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Case Report Open Access

Lidocaine Infusion for Hemodynamic Stability-A Case Report in a Child with Moyamoya Disease

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Abstract

Background and objectives: Hemodynamic stability is crucial during the perioperative management of patients with Moyamoya disease. Several studies have been published about the safety and effectiveness of lidocaine bolus and infusion for hemodynamic stability in adults. Descriptions of lidocaine infusions use in pediatric anesthesia are scarce. We discuss the use of lidocaine in a Moyamoya child.

Case report: We present a case of a 22-month, male child with a suspected Moyamoya disease, scheduled for cerebral and abdominal angiographies. Hemodynamic stability in Moyamoya is crucial during anesthesia to avoid stroke. Evidence exists about the safety and effectiveness of lidocaine in attenuation of stress response to surgery, contributing to hemodynamic stability in adults.

Conclusions: In our case, lidocaine bolus and infusion was safely used in a child and seemed to contribute to his hemodynamic stability. To our knowledge, this case report is the first to describe the use of lidocaine infusion in a Moyamoya child.

Keywords: Moyamoya; Lidocaine

Abbreviations: BPs: Systolic Blood Pressure; BPd: Diastolic Blood Pressure; HR: Heart Rate (bpm-beats per minute); SpO_2: Peripheral Oxygen Saturation; CT: Cutaneous Temperature; BIS L: Left Bispectral Index; BIS R: Right Bispectral Index; NMB: Neuromuscular Blockade Monitoring.

Introduction

There is growing evidence that intravenous lidocaine improves postoperative analgesia, reducing the need for opioid use [1]. Several studies have been published about the safety and effectiveness of lidocaine bolus and infusion in attenuation of stress response to surgery, contributing to hemodynamic stability in adults [2-4]. Descriptions of lidocaine infusions use in pediatric anesthesia are scarce.

In Moyamoya disease the precarious cerebral vascularization predisposes patients with recurrent stroke [5]. We describe the anesthetic management of a 22-month child with a suspected Moyamoya disease scheduled for cerebral and abdomen angiographies in the Neuroradiology Department, under intravenous lidocaine.

Case Report

A 22-month, male child, 10.8 kg, a right arm hemiparesis was scheduled for cerebral and abdominal angiographies.

At 19-months the child suffered a transitory neurological ischemic event. One day after discharge, he suffered a sudden right hemiparesis. Computed tomography scan revealed right cortical atrophy and a new ischemic area in the anterior fronto-cortical and left parasagittal locations. Both epileptiform activity and congenital glycosylation deficits were excluded. This patient had no other previous medical history besides the neurovascular pathology and sequelae as described. Steroid therapy and cyclophosphamide were started since then.

On the day of the procedure, after venous puncture under eutectic mixture of local anaesthetics (EMLA) cream, 25 mg hydrocortisone and 1 mL/kg/h of sodium bicarbonate 1.4% were administered to prevent adverse dye reactions. Capillary glycemia was 112 mg/dl. Body temperature was maintained with a forced-air-warming mattress. After anesthetic monitoring (pletismography, eletrocardiographic, cutaneous temperature and bilateral bispectral index monitoring), an infusion of remifentanil (0.05 mcg/kg/min) was started. 1.5 mg/kg of intravenous lidocaine administered. A 100 ml/h infusion of propofol 1% was started until loss of consciousness (25 mg). Noninvasive blood pressure and neuromuscular blockade monitoring's were started. After facial mask ventilation, 10 mg of rocuronium was administered. The airway was secured with an uncuffed 4 mm ID endotracheal tube. The ventilator mode chosen was volume controlled ventilation with fixed tidal volume of 6 ml/kg and the respiratory rate between 20 to 25 adjusted to end-tidal carbon dioxide targeted for 35 to 40 mmHg. Both driving and peak pressures remained below 13 cm H_2O and 23 cm H_2O respectively. Maintenance was done under continuous propofol, remifentanil and 2 mg/kg/h of lidocaine infusions. A total of 59 mg of intravenous lidocaine was administered during the anesthetic

