Case Report

Opioid-free anesthesia with interfascial dexmedetomidine in a high-risk infant

ABSTRACT

Despite the advances in pediatric anesthesia, infants have higher mortality and critical incidents rates than children, especially ex-prematures and those with comorbidity. We present the case of a high-risk infant who underwent elective laparoscopic gastrostomy under opioid-free anesthesia (OFA) combined with transversus abdominis plane (TAP) block with Dexmedetomidine (DEX). Perioperative opioids were entirely avoided, and intraoperative anesthetics and postoperative analgesic were considerably reduced. The infant showed cardiorespiratory stability and optimal analgesia during the uneventful procedure and the postoperative period. We consider OFA and TAP block with DEX a safe and effective anesthetic combination for high-risk infants.

Key words: Anesthesia adjuvants; child; dexmedetomidine hydrochloride; high-risk infant; opioid-free anesthesia; TAP block

Introduction

Despite the remarkable reduction in mortality (0.6-0.1/10000) and critical incidents (0.14%) rates in pediatric anesthesia, infants (<1 year) have rated four and three times higher than children (>1 year), respectively. The most common critical incidents are respiratory events, medication errors, and equipment failures.[1,2]

The main risk factors in infants (in addition to age) are ex-prematurity and comorbidity (American Society of Anesthesiologists [ASA] physical status ≥3). Within the latter, the following conditions stand out: congenital heart diseases, genetic or metabolic disorders, neurological diseases, obstructive sleep apnea (OSA), bronchial hyperreactivity and processes that present with/lead to fever or require treatment.[1,2]

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Adequate anesthetic management is considered a protective factor for high-risk infants. It is estimated that each year of experience reduces the risk of critical incidents by 1-2%. Therefore, it is recommended the management of high-risk infants in tertiary-level hospitals and by anesthesiologists with specific training in pediatric anesthesia and sufficient experience.[1,2]

Written informed consent for the present publication was obtained from the parents.

Case Description

We present the case of a 3-month-old term infant, ASA-III and weighing 6500 g, who underwent elective laparoscopic

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gastrostomy. The patient had a history of fetal macrosomia; severe hypoxic-ischemic encephalopathy with upper limb paresis; patent foramen ovale; moderate-severe pulmonary hypertension; mild left ventricular dysfunction with septal hypokinesia, treated with enalapril; right hemidiaphragmatic paralysis; gastroesophageal reflux treated with omeprazole and associated with apneic episodes and an episode of aspiration pneumonia; and catheterization for removal of peripheral access central catheter fragment in pulmonary artery.

On arrival to the anteroom, the withdrawal of enalapril 24 hours earlier and a formula milk fast for ≥6 hours were verified. Once in the operating room, an ultrasound was performed for qualitative assessment of the pyloric antrum (Perlas classification grade 0) and inferior vena cava (collapsibility index >50%). Subsequently, an inhalational induction was carried out with Sevoflurane 5% (up to the peripheral venous access cannulation) and Rocuronium 8 mg. Following the endotracheal intubation (cuffed tracheal tube nº 3 with cuff pressure adjustment using manometry), the patient was connected to mechanical ventilation (pressure controlled ventilation-volume guaranteed [PCV-VG] mode and the following parameters: driving pressure 15 cmH_2O; positive end-expiratory pressure 5 cmH_2O; minute ventilation 1.4 L/min; fresh gas flow 1.5 L/min; fraction of inspired oxygen 0.35) and ultrasound-guided bilateral subcostal TAP block was performed (Levobupivacaine 0.2% + DEX 6 mg, total volume 4 ml). Prior to the start of the surgical procedure, a 50 ml bolus of normal saline and Cefazolin 170 mg was administered.

Laparoscopic-assisted gastrostomy tube placement was performed using a pneumoperitoneum pressure of 8 mmHg and a gas flow of 1.4 L/min, with good hemodynamic tolerance. Anesthesia was maintained with Sevoflurane 1.8-2.2% (minimum alveolar concentration [MAC] 0.6-0.8); fluid therapy with Isofundin® 40 ml/h; and Metamizole 200 mg + dexamethasone 3 mg + Ranitidine 10 mg + magnesium sulfate 225 mg were administered as analgesic adjuvants.

The following parameters were monitored: oxygen saturation, 99%; end-tidal carbon dioxide, 40 mmHg; heart rate, 105-120 bpm; systolic blood pressure, >70 mmHg; mean arterial pressure, >50 mmHg; perfusion index, >2%; bispectral index, 40-50; temperature, >36.5°C. After the procedure was completed (operative duration of 60 minutes), Sugammadex 15 mg was administered, and emergence from anesthesia and tracheal extubation was performed prior to transfer to pediatric intensive care unit (PICU). During the uneventful 4-hour stay in the PICU, the patient was awake and calm, with cardiorespiratory stability and good scores on pain (Face, Leg, Activity, Cry, Consolability [FLACC] scale 2) and Agitation (Pediatric Anesthesia Emergence Delirium [PAED] scale 1) scales. Eight hours later on the ward, the patient was stable and maintained good analgesia (FLACC 2) with no need for painkillers, although some irritability was observed (PAED 2-3), probably related to the prescribed postoperative 24-hour fast.

