

Background and objectives: Currently there is no agreement regarding which one is the most adequate anesthetic technique for the treatment of retinopathy of prematurity. Peribulbar block may reduce the incidence of oculocardiac reflex and postoperative apnea. The goal of this study was to report the outcomes of peribulbar block, when combined with general anesthesia, for the laser treatment for retinopathy of prematurity, in premature babies.

Methods: A retrospective analysis of anesthetic records of all babies who underwent laser treatment for retinopathy of prematurity from January 2008 through December 2015 in a tertiary hospital was performed.

Results: During that period a total of six babies was submitted to laser treatment for retinopathy of prematurity, all under peribulbar block combined with general anesthesia. A single infratemporal injection of 0.15 mL.kg⁻¹ per eye ropivacaine 1% or 0.75% was performed. At the end of the procedure, all babies resumed spontaneous ventilation. No perioperative complications were reported.

Conclusions: Peribulbar block was a safe anesthetic technique in our sample considered.

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PALAVRAS-CHAVE

Retinopatia da prematuridade;
Bloqueio peribulbar;
Prematuro;
Tratamento a laser

Bloqueio peribulbar combinado com anestesia geral em bebês submetidos a tratamento a laser para retinopatia da prematuridade: uma análise retrospectiva

Resumo

Justificativa e objetivos: Até o momento não há um consenso sobre a técnica anestésica mais adequada para o tratamento de retinopatia da prematuridade. O bloqueio peribulbar pode reduzir a incidência de reflexo oculocardiaco e apneia no pós-operatório. O objetivo deste

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estudo foi relatar os resultados do bloqueio peribulbar, quando combinado com anestesia geral, para o tratamento a laser de retinopatia da prematuridade em bebês prematuros.

Métodos: Uma análise retrospectiva dos registros anestésicos de todos os bebês submetidos ao tratamento a laser para retinopatia da prematuridade de janeiro de 2008 a dezembro de 2015 foi realizada em um hospital terciário.

Resultados: Durante esse período, seis bebês foram submetidos ao tratamento a laser para retinopatia da prematuridade, todos sob bloqueio peribulbar combinado com anestesia geral. Uma injeção infratemporal única de ropivacaína a 1% ou 0,75% (0,15 mL.kg⁻¹) foi administrada por olho. No final do procedimento, todos os bebês retomaram a ventilação espontânea. Não foram relatadas complicações perioperatórias.

Conclusões: O bloqueio peribulbar foi uma técnica anestésica segura em nossa amostra considerada.

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Introduction

Retinopathy of Prematurity (ROP) is a vasoproliferative disorder that represents an important cause of preventable blindness in children. In recent decades, advances in neonatal care have improved the survival rate of preterm infants. The incidence of ROP has also increased as well as the need of surgical management.¹ The surgery consists in peripheral laser followed by vitrectomy in patients who develop retinal detachment. Nonetheless, there is still no consensus on which is the most appropriate anesthetic technique for the treatment of ROP.

Preterm babies present unique challenges to the anesthesiologist due to their immature physiology and anatomy.² Many studies have reported that premature and formerly premature infants of less than 60 weeks of Post-Conceptual Age (PCA) experience respiratory complications more frequently following general anesthesia than other infants with full-term. There are also concerns that anesthetic and sedative agents may have a direct toxic effect on the developing brain even after birth.

Regional anesthesia can minimize the use of opioids in the perioperative period, thus its use should be considered in this age group.² When it comes to peribulbar block in premature babies undergoing treatment for ROP, data describing its use are scarce.^{1,3}

The purpose of this study was to report the outcomes of peribulbar block, when combined with general anesthesia, for laser treatment of ROP, in premature babies, at our institution.

Methods

A retrospective review of the anesthetic records of all patients who underwent laser treatment for ROP under peribulbar block combined with general anesthesia, from January 2008 through December 2015, in our institution was conducted.

Information regarding gender, gestational age at birth, PCA at the time of surgery, weight at birth and at the time of surgery, relevant comorbidities, previous need for mechanical ventilation and oxygen supplementation was gathered.

Anesthesia charts were reviewed for data concerning induction technique, airway management, drugs used, peribulbar block execution, intraoperative adverse events and need for mechanical ventilation at the end of the procedure. Postoperative information, including the need for complementary analgesics, ventilatory support or oxygen supplementation, and the occurrence of any complications, was gathered after reviewing neonatal Intensive Care Unit (ICU) registers. All information was collected anonymously.