procedure. A total of 130 mg of propofol and 154 mcg of remifentanil were infused. 15 mg/kg acetaminophen was administered. At the end of the procedure, there was a train of four (TOF) ratio of 0.25. 20 mg of sugammadex was performed with complete block reversal (TOF ratio 0.98 at extubation). Anesthetic procedure was uneventful (Figure 1). Anesthesia and angiographic procedures lasted 122 and 41 min, respectively. Angiographies were compatible with Moyamoya disease. The patient was discharged home one day after the procedure without new sequelae, waiting for elective surgery scheduling.

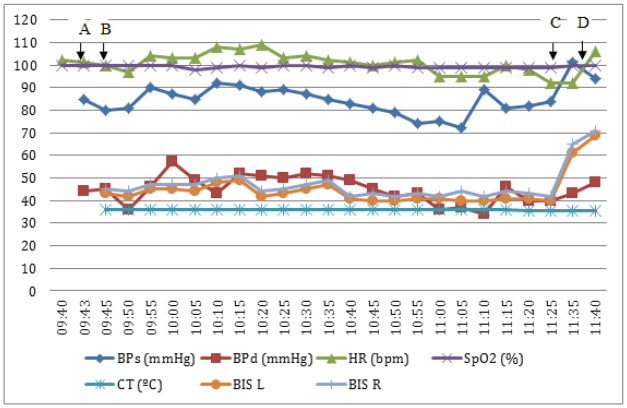

Figure 1: Graph of the vital signs monitoring record, Bispectral Index (BISTM) and neuromuscular monitoring record. Blood pressure and temperature monitoring started after induction but immediately before intubation. A-Beginning of remifentanyl and propofol infusions; B-Laringoscopy and intubation; C-Infusions interruption; D-extubation.

Discussion

Moyamoya syndrome is a cerebrovascular condition which predisposes patients to stroke, due to the existence of a progressive stenosis of the intracranial internal carotid arteries and an abnormal vascular network at the base of the brain. The reduction of blood flow, mainly in the anterior circulation, leads to the development of collateral small vessels near the apex of the carotid arteries. There are two peaks in incidence: a younger group of patients around five years old and, a second one, in the mid 40 s. The female to male ratio is 2:1 [6]. Usually patients present with symptoms of brain ischemia and, or hemorrhage and headache from dilated fragile, transdural collaterals [7]. The procedure should not be delayed use to the fact radiographic evaluation is needed for diagnosis and to define the best treatment, avoiding new neurologic sequelae.

Hemodynamic liability is a known risk factor for cerebral ischemic events [5]. Strict hemodynamic control is essential during anesthesia management.

The patient multimodal monitoring and anesthetic options were carefully selected. Concerning mechanical ventilation, a protective strategy was adopted to avoid barotrauma, volutrauma, atelectotrauma and biotrauma. A good oxygenation and ventilation, and a reduction in factors that could decrease preload and cerebral drainage are essential for optimizing cerebral blood circulation and oxygen delivery, avoiding blood stasis and thrombosis.

Some monitors are commercially available for noninvasive cerebral oximetry monitors. In the case of the INVOSTM monitor (Somanetics), near-infrared spectroscopy is used to trend cerebral oximetry. Unfortunately, in our case, the pediatric disposable electrodes were not available due to a supply shortage. The need to do the radiology procedure would not be compatible with a delay.

The authors used a depth anesthetic monitor to assure an adequate anesthesia depth during the procedure. During cardiac surgery, bispectral index monitoring was reported to detect brain ischemia in real time. An acute decrease in the reading value was suggested to be indicative of cerebral ischemia [8].

