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Michael Kaczmarski[1]*, Neethu Chandran[2], Ranjith Vellody[1], Bhupender Yadav[1] and Richard Kaplan[1]

[1]Children's National Health System, USA
[2]UT Southwestern Medical Center, USA

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*Corresponding author: Michael Kaczmarski, Children's National Health System, USA, Tel: 317-413-1881; E-mail: mwkaczma@gmail.com

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Case Report

Prolonged use of an Arndt Endobronchial Blocker with Radiocontrast Dye in a Neonate

Introduction

Lung isolation management has long been a complicated issue in the neonatal patient due to the patient's size which limits the ability to use many of the devices used in the adult patient. The Arndt bronchial blocker is now available in sizes that allow lung isolation to be feasible in the pediatric patient. Traditionally, use of the Arndt bronchial blocker has been limited to short term use in the operating room. This case report discusses the use of the Arndt bronchial blocker for an extended period of time in the Cardiac Intensive Care Unit (CICU) to successfully treat multiple unilateral pneumatoceles in a neonate and in the process avoid the use of Extracorporeal Membrane Oxygenation (ECMO) and its associated risks. It also describes the use of radiocontrast dye in the bronchial blocker cuff in order to facilitate identification of cuff position by subsequent chest xrays.

Case Description

Written parental consent was obtained for this case report. A 9 day old 2.7 kg male born at 37 weeks and 3 days gestation presented in cardiogenic shock and was diagnosed with juxtaductal critical coarctation of the aorta causing severely decreased left ventricular systolic function. Prior to surgical repair, the patient was optimized in the CICU, including intubation with a 3.0 Mallinckrodt cuffed endotracheal tube (ETT) and initiation of dopamine and prostaglandin infusions for hemodynamic support. Chest radiograph showed no abnormal lung pathology. On hospital day 2, the patient underwent an uneventful repair of the coarctation via a left thoracotomy (right lateral decubitus position). The patient remained intubated postoperatively and was returned to the CICU in stable condition. Over the course of the next 24 hours, the patient became increasingly difficult to ventilate and a chest radiograph revealed new multiple right side parenchymal air pockets. The patient worsened and experienced hemodynamic instability, including hypotension, pulsus paradoxus, and decreased breath sounds on the right. A repeat chest radiograph was performed revealing a tension right pneumothorax with potential early stage pneumatoceles in the compressed right lung. Immediate needle decompression and pigtail chest tube placement were performed with improved hemodynamics, however a large air leak from the chest tube was present. This air leak caused difficulty with ventilation and, despite attempts with both conventional and high frequency oscillation ventilator methods, exhaled tidal volumes and EtCO2 readings were variable and inconsistent with arterial pCO2 levels as high as 122 mmHg. Broad spectrum antibiotics were initiated to treat a possible underlying pulmonary infection and a right thoracotomy was planned to repair the air leak.

The thoracotomy revealed multiple pneumatoceles throughout the right lung with a large opening in the upper lobe. The large opening was plicated and fibrin glue placed over the surface area. The patient returned to the CICU with a small air leak from the chest tube. However, over the next 12 hours the air leak increased and ventilation once again became difficult. Arterial pCO2 rose to 91 mmHg despite multiple modes of mechanical ventilation. At this point it was decided the best option was to "rest" the right lung, which could allow the multiple right lung pneumatoceles to heal. Treatment methods considered were placing the patient on ECMO, or isolating the right lung using an Arndt bronchial blocker while continuing to ventilate the left lung.

A multidisciplinary meeting was held and after discussion with family of the risks and benefits of each treatment course, the plan was to place an Arndt blocker into the right bronchus and allow the lung to heal. If successful, this method would avoid ECMO. The patient was taken to an interventional radiology procedure room where a 5 French Arndt blocker was passed through the 3.0 Cuffed ETT and successfully placed into the right bronchus intermedius. The exact location of the blocker was verified using both fiberoptic and fluoroscopic techniques. With the location confirmed the blocker was kept in place and

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the ETT was removed and immediately replaced with a 3.0 ETT so that the blocker was now in an extraluminal position in relation to the ETT. This minimized any airway resistance the blocker would cause if left within the original ETT. The final placement of the ETT was 9cm at the lip. The bronchial blocker was at 14cm at the upper lip. Final position was again confirmed both radiographically and fiberoptically. The bronchial blocker cuff was inflated with 1 ml of radiocontrast dye (Optiray 320) mixed with saline (1:1 mixture). This mixture was used to allow subsequent radiographic visualization of the cuff (Figure 1). The blocker pressure was measured to be 15 mmHg.

