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Epinephrine Alleviates Intraoperative Hypoxemia in an Infant with Bronchogenic Cyst: A Case Report

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Abstract

An 11-month-old male infant was diagnosed with bronchogenic cysts and required a right lung cystectomy. The surgical approach involved one-lung ventilation (OLV) using lung isolation techniques. During the procedure, oxygenation could not be adequately maintained using conventional methods. Ultimately, a successful outcome was achieved by administering low-dose epinephrine via a microinjection pump. This case report discusses the methods for achieving OLV during thoracic surgery in infants and the feasibility of using small doses of epinephrine during OLV in pediatric thoracic surgery when encountering intraoperative hypoxia.

Keywords

Epinephrine, One-lung Ventilation, Bronchogenic Cysts, Case Report

Introduction

Congenital pulmonary cystic lesions refer to a rare group of developmental abnormalities affecting the lungs [1]. These lesions can be classified into several subtypes: bronchogenic cysts, congenital cystic adenomatoid malformation (CCAM), congenital lobar emphysema (CLE), and pulmonary sequestration (PS) [2]. Bronchogenic cysts are relatively common among congenital cystic lung lesions. For symptomatic bronchogenic cysts, surgical resection is almost universally recommended, provided anesthesia and surgical risks are manageable [3]. The primary goals of surgery are to remove abnormal tissue, alleviate symptoms, prevent complications, and allow sufficient thoracic volume for compensatory lung growth, especially in infants [4].

Currently, minimally invasive video-assisted thoracoscopic surgery (VATS) is employed to reduce trauma and expedite pediatric patient recovery [5]. To ensure a clear surgical field and minimize potential damage, intraoperatively, lung isolation techniques are often utilized for OLV [6]. However, achieving successful lung isolation in infants remains challenging. This case study explores lung isolation methods in infants during surgery and addresses the management of intraoperative hypoxemia.

Case Report

An 11-month-old male infant was prenatally diagnosed with a right bronchogenic cyst. At 3 months of age, the infant underwent surgical resection of the cyst. However, postoperatively, the right bronchogenic cyst recurred (**Fig-1**).

Case Report

Fig-1: Axial view of Computed Tomography(CT) scan of the chest showed cystic lesions

The patient now requires a repeat right bronchogenic cystectomy. Due to the lack of suitable double-lumen endotracheal tubes (DLTs) for infants, we plan to use a single-lumen endotracheal tube (ETT) with an internal diameter (ID) of 3.5 mm and a 5Fr Arndt endobronchial blocker for achieving OLV. Given the limitations of the ETT diameter, an external placement technique for the blocker will be employed. During anesthesia induction, we will first place the blocker using a video laryngoscope. Subsequently, an ID 3.5 mm reinforced ETT will be inserted into the mainstem bronchus, and a fiberoptic bronchoscope (FOB) will guide the positioning of the blocker into the right mainstem bronchus (**Fig-2**). The patient will be positioned in the left lateral decubitus position, allowing for OLV of the left lung, with normal oxygen saturation.

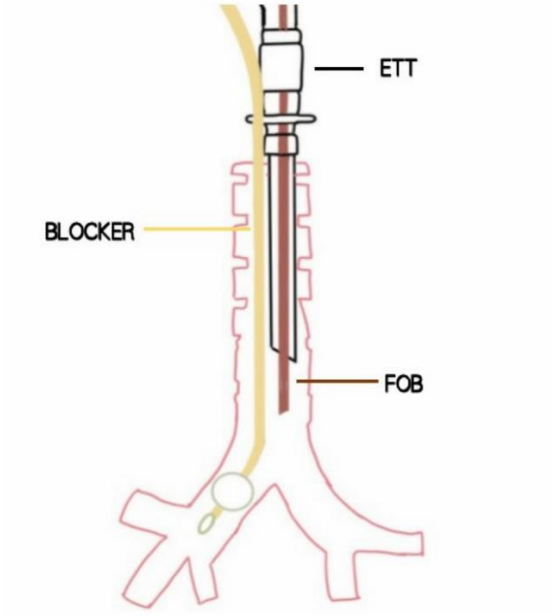

Fig-2: The relationship between the FOB, blocker and ETT position

However, once surgery commences, the patient experiences decreased oxygen saturation and increased airway pressure. Despite further FOB-guided interventions (such as suctioning), no significant improvement is observed. Auscultation reveals wheezing sounds in the lung. After temporarily suspending the surgery and OLV, the patient's condition slightly improved. Although adjustments to anesthesia parameters and the use of corticosteroids do not yield substantial relief, the administration of low-dose epinephrine results in a significant increase in oxygen saturation. Auscultation reveals a reduction in wheezing sounds in the patient's lung. We continue to infuse epinephrine at a rate of 0.01 μg/kg/min, maintaining oxygen saturation between 95% and 100% throughout the procedure. Postoperatively, the patient awakens, is extubated, and receives 5 days of treatment for infection control and nutritional support before discharge from the hospital (**Fig-3**).

Fig-3: Axial view of CT scan of the chest after surgery

Discussion

Hypoxemia is the most common complication during OLV. Infants and young children have higher oxygen consumption compared to adults, yet their functional residual capacity is smaller [6]. OLV itself adversely affects the respiratory and circulatory systems [7]. This impact includes ventilation/perfusion (V/Q) mismatch, increased pulmonary shunting (Qs/Qt), and decreased arterial oxygen partial pressure (PaO_2) [8]. Several factors contribute to this phenomenon in infants and young children:

1. Infants have less supportive chest walls, leading to increased airway resistance when the healthy lung is compressed in the lateral position [9].
2. Hypoxic pulmonary vasoconstriction (HPV) response is less effective in infants, affecting

pulmonary blood flow distribution [10].

3. Surgical traction and other factors can exacerbate these challenges.

Additionally, infants with congenital lung hypoplasia often present with concurrent respiratory infections, rendering their airways highly sensitive [11]. Stimuli can lead to increased airway pressures [12].

When intraoperative hypoxemia occurs, we first ensure adequate anesthesia depth, use corticosteroids, and adjust anesthesia machine parameters. If conventional methods prove ineffective [13], we consider using low-dose epinephrine [14]. Epinephrine stimulates β2 receptors in bronchial smooth muscle [15], relieving spasm and inhibiting mast cell release of allergic substances. It also constricts bronchial mucosal vessels [16], reducing capillary permeability, resolving mucosal edema, and alleviating airway spasm [17]. Furthermore, epinephrine enhances HPV [18], altering fluid pressure gradients between the two lungs and mitigating hypoxemia.

In conclusion, for infants requiring surgical resection of bronchogenic cysts, the combination of a single-lumen endotracheal tube and an endobronchial blocker facilitates OLV. When routine interventions fail to maintain oxygen saturation during surgery, although further experimentation is needed for validation, low-dose epinephrine may be a viable option based on the scenario presented in this case.

Conflict of Interest

The author has read and approved the final version of the manuscript. The author has no conflicts of interest to declare.

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