

Anesthetic management of a premature infant weighing 1100 g undergoing ligation of the patent ductus arteriosus

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Introduction

Patent ductus arteriosus (PDA) is a common congenital heart disease, and the mortality is higher in infants with persistent PDA.^[1] Usually, surgical intervention through left thoracotomy or video-assisted thoracoscopy is recommended if the preceding or intent medical treatment fails or is contraindicated.^[2-4] Once surgical intervention is decided, however, various complications are still a real fear in the mind of the surgeon and the anesthesiologist, particularly if the infant is premature or very sick. Here we report a case of the anesthetic management of a premature infant weighing 1100 g, who underwent the ligation of PDA.

Case report

The infant was delivered by Caesarean section at a gestation age of 35⁺¹ weeks with Apgar score of 8 at the first minute after birth. The 9th day after his birth his stool became peptic, and on the 11th day apnoea developed. On the 12th day he was sent to the neonatal intensive care unit (NICU), Children's Hospital, Zhejiang University School of Medicine. His temperature was 35°C, the respiratory rate was 62 breaths/min with a short and quick frequency, the heart rate was 138 bpm with narrow QRS complexes (<0.08 seconds), and the blood pressure was 71/38 mmHg. Blood gas examination suggested acidosis of decompensation and hypogly-

cemia. Ultrasonic cardiography (UCG) gave a clue to PDA (ϕ 0.45 cm), ASD with the secondary hole (ϕ 0.5 cm), severe pulmonary hypertension, and mild backflow of the atrioventricular valve and the right pulmonary artery valve. Chest X-ray revealed that the ratio between the heart and thorax exceeded 0.65. Primary diagnosis included (1) premature, extremely low birth-weight (ELBW); (2) congenital heart disease; and (3) blood poisoning. In the NICU, the patient was treated by breath support with a breathing machine, hemostasis, correction of acidosis, adjustment of blood sugar, supplement of liquid, warm preservation using a radiant bed and so on. At the age of 19 days the infant underwent the ligation of PDA. Perioperative course included stomach decompression and administration of 2.5 ml of 50% glucose and 50 ml of 4:1 GNS including 5% GS (6 ml) and 10% potassium chloride (0.75 ml) at a speed of 10 ml · kg⁻¹ · h⁻¹. Thirty minutes before the operation the infant was given atropine (0.03 mg), and antipsychotic (2 mg) at the buttock. The infant was intubated with assisted breath and brought to the operation room. The temperature of the operation room was 28°C and a Warm-Touch machine was used as the warming equipment and the infant received Linger's solution as a maintenance fluid at a speed of 10-12 ml · kg⁻¹ · h⁻¹. Before the operation, the infant's blood pressure was 66/30 mmHg, nasal temperature 36°C, heart rate 133 bpm, assisted respiratory rate 37 breaths/min, and SpO₂ 91%. General anesthesia was induced by intravenous injection of midazolam (0.01 mg), norcuron (0.4 mg), and fentanyl (0.01 mg). The ventilation mode was IPPV with limited air pressure: air pressure, 16 cmH₂O; respiratory rate, 37 breaths/min; and I:E = 1:2. A low inspired oxygen fraction (30% -40%) was given. Five minutes after induction of anesthesia, blood gas analysis showed pH 7.311, K⁺ 3.2 mmol/L, ABE- 4.9 mmol/L, P_{ET} CO₂ 42.4 mmHg, and PO₂ 87 mmHg. Five percent NaHCO₃ (1.2 ml) and 10% KCl (0.3 ml) in 10 ml Linger's solution at a speed of 10 ml ·

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$\text{kg}^{-1} \cdot \text{h}^{-1}$ were given. Anesthesia was maintained with 5 mg of fentanyl at the time of skin incision and ligation of PDA respectively, while 0.3% -0.7% enflurane was given intermittently and oxygen was supplied throughout the operation. Before ligating PDA, the blood pressure of the infant was 58/29 mmHg, and after ligation it was 68/49 mmHg. During the period of anesthesia, invasive blood pressure, ECG, SpO_2 , $\text{P}_{\text{ET}}\text{CO}_2$, T, etc were all monitored and the infant's blood pressure fluctuated a little bit and his life signs were balanced. The operation took about 45 minutes. The infant with a tracheal tube was brought back to the NICU. The tube was removed the day after the operation. On the 52th day after hospitalization he left the hospital with a good recovery.

