Case report

Navigating Challenges: Successful Anaesthesia for Very Low Birth Weight Baby with Retinopathy of Prematurity

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Abstract

Retinopathy of Prematurity (ROP) is a condition affecting the developing retina of preterm infants with low birth weight, posing a risk of blindness in these newborns. The primary treatment for severe ROP involves peripheral retinal ablation using a diode laser, recognized as the preferred method. Administering anaesthesia to neonates requires a thorough understanding of neonatal and transitional physiology, along with proficiency in airway management and vascular access. Very Low Birth Weight infants exhibit distinctive characteristic features like insufficient production of effective surfactant, vulnerability of retinal blood vessels to oxygen toxicity, susceptibility to hemorrhagic and ischemic brain damage, bronchopulmonary dysplasia and apnea episodes. These factors make anesthesia management more challenging for Very Low Birth Weight infants. We report an uneventful management of a 34 week, 1.4kg preterm baby who underwent laser ablation twice 6 weeks apart without any discernible complications.

Keywords

Retinopathy of prematurity, very low birth weight, anaesthesia challenges.

Introduction

Retinopathy of Prematurity (ROP) stands as a primary contributor to blindness among premature infants across the globe. Blindness secondary to ROP can be prevented by initiating early screening and intervention in the majority of cases.[1] The overall incidence of ROP ranges from 20% - 52%. Recent studies report a positive trend, indicating lower rates of ROP between 20%-30% due to early screening.[2]

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Premature birth emerges as the predominant risk factor for the development of ROP. Prolonged exposure to arterial oxygen levels exceeding 80 mmHg in premature infants weighing between 500 to 1300 grams, has been linked to increase the likelihood and severity of ROP.[3] While laser therapy and intravitreal injections can be management options in early stages, vitreo-retinal surgery is required in advanced stages. The risk of adverse complications and difficulty of general anaesthesia increases manifold in premature infants due to unique anatomical, physiological, and pharmacological challenges. We report an uneventful management of a baby born at 28 weeks of gestation with a birth weight of 1.08kg who underwent vitreoretinal surgery 6 weeks apart without any discernible complications.

Description

A 2 months old baby born at 28 weeks of gestation, 34 weeks postmenstrual age, weighing 1.4kg and diagnosed with left eye stage IV b ROP with vitreous hemorrhage was posted for pars plana lensectomy and pars plana vitrectomy (PPV) (Figure 1).

Figure 1- A 2 month old, 28 weeks gestation, 34 weeks post-conceptional age, weighing 1.4kg and diagnosed with ROP was posted for pars plana lensectomy and vitrectomy in left eye

Patient had a history of respiratory distress at birth for which ventilatory support was provided for 10 days and had to stay for 45 days in the neonatal intensive care unit (NICU) in view of extreme low birth and anemia. Biochemical investigations revealed a hemoglobin (Hb) of 10.8gm/dl and deranged liver function with a total bilirubin level of 5mg/dl, serum glutamic oxaloacetic 122U/L and serum glutamic pyruvic transaminase 119U/L. Preoperatively, a written informed consent was taken and adequate nil by mouth status was confirmed. On receiving the patient in the preoperative area, standard monitors were attached which revealed skin temperature of 32^{o} Celsius, oxygen saturation of 92% with intermittent apnea after every 2-3 breaths which lasted for 20 sec with no bradycardia. Child was transferred under a baby warmer for temperature maintenance. An intravenous access was secured with 24G cannula and nasal oxygen at 1 liter/min was administered. Basal sugar level was found to be 42gm/dl after which a bolus of 2ml 10% dextrose was administered followed by 2% dextrose ringer lactate infusion was started at 4ml/kg/hr. A 40mg paracetamol suppository was inserted. The baby was monitored in the preoperative area for an hour after which the repeat blood sugar level was found to be 101mg/dl, temperature was 35.5^{0}C. After initial stabilization and maintaining standard preoperative guidelines, the baby was shifted to the operation theater and all ASA monitors were attached. The infant was premedicated with 0.1 mg of intravenous atropine.

All haemodynamic parameters were noted with heart rate (HR) of 144/min, noninvasive blood pressure (NIBP) of 88/52mmHg, peripheral oxygen saturation (SPO_2) of 98%. Anaesthesia was induced with incremental use of sevoflurane and oxygen. After achieving minimum alveolar concentration (MAC) 0.9%, AMBU Auragain laryngeal mask airway (LMA) size one was inserted. Anaesthesia was maintained with low concentration of oxygen to avoid hyperoxia and air mixture with sevoflurane. Monitoring of vitals was done throughout the procedure. A radiant warmer was used and the baby was covered by rolling gauze pads on all 4 limbs to avoid hypothermia during the intraoperative period. The child was kept on spontaneous respiration on Jackson Rees circuit (Figure 2).

Figure 2- Airway was secured using a size one Ambu Aurogain Laryngeal Mask Airway and kept on spontaneous respiration using Jackson Rees circuit.

The patient had a single episode of intraoperative apnea where the HR went lowest up to 66/min and SPO_2 dropped up to 78%. This was promptly addressed by giving 100% oxygen via manual bag ventilation using the JR circuit for that brief period of time. After stabilization of haemodynamic parameters, the surgery was further continued.

The procedure lasted for 25 minutes after which sevoflurane was discontinued and LMA was removed after confirmation of adequate spontaneous and regular breathing. Patient withstood the procedure well and was shifted to NICU for overnight monitoring.

