Case Report

Anesthetic management of extremely low-birth-weight neonates for laparotomy

ABSTRACT

Anesthetic management of extremely low-birth-weight (ELBW) neonates is always accompanied by many dilemmas and challenges. Here, we report a case in which 512 g of ELBW newborns underwent exploratory laparotomy for perforation. Anesthesia management of such ELBW infants has not been reported in the literature.

Key words: Extremely low birth weight, neonate, peri-operative management, pre-term

Introduction

Extremely low-birth-weight (ELBW) neonates for surgery exhibit distinctive uncertainties to the anesthesiologist due to their underdeveloped anatomy and physiology. Approximately half a kilogram of the neonate is critically ill and can develop hypothermia, hypoglycemia, heart failure, necrotizing enterocolitis, retinopathy, and respiratory and neurological complications. Generally, one-third of ELBW neonates survive.[1] A basic understanding of neonate physiology and anatomy plays a vital role in anesthesia management.

Case Report

A female child was born at 28+2 weeks of gestational age with a birth weight of 550 g after elective cesarean section delivery in view of the reversal of flow in the umbilical artery in this twin and the absence of diastolic flow in the other twin. The newborn cried immediately after birth but with inadequate respiratory effort and pallor as well as chest retraction. The neonate was then transferred to the neonatal intensive care unit (NICU) and placed on a continuous positive airway pressure (CPAP) with a positive end-expiratory pressure (PEEP) of 5 cm of H_2O and a peak inspiratory pressure of 20 cm of H_2O [Figure 1]. Over the next 15 days, the baby developed respiratory distress syndrome (RDS) and hypoglycemia, for which the child was treated with caffeine, dextrose, or amino acid infusion and vitamin K. A peripherally inserted central catheter (PICC) line at the right cubital fossa was used to administer maintenance fluids. The newborn did not pass meconium on the second day of life, and her condition did not improve with conservative care. Following further assessment, she developed intestinal obstruction and perforation, as determined by chest X-ray, on the 15th day in the NICU, necessitating exploratory laparotomy [Figure 2].

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Website: https://journals.lww.com/sjan	Quick Response Code
DOI: 10.4103/sja.sja_82_24	

How to cite this article: Mishra SK, Davera S, Viswanath G, Singh S. Anesthetic management of extremely low-birth-weight neonates for laparotomy. Saudi J Anaesth 2024;18:456-8.

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Submitted: 14-Feb-2024, **Revised:** 15-Feb-2024, **Accepted:** 16-Feb-2024, **Published:** 04-Jun-2024

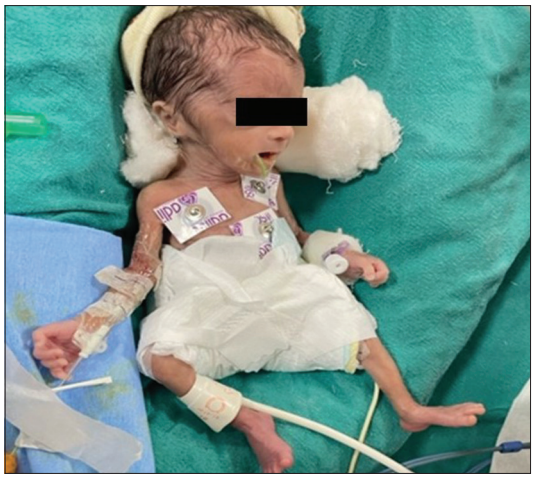

Figure 1: Image of the neonate in neonatal images of neonates in the NICU

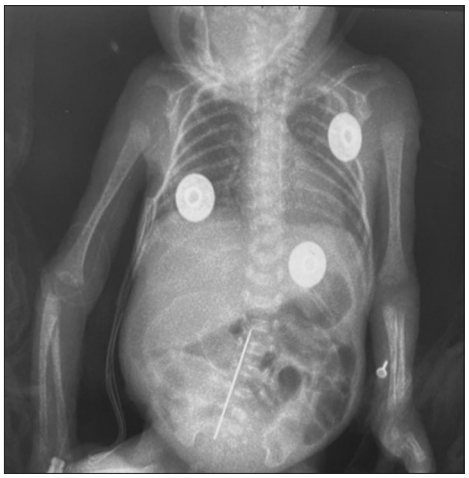

Figure 2: Chest X-ray of the neonate showing intestinal obstruction and perforation

In the NICU, two 24G additional intravenous (IV) access points were acquired through the left foot and hand, and the trachea was intubated with a 2.5 mm inner diameter uncuffed endotracheal tube and fixed at a 7 cm mark at the angle of mouth. The operation theater (OT) was prepared with a warm ambient OT temperature of 25 °C, and the OT table was warmed using a Bayer hugger warmer. Blankets and bedsheets were all warmed prior to taking the neonate in OT.