Discussion

Premature and extremely low birth-weight (ELBW) infants are prone to various prematurity-related morbidities, one of which is PDA.^[2] The management of anaesthesia is very difficult in ELBW infants who are subjected to ligation of PDA.^[5,6] There are some particular requirements on preoperative preparation, anaesthetic inducement, the mechanical ventilation, and management and monitoring of anaesthesia. First, preoperative preparation is essential to successful anaesthesia, including the correction of water, electrolyte, disturbance of acid and alkali, gastric decompression and transfusion of hypertonic glucose in the morning of the operation for the prevention of hypoglycemia caused by fasting while hemostatics and antipyrotics are given; someone think hemodynamic situation more stable during surgery. Second, the airway pressure-limited ventilation not only guarantees the infants' ventilation (6-8 ml/kg per time) but also avoids airway pressure exorbitant to injure the airway and lung tissues, which can be induced by hyperventilation of routine volume-limited ventilation.^[7] The least ventilation at a time when an Ohmeda anaesthetic machine is used is 20 ml. Third, since the ELBW infant is prone to hypotension,^[8] monitoring and management during the operation should be strengthened. The monitoring of continuous traumatic blood pressure prevents blood pressure from being unreliable or even unmeasured^[5] because of such factors as feeble pulse and unfit sleevelet. Moreover, the anesthetic depth and circulation can be estimated for the adjustment of narcotics in combination with blood gas and timely adjustment of parameters shown by the breath machine, by which the balance of water and electrolyte, and that of acid and alkali are ensured for tranquilization of intercircumstance. Fourth, since the blood pressure and vessel tension of premature or

ELBW infant is not high, in the course of ligating PDA no specific hypotensors are required except for a small dose of fentanyl according to the blood pressure. Fifth, because of the domino effect of auto-blood transfusion after ligating PDA, the capacity of transfusion should be controlled, and the speed of transfusion with the pump adjusted to stabilize the hemodynamics effectively. Sixth, the ratio of external area to weight of the ELBW infant is greater than that of the adult. The endermic fat of ELBW infant is so little that he is apt to lose heat, thus hypothermia, breath restrained, cardiac output descending, and metabolized acidemia are all easy to be induced. Many think the most important causes of hypothermia for the neonate (especially low weight infants) are lower operation room temperature, preoperative hypothermia and so on.^[9] The application of the Warm-Touch machine prevents hypothermia effectively, but heat is lost obviously after sterilization of operative region with PVP (nasal temperature fell to 35°C). Hence, it is important to raise the temperature of operation room,^[2,10] and protect the temperature of surgical region.^[2] Seventh, postoperative maintenance of the tracheal tube for the infant back to INCU is safe and feasible for the support of breath and circulation. Eighth, many think ELBW infant requires less drug to achieve anesthetized state than mature.^[2,8,11] Ninth, inspired oxygen concentration should be adjusted to avoid hyperoxia.^[2] One of the key points of anesthetic management is the use of a low inspired oxygen infraction to avoid retrolental fibroplasia to the premature especially at a gestational age before 32 weeks.^[12] However, surgical ligation as early as possible in medically refractory PDA in ELBW is considered to be a safe and effective treatment. It prevents the development of further complications and cardiopulmonary vascular problems.^[13] In anesthesia for low birth weight (extremely premature) infants, utmost care and proficient procedure are required because of their immaturity, fragility and smallness.^[14,15]

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