After 6 weeks, the baby was rescheduled for right eye lens sparing vitrectomy as it was progressing into stage IVa ROP despite multiple laser intervention. Baby now weighed 2.2kg and had a Hb of 9gm/dl. Other investigations were within normal limits. After confirmation of nil per orally for 3 hours for breast milk, preoperative blood glucose level was measured and noted to be 96gm/dl. Patient was taken to the operating room and standard ASA monitors were attached.

Anaesthesia was induced with incremental use of sevoflurane and an intravenous access was secured after achieving MAC of 0.9% with 24G cannula. Intravenous propofol 5 mg and atracurium 1.2 mg was administered and the baby was intubated with a 3mm endotracheal tube (ETT). Intraoperative vitals were stable with HR of 128/min, NIBP of 98/56mmHg and end tidal carbon dioxide of 32mmHg. Anaesthesia was maintained with low concentration of oxygen and air mixture and sevoflurane. A 60mg paracetamol suppository was inserted. The procedure lasted for 45 minutes after which neuromuscular blockade was reversed and the patient was extubated after confirmation of adequate spontaneous breathing. Intraoperative monitoring, hypothermia prevention measures were instituted similar to the first procedure and the patient was shifted to the NICU.

Discussion

Very low birth weight (VLBW) is a term used to describe babies who are born weighing less than 1.5 kg. VLBW infants exhibit distinctive characteristic features like insufficient production of effective surfactant in lungs, vulnerability of retinal blood vessels to oxygen toxicity, susceptibility to hemorrhagic and ischemic brain damage, bronchopulmonary dysplasia and apnea episodes. These factors make anesthesia management more challenging for VLBW infants. (4) ROP is a condition affecting the developing retina of preterm infants with low birth weight. It poses a risk of complete or partial loss of vision and blindness in these newborns. ROP goes through 5 stages of increasing severity. Stage 1 and 2 may sometimes regress. Stage 3 (sight threatening ROP) usually needs treatment. Stage 4 and 5 are the most severe and often have poor visual outcomes despite treatment. Thus, early surgical intervention with vitrectomy has been attempted to treat and prevent further retinal detachment associated with severe forms of ROP.[5]

Historically, vitreoretinal surgery for neonates has predominantly been conducted under general anesthesia due to the extended duration of the procedures, the necessity for an immobile surgical field, and the significant intensity of the surgical stimulus.[6] Aoyama et al. conclude in their study that anesthesiologists play an important role in the perioperative management of high-risk infants.[7]

This role involves thorough preoperative planning and preparation to ensure the best possible outcomes. Children with congenital eye problems who require surgery and anesthesia often have a range of additional pathologies that significantly affect their perioperative management.[8] A thorough preoperative assessment by taking a detailed antenatal history, gestational age, and weight is crucial. Examination of all systems should be conducted, with particular attention to the appearance of the upper airway and the potential for difficult intubation. Obtaining written informed consent from the caregivers is essential after explaining the intraoperative concerns and the need for postoperative ventilation. In addressing concerns regarding the administration of repeated anesthesia in a short time interval, it is imperative to provide assurance that a single, carefully conducted anesthesia is deemed safe. It is recommended to strictly follow fasting guidelines for neonates ensuring avoidance of excessive fasting to prevent hypoglycemia.[9]

Standard monitoring for infants is essential, encompassing electrocardiogram, non-invasive blood pressure, capnography, pulse oximetry and temperature. Sevoflurane is the inhalational induction agent of choice in most neonates due to its rapid onset and cardiovascular stability. The effects and side effects of propofol in neonates can vary widely and are often unpredictable. Due to complex pharmacokinetics, lower clearance rates and prolonged elimination half-lives of drugs in preterm infants the use

of smaller doses of anesthetic drugs compared to term infants and older children is recommended with close monitoring of blood pressure and hemodynamic status.[10]

Atracurium remains the muscle relaxant of choice. The airway can be effectively secured using an endotracheal tube. LMA is a safe and easy to use alternative for airway management, but it is susceptible to dislodgement and prolonged procedures are poorly tolerated.[11] We opted LMA in the first procedure to address preoperative apnea episodes, ensuring reduced risk of postoperative apnea and facilitating early recovery by allowing spontaneous respiration. In the second procedure, anticipating the procedure duration of 45 minutes or more, we chose an ETT for effective airway management. Anesthesia maintenance involves oxygen with either nitrous oxide or air. Key anesthesia considerations include adjusting inspired oxygen concentration to prevent hyperoxia, maintaining stable hemodynamic parameters and preventing hypothermia and hypoglycemia through appropriate measures.[12] In the case of premature babies undergoing surgery, close monitoring is essential due to their susceptibility to apneic episodes. During the initial surgery, the baby experienced preoperative apneic episodes, necessitating adequate oxygen supplementation and the readiness of the NICU for postoperative monitoring of apnea for 48-72 hours. In the absence of any complications, it is advisable to promote early initiation of oral feeds shortly after the procedure.

Conclusion

Preterm, low birth weight babies with ROP are an extremely challenging subset of patients who may need general anaesthesia. Meticulous preoperative evaluation, selection of the appropriate anaesthetic agent and intubation device and vigilant monitoring are keys to success.

Conflicts of interest

There are no conflicts of interest.

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