Results

During the time lapse reviewed a total of six patients underwent laser treatment of ROP. All patients did the procedure under peribulbar block combined with general anesthesia.

Demographic and clinical data are displayed in [Table 1](#). Median (range) gestational age at birth was 27 (24–33) weeks and PCA at the time of surgery was 39 (34–47) weeks. Median weight at birth and at the treatment time were 856 g (650–1200) and 2098 g (1576–3000), respectively. All patients were classified as American Society of Anesthesiologists (ASA) III and half of them were female. At the time they presented for surgery, neither of them required mechanical ventilation and only one needed oxygen supplementation delivered by nasal cannula ("Premature 6"). The median (range) time that patients spent in the current episode of hospitalization before surgery was 66 days (1–93). Only one had previous surgery which occurred without complications ("Premature 2" – previous central venous catheter placed under general anesthesia).

All babies underwent a detailed preanesthetic evaluation and followed the fasting guidelines of ASA. Intraoperative monitoring consisted of continuous electrocardiography, pulse oximetry, noninvasive blood pressure, end-tidal carbon dioxide, temperature and glycemia. Apart from warming the operating room, a forced air warming was used during the entire intraoperative period. Intravenous access was previously secured in the neonatal ICU from where they were transferred. An inhalational induction of anesthesia with a mixture of sevoflurane, oxygen and air through a Jackson-Rees system as performed in all patients. After attaining adequate anesthetic depth fentanyl was administered.

Table 1 Characteristics of the study population.

	Gestational age at birth (weeks)	Weight at birth (g)	Weight at treatment (g)	PCA at treatment (weeks)	Days of previous IV support	Days of previous NIV support	[Hb] before surgery (g.dL ⁻¹)	Relevant comorbidities
Premature 1	33	1200	2420	40	0	0	16.1	Not mentioned
Premature 2	24	650	1810	34	29	67	11.7	BPD
Premature 3	25	665	1980	45	140	25	11.1	BPD; PFO; PDA uncorrected
Premature 4	28	650	1800	37	0	8	12.1	BPD
Premature 5	29	1310	3000	38	0	28	13.8	BPD; PFO
Premature 6	25	660	1576	47	43	41	10.9	BPD; PFO

NVI, noninvasive ventilation; IV, invasive ventilation; BPD, bronchopulmonary dysplasia; PDA, patent ductus arteriosus; PFO, patent foramen ovale; [Hb], hemoglobin concentration in plasma.

Table 2 Anesthetic and surgical management details.

	Airway management	Intraoperative analgesia	Anesthesia duration (min)	Surgery duration (min)
Premature 1	ETT	Fentanyl 2 $\mu\text{g} \cdot \text{kg}^{-1}$ Acetaminophen 15 $\text{mg} \cdot \text{kg}^{-1}$	202	151
Premature 2	ETT	Fentanyl 2.2 $\mu\text{g} \cdot \text{kg}^{-1}$ Acetaminophen 15 $\text{mg} \cdot \text{kg}^{-1}$	187	109
Premature 3	ETT	Fentanyl 2 $\mu\text{g} \cdot \text{kg}^{-1}$	206	148
Premature 4	LMA (ProSeal [®])	Fentanyl 1.7 $\mu\text{g} \cdot \text{kg}^{-1}$ Acetaminophen 15 $\text{mg} \cdot \text{kg}^{-1}$	208	120
Premature 5	LMA (Classic [®])	Fentanyl 1.2 $\mu\text{g} \cdot \text{kg}^{-1}$ Acetaminophen 15 $\text{mg} \cdot \text{kg}^{-1}$	186	178
Premature 6	ETT	Fentanyl 1 $\mu\text{g} \cdot \text{kg}^{-1}$ Acetaminophen 15 $\text{mg} \cdot \text{kg}^{-1}$	307	148

ETT, endotracheal tube; LMA, laryngeal mask airway.

