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Case report

Delivery and management of a preterm infant in the burn unit: A multidisciplinary approach

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ABSTRACT

Burns during pregnancy can have profound effects on both the mother and her fetus. While the mother can suffer cardiovascular collapse, infection, hemorrhage and inhalation injury with respiratory failure, the fetus is affected through the placenta by all of these changes as well as by the transfer of drugs administered to the mother. We report a case of severely burned female patient at 29 weeks gestation, who, due to deteriorating maternal condition, was delivered and managed at 32 weeks gestation by a multidisciplinary team. To the best of our knowledge this is the first reported case of a preterm infant delivered in a burn unit.

1. Introduction

Burns sustained during pregnancy carry high morbidity and mortality for both the mother and the fetus. Outcomes depend on the percentage of the total body surface area (% TBSA) involved in the burn and the presence of inhalation injury, which results in higher fetal mortality [1]. The alterations in intravascular volume, systemic vascular resistance and cardiac output in pregnancy exacerbate the hypovolemia and potential cardiovascular collapse that occur with extensive burns [2]. Burns of this severity put the mother at risk for infection, hemorrhage, hypovolemia, and electrolyte disturbances. Concurrent inhalation injury can cause direct injury to the airways as well as result in intoxication with carbon monoxide (CO) and cyanide (CN), both of which substantially reduce oxygen delivery to the mother and fetus with the latter potentiating the lethality of the former. CO impairs fetal oxygen delivery by reducing its availability to cross the placenta as well as through diffusion of CO itself with subsequent binding to fetal hemoglobin. Fetal CO concentrations increase with advancing gestational age and peak approximately 4 h later than the maternal concentration because of its slow release from maternal hemoglobin [3].

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Abbreviations: CPAP, continuous positive airway pressure; NAS, neonatal abstinence syndrome; NICU, neonatal intensive care unit.

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Once pregnancy has advanced beyond 24 weeks, fetal monitoring should be instituted and antenatal steroids considered up to 34 weeks gestation. Mode of delivery is determined by obstetrical indications and caesarian section through burned skin may have to be considered [4]. Management also utilizes heavy sedation and analgesia with opioids being the mainstay of therapy. A fetus born to a mother on opioids is at risk for neonatal abstinence syndrome (NAS), which can cause feeding difficulties, autonomic dysfunction and failure to thrive. In addition to addressing the effects of maternal burns and their treatment on the fetus, we report a case of delivery and subsequent management by a multidisciplinary team of a premature infant in the unusual location of a burn unit.

2. Case report

A 30-year-old Chinese G_1P_0 pregnant woman at 29 weeks gestation was admitted to the burn unit after sustaining in a house fire a 20% second and third degree flame burn with inhalation injury to and involving her chest, abdomen and bilateral lower extremities (Fig. 1). Initial carboxyhemoglobin was 19.2%, which was treated with 100% oxygen through mechanical ventilation. Intravenous fluids, cardiovascular monitoring and local wound care were provided. Consultants included obstetrics–gynecology and neonatology. A fetal cardiac monitor was placed. The third degree abdominal burns were debrided in the operating room under general anesthesia and reconstructed with split-thickness grafts harvested from the patient's leg. Intravenous sedation was provided with medications including propofol (5 mg/h), and midazolam (4 mg/h), both initially administered by continuous infusion followed by intermittent bolus dosing. Analgesia was provided with continuous morphine infusion at 5 mg/h and intermittent doses of fentanyl and hydromorphone as needed. Due to the expectation of imminent delivery, magnesium sulfate was started for fetal neuroprotection.

