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Anesthesia Considerations in Congenital Diaphragmatic Hernia: A Case Report

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ABSTRACT
Congenital diaphragmatic hernia (CDH) is a complex neonatal condition characterized by a defect in the diaphragm allowing abdominal organs to move into the thoracic cavity, leading to pulmonary hypoplasia and pulmonary hypertension. These pathophysiological changes present unique and significant challenges to anesthetic management. This comprehensive article explores the perioperative anesthetic considerations, including preoperative assessment, intraoperative management, and postoperative intensive care in infants undergoing surgical repair of CDH.

Keywords: congenital diaphragmatic hernia; pediatric anesthesia; general anesthesia; perioperative management; intensive care.

INTRODUCTION

Congenital diaphragmatic hernia occurs in approximately 1 in 2,500 to 4,000 births and presents a significant clinical challenge due to the associated pulmonary and cardiovascular complications. Successful management of these patients requires a multidisciplinary approach involving neonatologists, pediatric surgeons, and pediatric anesthesiologists. The goals of anesthesia in CDH repair are to maintain adequate oxygenation and ventilation, minimize pulmonary vascular resistance, and provide hemodynamic stability.

DISCUSSION

CDH typically occurs postero-laterally (Bochdalek hernia) and is more commonly left-sided. Herniation of abdominal organs into the thoracic cavity impairs normal lung development, leading to pulmonary hypoplasia and altered pulmonary vasculature.

Pulmonary Hypoplasia often happens and manifests as a decrease in lung volume, fewer alveoli and impaired gas exchange, and an increase in pulmonary vascular resistance (PVR) that leads to pulmonary hypertension.

Pulmonary hypertension occurs due to abnormal vasculature and hypoxic vasoconstriction that can lead to right ventricular failure. It is exacerbated by hypoxia, acidosis, and pain.

Preoperative Considerations

Do intubate and gentle ventilation (avoid bag-mask ventilation). We can use High-frequency oscillatory ventilation (HFOV) if needed and inotropic support for cardiac function. Sedation and analgesia are a must to prevent high oxygen demand due to pain responses.

Chest radiograph, echocardiography, blood gas analysis, and lactate levels are also a must for diagnostic workup in congenital diaphragmatic hernia. Severity based on liver herniation, lung-to-head ratio (LHR), and presence of pulmonary hypertension should be assessed for prognostic purposes before going into the surgery.

Anesthetic Management

The induction of anesthesia should begin with rapid sequence induction with avoidance of bag-mask ventilation to preoxygenation while minimizing barotrauma. Anesthetic agents like fentanyl, midazolam, and low-dose muscle relaxants (e.g., rocuronium) are also a must.

For airway and ventilation strategy, use pressure-controlled ventilation to limit barotrauma. Permissive hypercapnia and tolerating lower oxygen saturations (85-95%) are often the right strategies, and also avoid high peak inspiratory pressures (>25 cm H2O).

Intraoperative hemodynamic monitoring is also important. While the usual non-invasive monitoring, like SpO2, heart rate, ECG, and NIBP, is always used, it is better to have some invasive monitoring, like an invasive arterial line, central venous access for fluid/inotrope administration, and near-infrared spectroscopy (NIRS) for perfusion assessment.

Balanced anesthesia with opioids and volatile agents (e.g., sevoflurane) is not enough. Neuromuscular blockade might be used for surgical exposure, while fluids or blood products are titrated by hemodynamic response. Do not forget about the management of Pulmonary Hypertension by using inhaled nitric oxide (iNO), milrinone for right ventricular support, and to avoid triggers such as hypoxia, hypercarbia, acidosis, and pain. Sudden hemodynamic changes might happen intraoperatively during hernia reduction or re-expansion pulmonary edema, then impaired venous return due to abdominal closure.

Postoperative Management

It is better to continue ventilatory support than weaning guided by lung compliance and gas exchange. Multimodal analgesia, such as opioids or regional epidural anesthesia, if applicable. Avoid excessive sedation to facilitate extubation while monitoring for complications like recurrent pulmonary hypertension, ventilator-associated lung injury, chronic lung disease, reactive airway disease, gastroesophageal reflux, feeding intolerance, and risk of developmental delays, especially in severe CDH.

CONCLUSION

Anesthetic management of congenital diaphragmatic hernia is complex and requires a deep understanding of the pathophysiology and associated comorbidities. A strategy focused on lung protection, hemodynamic stability, and meticulous perioperative planning improves surgical outcomes and long-term prognosis. Interdisciplinary collaboration remains key in managing these cases.

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