Lidocaine is local anesthetic acting by inhibiting voltage-gated sodium channels, preventing membrane depolarization. Because of its short half-life and a favorable safety profile it is the local anesthetic of choice for continuous intravenous administration. Studies have been published about the safety and effectiveness of lidocaine bolus and infusion in attenuation of stress response to surgery, preventing the hemodynamic consequences of laryngoscopy in adults, if administered prior to intubation (1-1.5 mg/kg) [3]. Lidocaine doses vary significantly, but most studies report the use of 1.5 mg/kg as initial bolus, and infusion ranges between 1.5-2 mg/kg/h.

Intravenous lidocaine had been described as having analgesic, anti-hyperalgesic and anti-inflammatory properties. Its role in pain is also related to a reduction in central sensitization. Some studies found a relation between its use and a clinically relevant decrease in systemic inflammatory markers in patients receiving lidocaine perioperatively [9]. The analgesic dose of intravenous lidocaine needed in the perioperative period is 1-2 mg/kg as an initial bolus, followed by a continuous infusion of 0.5-3 mg/kg/h. The most widely reported and clinically effective dose range appears to be from 1-2 mg/kg/h.

Despite the well-described safety profile in numerous clinical trials, it must be reiterated that systemic lidocaine has a very narrow therapeutic index (2.5-3.5 μg/ml). Central nervous system toxicity occurs when plasmatic concentration is above 5 μg/ml. Factors influencing the plasma concentration of free lidocaine include the dose and rate of injection, acid-base status, hypercapnia and hypoxia, low plasma protein levels, and altered hepatic or renal function.

Some published studies also described lidocaine neuroprotective effects in focal ischemia models, in animals and *in vitro* research [10-19]. Despite this evidence, the authors did not find descriptions of lidocaine use in human patients with ischemic stroke. The reason for this is not clear. One factor may be the existence of concerns related to adverse effects and, or the uncertainty of drug concentrations in stroke patients whose blood-brain barrier is disrupted. In addition, the low cost of lidocaine offers no financial incentive to pharmaceutical companies.

Pediatric studies on lidocaine infusion for hemodynamic stability are lacking. Concerning safety, there are studies reporting the use of lidocaine infusion in pediatrics for status epilepticus, with higher doses than the ones used in adults for hemodynamic stability [20].

Based on the current literature on the topic, the authors considered the use of propofol for these patients safe. Propofol use in children, especially in younger ones, is indeed controversy and, its use for induction of anesthesia in children less than 3 years of age still remains off-label. Still, propofol is an intravenous agent used commonly for induction and maintenance of anesthesia, procedural and critical care sedation in children [21].

The concern about propofol use in children rose after reports describing cases of propofol infusion syndrome (PRIS) in the 90 s. This syndrome is now known as being associated with high-dose (>4 mg/kg/h) and prolonged (>29 h) infusions of the drug, in high risk patients (severe head injuries, sepsis, high exogenous or endogenous catecholamine and glucocorticoid levels, low carbohydrate to high lipid intake, and inborn errors of fatty acid oxidation) [22]. Even though, a recent survey in Germany identified widespread use in pediatric intensive care (PICU) with a time limitation of <24 h in most cases, and a median dose limit of 4 mg/kg/h [23].

At the moment, no case of PRIS was reported in healthy children, during routine anesthesia care. Also, the National Institute of Health and Care Excellence (NICE), from the United Kingdom, also consider as indications for propofol its use for induction and maintenance of children >1 month [24].

Currently, there is also no direct evidence in humans for propofol induced neurotoxicity in the infant brain. In our case, hemodynamic stability was achieved safely with lidocaine bolus and infusion combined with an intravenous anesthesia. To our knowledge, this case report is the first to describe the use of lidocaine infusion in a Moyamoya child. Conclusions cannot be generalized to other pediatric Moyamoya patients. Cerebral oximetry monitoring, if available at that time, could play an important role in anesthetic management of these patients. More data have to be gathered in order to establish the safety and effectiveness of lidocaine to hemodynamic stability in pediatric anesthesia.

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