Discussion

Hypoxic-ischemic encephalopathy is one of the leading causes of full-term neonates' morbidity and mortality. In developed countries, its incidence can reach 4/1000 live births and neonatal mortality is 25%. In the short term, lethargy, hypotonia/hyporeflexia, seizures, and respiratory and cardiovascular alterations may occur; while in the long term they may develop cerebral palsy, epilepsy, and cognitive/behavioral delay. Optimal perioperative management of these patients during infancy plays a crucial role in the prevention of neurological damage potential progression, and poses a challenge given the potential respiratory (*i.e.,* apnea and persistent pulmonary hypertension) and cardiac (*i.e.,* bradycardia, ventricular dysfunction and myocardial damage) comorbidity.[3,4]

In addition to the foregoing, there is the potential risk posed by anesthesia in neonates and infants on neurocognitive development, mainly owing to the following circumstances: cardiac surgery and neurosurgery, multiple exposures to general anesthetics, and alterations of brain homeostasis. Proper anesthetic management to counteract the latter entails accurately defining the events that may compromise blood flow and cerebral metabolism (*i.e.* hypotension, hypocapnia, hyperoxia, hypoglycemia or hyponatremia) and evaluating the benefit-risk of the various therapeutic measures.[5,6]

Opioids are potent analgesics widely prescribed in perioperative pain management. In parallel to their proven effectiveness, they exhibit potential side effects, both in the short term (*i.e.,* nausea/vomiting, sedation, respiratory depression and paralytic ileus) and in the medium to long term (*i.e.,* central sensitization, chronic pain and dependence), which can increase the length of stay and hospital costs. OFA reduces perioperative pain and postoperative analgesic requirements and avoids or minimizes the side effects of opioids. It is particularly interesting in fragile patients (neonates and infants) and those at risk of

postoperative apnea (OSA, acute or chronic respiratory failure), as it facilitates spontaneous breathing recovery and early extubation, as well as reducing the length of stay in PICU. OFA rests on two pillars: regional anesthesia (neuraxial and peripheral) and multimodal analgesia (Paracetamol, steroidal and nonsteroidal anti-inflammatory drugs, α-2 agonists, N-methyl-D-aspartate receptor antagonists, local anesthetics, and gabapentinoids).[7-9]

Regional anesthesia allows preventing or reducing the doses of general anesthetics and opioids, counteracting the potential neurotoxic effects of the former and the respiratory and hemodynamic effects of both, as well as controlling pain and the neuroendocrine response associated with perioperative stress. In addition to its effectiveness, it has an optimal safety profile with a very low incidence of adverse events. It therefore represents a cornerstone of "low-neurotoxicity anesthesia" and OFA, being a technique of choice in high-risk infants.[10-12]

DEX is a potent a2-adrenergic agonist, more selective and with a shorter half-life than Clonidine. DEX has sedative, analgesic, sympatholytic and organo-protective properties, causes minimal cardiorespiratory depression and has multiple routes of administration. Despite the U.S. Food and Drug Administration not approving its use in children or in regional anesthesia yet, DEX allows reducing Sevoflurane and intraoperative opioid requirements, prolongs the duration of postoperative analgesia and reduces the need for rescue analgesia. On the basis of the above, DEX is a very useful drug in pediatric anesthesia, especially in infants at risk of apnea, airway obstruction or respiratory distress, being one of the mainstays of "low-neurotoxicity" anesthesia and OFA. Interfascial block with DEX as an adjuvant (1-2 μg/kg) reduces local anesthetics doses and the risk of systemic toxicity. It also reduces pain and postoperative analgesia needs by >50%, and extends the duration of analgesia by >50% in the first 24 hours.[12-15]

With regard to our case, the specific reasons behind opting for an OFA combined with a regional block were as follows: To enable early extubation and prevent or minimize postoperative apnea and respiratory failure episodes, by avoiding opioids in a patient with hemidiaphragmatic paralysis and previous apnea episodes; and to prevent or minimize potential low cardiac output and hypoxemia episodes associated with right-to-left shunt, by reducing the dose of Sevoflurane in a patient with left ventricular dysfunction, pulmonary hypertension and patent foramen ovale. The use of DEX in TAP block was indicated to enhance and prolong the perioperative analgesic effect, and to reduce the need for systemic agents in a high-risk infant.

It was remarkable that Sevoflurane requirements decreased significantly during the procedure, reaching a minimum dose of 1.8% (MAC 0.6) for a BIS of 40-50. In infants, the usual doses to achieve these BIS values are 2.5-3% (MAC 1), which would result in a 30-40% reduction. Such a reduction is more marked than that observed in this same block without DEX and is probably due to some degree of systemic absorption of DEX through the internal oblique and transverse muscles.

Our hospital is highly experienced in both opioid-sparing anesthesia and regional anesthesia techniques in pediatrics. However, the use of non-opioid adjuvants in regional blocks has been limited to magnesium sulfate and DEX via the epidural route. Recent use of DEX in peripheral blocks has been very well received, given the positive outcomes in terms of pain reduction and the need for perioperative anesthetics and analgesics, with consequent benefits for patients, especially those at higher risk.

In conclusion, we consider OFA a safe and effective technique to promote in the perioperative management of high-risk infants. The use of DEX in peripheral regional blocks is a very useful tool that allows it to be performed with greater success.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient's parents have given their consent for the images and other clinical information to be reported in the journal. The patient's parents understand that names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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