Additionally, when endotracheal intubation was executed, atracurium was given. Anesthesia was then maintained with sevoflurane using controlled ventilation with a closed circuit. No anticholinergic drugs were used in any case before induction. Peribulbar block was performed bilaterally in all patients, after induction of general anesthesia, through a single infratemporal injection of ropivacaine 1% ("Premature 1" to "Premature 5") or 0.75% ("Premature 6") 0.15 $\text{mL} \cdot \text{kg}^{-1}$ in each eye, using a 30 gauge $\frac{1}{2}$ inches needle. The volume of ropivacaine per eye was determined taking into account the drug maximum dose of 3 $\text{mg} \cdot \text{kg}^{-1}$ and converting it to the respective volume of ropivacaine 1%. That volume was further divided by both eyes. Fentanyl was only administered before airway manipulation. A more detailed description of the anesthetic and surgical management is presented in Table 2. Mean (range) capilar glycemia during surgery was 114 (93–195) $\text{mg} \cdot \text{dL}^{-1}$. At the end of the procedure, neuromuscular blockade was reversed with 50 $\mu\text{g} \cdot \text{kg}^{-1}$ neostigmine and 20 $\mu\text{g} \cdot \text{kg}^{-1}$ atropine. The median (range) time of anesthesia and surgery were 204 (186–307) and 148 (109–178) minutes, respectively. All babies resumed effective spontaneous ventilation. Afterwards, they were immediately transported to the neonatal ICU, as this constitutes our current practice regarding this setting. The patient referred as "Premature 2" needed a short period of non-invasive ventilation in the ICU and he was also the only one needing a reinforcement of the analgesia in the first 24 h, but only with acetaminophen being administered. Other than that, and throughout the entire perioperative period, hemodynamic and respiratory measurements remained stable, and no complications were reported, including those that could be attributed to peribulbar block. The other babies had no need of rescue analgesics.

The median of the hospital discharge time was 5.5 (2.0–21.0) days.

Discussion

The six babies represent the whole cohort of patients in the seven year period who underwent laser treatment for retinopathy. Our main conclusion is that peribulbar

block was safe in our cohort of premature babies, when considering our population. An opioid free approach was not chosen due to the possible hemodynamic instability related to the airway manipulation. Although the use of opioids can be a confounder when analysing hemodynamic stability and the need for further analgesics, the short half-life of a single bolus of fentanyl could not fully explain those variables because the duration of the procedure is well beyond the drug clinical effect. Besides that, the authors consider that children airway manipulation is safer under the influence of opioids to obviate the possibility of bronchospasm/laryngospasm and the need for a deeper anesthesia plane with its possible adverse effects. Nevertheless, conclusions regarding its effect on opioids dose cannot be drawn, since there was no control group to compare it with. During intraoperative period, hemodynamic pattern was stable with no need for supplementary opioids administration. This could be attributed to the sufficient analgesia provided by the block. Also, all patients recovered spontaneous ventilation at the end of the procedure with no requirement for mechanical support. Apart from one baby needing a short period of noninvasive ventilation in the postoperative period, there were no reports of apnea, desaturation or bradycardia. This patient, referred as "Premature 2", had a history of bronchopulmonary dysplasia, and needed a long period of both invasive (29 days) and noninvasive ventilation (67 days), as it is described in Table 2. The fact that this patient ended up needing noninvasive ventilation has to be interpreted taking into account its baseline status.

During the postoperative period, the main concerns for preterm babies undergoing general anesthesia are cardio-respiratory complications, namely apnea, bradycardia, and oxygen desaturation. The incidence of postoperative apnea is inversely proportional to PCA; younger gestational age and anemia are additional risk factors. Several risk factors for postoperative apnea were present in our population, such as PCA age less than 60 weeks at the time of surgery, anemia, lung and heart pathology.

Nowadays, it is known that premature babies are capable of perceiving pain and that significant painful stimulus can result in bradycardic and apneic episodes, which could then

translate into significant morbidity. Although laser treatment may not necessarily be painful, the light stimulus from the indirect ophthalmoscope, insertion of a lid speculum, and manipulation of the globe may induce stress and systemic instability.⁴ Therefore, providing adequate analgesia is of paramount importance. As preterm babies are very sensitive to the respiratory depressant effect of opioids, which may then lead to a delayed recovery, the implementation of regional anesthetic techniques could have an important role in this context.

Reports of regional anesthesia and analgesia in premature and ex-premature babies are mostly limited to hernia surgery.⁵ In this setting, there is some evidence to suggest that the administration of spinal in preference to general anesthesia without sedative administration may decrease the risk of postoperative apnea by up to 47%.⁵ Few studies evaluate the use of regional anesthesia in pediatric ophthalmic surgery. In ophthalmic procedures a "quite eye" is fundamental to improve surgical conditions.⁶ Pediatric patients who underwent vitreoretinal surgery under peribulbar block and general anesthesia were observed to have less hemodynamic variability, postoperative pain, postoperative nausea and vomiting and oculocardiac reflex.⁷⁻⁹ They also had lower needs of inhaled volatile agent concentrations. During the procedure they had a better eye immobility, and after their were able to early return to normal feeding and discharge.¹⁰ Stein et al., in an update about pediatric regional anesthesia, documented their practice of using it with an infratemporal approach.¹¹ They refer that they use 0.25 mL.kg⁻¹ of 0.375% ropivacaine or 0.25% bupivacaine (3 mg.kg⁻¹, max dose), but neither present outcomes of their practice nor describe demographical variables of pediatric patients where they use this block.