Initial consideration of cesarean delivery to optimize chances for maternal and fetal survival was replaced by expectant management once the patient was stabilized. After 3 weeks, she developed preeclampsia with increasing doses of labetalol to control hypertension. Unconscious and dependent on mechanical ventilation, she developed fever and was started on cefotaxime, clindamycin, and vancomycin. With delivery indicated, the vaginal route was preferred to avoid incising the marginally viable tissue of the abdominal skin graft and potentially increasing the patient's risk of sepsis. Betamethasone was administered to accelerate fetal lung maturity, and vaginal dinoprostone was administered to augment labor and facilitate vaginal delivery. The burn ICU room adjacent to the patient's was equipped with an overhead radiant warmer, an isolette, a non-invasive ventilatory device (CPAP, INCA, Cooper surgical, Trumball, CT), cardiorespiratory monitor, a pressure-limited, time-cycled neonatal mechanical ventilator (VIP, Bird, Viasys, San Diego, CA) and a neonatal resuscitation code cart. After 24 h, the patient's cervix became fully dilated. With a neonatal resuscitation team consisting of a neonatologist, pediatric resident, nurse practitioner, respiratory therapist, and two neonatal nurses in attendance, a live male infant was delivered vaginally after application of fundal pressure with apgar scores of 1 (heart rate < 100), 3 (heart rate > 100 and weak, irregular respirations), and 6 (heart rate > 100, acrocyanosis, some flexion, grimace and irregular respirations) at 1, 5 and 10 min, respectively. The infant's weight, length and head circumference were all appropriate for gestational age at the 75th percentile. After the infant remained apneic despite 30 s of positive pressure ventilation via face mask, he was intubated, and manually ventilated. Due to pallor and poor perfusion, an umbilical venous catheter was placed under sterile conditions and a normal saline bolus was administered. The infant was placed in the transport isolette and taken to the NICU, where umbilical arterial and venous catheters were placed and the baby was placed on mechanical ventilation. Initial chest radiograph showed no evidence of respiratory distress syndrome and arterial blood gas on FiO_2 0.4, PIP/PEEP 15/5, and IMV 30/min was pH 7.28 pCO_2 59, pO_2 33, with a base excess of 0.4. Blood culture was taken and the infant was treated with ampicillin and gentamicin until blood culture was negative for 48 h. Caffeine was started on day 1 of life to stimulate respiratory drive and the infant was extubated to nasal CPAP on day 2. He was subsequently weaned to room air by day 15. On day 2, the infant demonstrated signs of neonatal opioid withdrawal including increased tone, frequent bowel movements and increased irritability. Treatment was initiated with intravenous morphine and when enteral feeds were started on day 3, changed to oral tincture of opium (0.4 mg/mL morphine equivalent), which was maintained until day 12. Feedings were initially administered via orogastric tube, but were all taken orally by day 30. Cranial ultrasounds performed on three occasions in the first month of life were normal with no intraventricular hemorrhage or periventricular leukomalacia. Serial neurological exams were all normal except for initial hypertonia, which resolved by the time of discharge. At discharge, the infant weighed 2577 g and his only medications were multi-vitamins and iron supplementation. The infant and mother are currently thriving with the infant recently turning 3 years old (Fig. 2).

3. Discussion

The fetal response to maternal hypoxia like that seen in smoke inhalation has been widely studied. It is characterized by redistribution of the fetal arterial and venous blood flow, increased resistance to blood flow in the umbilical artery and preferential sparing of blood supply to the brain, heart and placenta [5,6]. Along with these changes in blood flow, oxygen consumption in the fetus decreases, and there is selective vasoconstriction in the vascular beds of the gut, muscle and skin [7]. These effects are all amplified in the setting of concurrent maternal cardiovascular collapse that may occur in the setting of extensive burns. Burns with a 15% TBSA or greater cause activation of an inflammatory cascade resulting in the systemic inflammatory response syndrome (SIRS), which causes decreased cardiac output and initial vasoconstriction, followed by, vasodilatation, and leaky, porous capillaries. Prompt intravenous fluid resuscitation is critical to maintain tissue perfusion, decrease severe hypovolemia and prevent circulatory collapse. Inhalation injury augments