A five-member team shifted the neonate from the NICU to the OT in a transport incubator. The limbs, head, and neck were wrapped with cotton rolls to maintain temperature homeostasis. The child was continued on a spontaneous CPAP mode of ventilation and with a 100% oxygen supply. In the OT, all standard monitoring methods, such as electrocardiography, pulse oximetry (SpO_2), temperature, end-tidal carbon dioxide ($EtCO_2$), and urine output, were recorded. The child was induced with 1 mg of fentanyl IV, 1 mg of ketamine IV, and atracurium 0.25 mg IV. Atropine 0.016 mg IV was given during the induction of anesthesia to prevent bradycardia. Ventilation was controlled to maintain an $EtCO_2$ of 40–45 mm Hg with Jackson Ree's breathing circuit. Anesthesia was maintained with intermittent doses of 0.5 mcg of fentanyl IV, 0.25 mg of atracurium IV, sevoflurane, air, and O_2. The maintenance fluid administered was a balanced salt solution (10% dextrose and 3% NS) at a rate of 3.5 mL/hr. Intra-operatively, her SpO_2 was maintained at 90–95%, and her heart rate was maintained between 145 and 160 beats/min. Blood sugar levels were measured hourly intra-operatively. The duration of surgery was 1 hour. The total fluid given was 6 ml, and the blood loss was 1 ml. Paracetamol IV was used for post-operative pain management. Post-operative elective ventilation was planned, and the child was transferred to the NICU in a transport incubator on Jackson Ree's circuit with intermittent positive pressure ventilation. The intra-operative period was uneventful. The child was extubated on the 2nd post-operative day.

Discussion

The peri-operative management of very ELBW neonates poses extreme challenges and dilemmas for anesthesia teams, especially given that the birth weight is 550 g, as there is a very limited amount of experience and literature available.[2] Intra-operative ventilation is a significant challenge because the existing anesthesia equipment cannot provide the tidal volume required for babies with ELBW. However, moderation of ventilation was achieved by bag ventilation using Jackson Ree's circuit. Peri-operative IV fluid management is highly important. The PICC line was used to administer maintenance fluids, and peripheral IV lines were used to administer drugs intra-operatively with a minimum amount of flushing. Thermoregulation of the OT and all the surfaces that the baby encounters play an important role in preventing life-threatening hypothermia.[3] The baby's head, chest, and all limbs were covered with cotton rolls. Anesthesia should be used to prevent hypothermia as neonates have greater body surface areas and body weight ratios and lower brown fat and glycogen stores, allowing neonates to generate body heat and not be able to conserve heat. Extreme care was taken while adhesive tape was used for fixing IV cannulas and endotracheal tubes to avoid exfoliation of the epidermis.[4] This trauma may lead to increased trans-epidermal water loss. Pectin-based or hydrocolloid adhesives should be used between the skin and other adhesives. Pre- and post-operative transport of these patients requires meticulous planning to prevent any inadvertent, such as removal of IV cannulas, hypothermia, or extubation of the trachea. Strict asepsis is to be maintained as risks of infection are increased because of immunologic immaturity. Pre-mature infants are at increased risk of sudden infant death syndrome, so a continuous heart rate and hemodynamic monitoring are very important.

Indirect hyperbilirubinemia due to bruising or hemorrhage and a short red blood cell life along with hepatic immaturity should be kept in mind. With intra-uterine growth restriction, risk factors may include infection and/or polycythemia. Neonates are prone to increased insensible water loss along with impaired renal function which is prone to fluid overload, dehydration, and dyselectronemia. Neonates of ELBW have low glycogen and fat stores, which increase susceptibility to hypoxia and hypothermia. The umbilical artery can be used for sampling and invasive blood pressure measurements. For intra-operative hypotension, bolus fluids are avoided, and low-dose dopamine is the preferred inotrope for hemodynamics.[5] Generally, all ELBW neonates may require blood transfusions, and parental consent and blood arrangements should be obtained prior to surgery.[6] Post-operatively, all these neonates were advised about an ophthalmology examination for retinopathy at 30 days after birth.[7] During ventilation, we avoid higher oxygen saturation, hyperventilation, high-peak inspiratory pressure, and barotrauma. A saturation of 85–92% is optimum. Closed blood sugar monitoring is important as hyperglycemia may cause intra-ventricular hemorrhage.

To summarize, ELBW and pre-term neonates present numerous challenges to the team involved in their management, and anesthesiologists must be prepared to handle these patients with extraordinary care and patience to achieve a positive outcome.

Declaration of patient consent

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

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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