General anesthesia has been reported to provide more stable intraoperative course than sedation and topical anesthesia for laser therapy.¹²

Sinha et al. described the use of peribulbar block for vitreoretinal surgery for ROP as an adjunct to general anesthesia in three cases with a history of respiratory difficulty in whom fentanyl was omitted. These infants had an uneventful postoperative course.¹ These same patients were then included in a case series that reported the effects of peribulbar block in 24 premature or ex-premature babies undergoing vitreoretinal surgery for ROP in terms of postoperative outcome and intraoperative opioid use.³ Peribulbar block was considered to be safe by the authors, while providing an acceptable quality of analgesia. The median (range) gestational age at birth and PCA at the time of surgery was 28 (26-40) weeks and 52 (39-76) weeks, respectively, whereas in our study was 27 (24; 33) weeks and 39 (34; 47) weeks. Fentanyl was not administered in any patient, and there were no reports of postoperative respiratory adverse events. In our population, a single dose of fentanyl was administered before airway manipulation, but similarly all babies resumed spontaneous ventilation at the end of the procedure, with only one needing noninvasive mechanical support postoperatively ("Premature 2"). Regarding peribulbar block execution, the technique used was the same as in our sample, however the type, volume and concentration of local anesthetic were different. The authors describe the use

of lidocaine 1% and bupivacaine 0.25%, combined or alone with the median (range) volume of 1 (0.5-2.0) mL. Our study is the first to describe the use of ropivacaine for this purpose under a standardized protocol. Ropivacaine 1% was used in five babies, while ropivacaine 0.75% was used only in one ("Premature 6"), but always with the same volume (0.15 mL.kg⁻¹/eye). Indeed the concentration of ropivacaine used in our hospital, in this setting, is extrapolated from the one performed in adults. Even though the use of a lower concentration ropivacaine was described in only on the patient, it seemed to assure hemodynamic and respiratory measurements as stable as in the other babies.

Ropivacaine is an aminoamide local anesthetic with less neurologic and cardiovascular toxicities, more sensory selective, when comparing it to bupivacaine.¹³ Infants are prone to develop neurologic toxicity with bupivacaine.¹³ Indeed, the concentration for inducing neurologic toxicity of unbound bupivacaine is approximately 50% of unbound ropivacaine.¹⁴ In infants, dysrhythmias and QRS widening due to decreased intraventricular conduction by long-acting local anesthetics, may appear prior to any neurological manifestations.¹⁵ Due to their higher heart rate, neonates and infants have a higher intensity of the block (use-dependent block), being more prone to the toxic effects of bupivacaine, levobupivacaine and ropivacaine than adults. Hypothermia, low pH, hypoxemia and electrolyte disturbances lowers the threshold for cardiac toxicity.¹⁶

To the moment ropivacaine has been well tolerated in children regardless of the route of administration. Ropivacaine has been evaluated in children, mostly for caudal block anesthesia. In some studies, it provided similar onset and duration of action compared to bupivacaine but with less motor blockade.¹⁷⁻²⁰

In the pediatric age, a higher risk of perforation of the globe, which occupies at birth approximately 50% of the orbital volume (as opposed to 22% in adults), has been described when performing peribulbar block.^{6,21}

In our population, there were no reports of complications associated with its execution. Nevertheless, these concerns may raise questions about its application in this setting, and we consider that it should only be performed by an experienced anesthesiologist.

Limitations of the present study include its retrospective nature and small sample size. Patient's age adds ethical issues that should be addressed when considering different clinical study designs.

We conclude that peribulbar block is a safe anesthetic technique in our sample. Further prospective studies need to be done in order to better establish the role of peribulbar block in the perioperative outcome of premature babies undergoing treatment for ROP. These should also focus on determining the ideal concentration and volume of the local anesthetic used, in order to provide an optimal analgesia, while avoiding potential toxic systemic effects.

Conflicts of interest

The authors declare no conflicts of interest.

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