Immediately after inflation of the blocker, the chest tube air leak disappeared, ventilation improved and CO2 levels stabilized. The balloon of the bronchial blocker was noted to be below the RUL bronchus. Since the leak completely resolved the blocker was left in this position. The patient returned to the CICU and did not have recurrence of the air leak, although there was one brief episode of increased difficulty with ventilation. Serial portable chest radiographs were used to monitor the size of the right lung pneumatoceles and to confirm that the bronchial blocker had not migrated (Figure 2). On day 3 after blocker placement the balloon was deflated without recurrence of an air leak from the chest tube. A CT chest done at this time showed severe intraparenchymal cysts in the right lung with no left lung pathology. The deflated bronchial blocker was left in place so it could be reinflated in the event of recurrence of the air leak. The air leak did not recur and the bronchial blocker was removed. The ETT was simultaneously removed with the blocker and replaced with a microcuff 3.0 ETT. A microcuff ETT was used with the goal of having the cuff of the ETT in a different portion of the trachea than the prior ETT cuff. Over the next 2 weeks the patient was weaned and extubated to nasal cannula. The chest tube was removed on day 1 following extubation and the patient continued to have an uneventful recovery from this episode. The patient underwent a follow up CT chest several months after the treatment that showed no narrowing of the right bronchus intermedius (Figure 3) and almost complete resolution of the right sided pneumatoceles.

Discussion

Pneumatoceles are often infectious in etiology and can progress to form cysts, such as the intraparenchymal cysts seen in this patient's CT scan [1]. Oftentimes pneumatoceles are adequately managed with antibiotics and observation. However, in the event of pneumatocele rupture, patients can have respiratory decompensation including tension pneumothorax and require surgical intervention [2]. This patient had surgical intervention and was still having hypercapnic respiratory failure from residual rupture of pneumatoceles which was refractory to medical management. This is a consideration for ECMO [3]. Potential management strategies that would have avoided ECMO were lung resection or lung isolation.

The Arndt blocker has been shown to be a reliable method in achieving lung isolation in children ages 2-16 [4], and has also been described in the literature with successful use in patients younger than 24 months [5,6]. During the utilization of the bronchial blocker for lung isolation, Dr. Arndt and Dr. Hammer were contacted and in correspondences they described the use of the Arndt bronchial blocker in older patients for several days for lung isolation, in adults awaiting lung transplantation with chest radiograph to monitor blocker position [7], as well as in an adolescent with sickle cell disease and unilateral C. perfringens pneumonia [8,9]. Extraluminal use of the blocker to minimize airway resistance has also been described in the literature in the very small patient [10,11]. Radiographic confir-

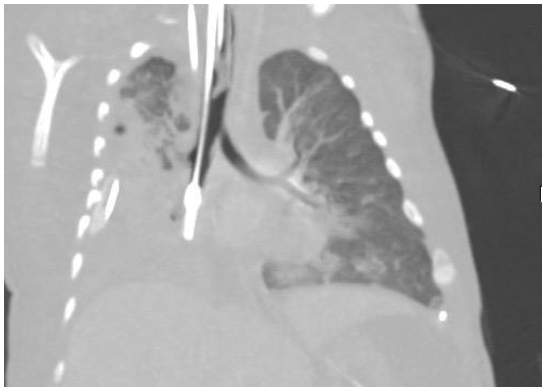

Figure 1: CT chest showing bronchial blocker placed below RUL bronchus.

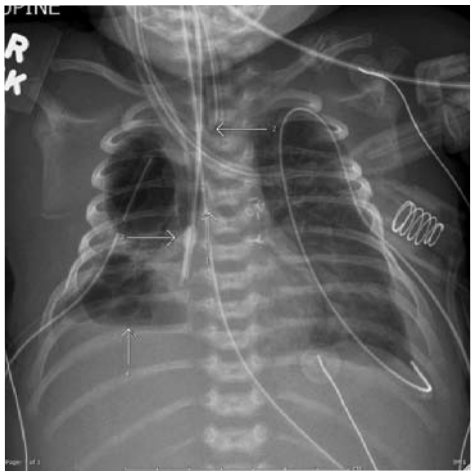

Figure 2: 1: Carina; 2: Tip of ETT; 3: Bronchial cuff below takeoff of RUL; 4: Elevated Rt hemi diaphragm. Note: small residual rt pneumothorax over RLL.

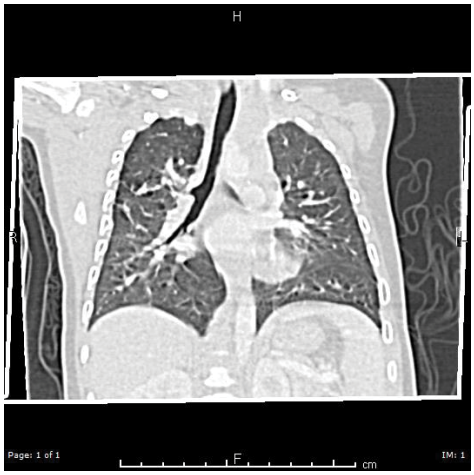

Figure 3: CT chest several months later.

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mation of successful bronchial blocker placement has also been described [12]. This case report describes the prolonged use of the Arndt endobronchial blocker in the extraluminal position in a newborn to avoid lung resection or ECMO. To successfully provide lung isolation, the bronchial blocker needed to stay in the right intermedius bronchus as migration proximal or distal would cause decompensation. Placement of the radiocontrast dye in the blocker cuff allowed easy identification of the blocker cuff position by serial radiographic monitoring and thus aid in the differential diagnosis of acute pulmonary decompensation due to blocker migration. This method of monitoring the location of the bronchial blocker does not replace the gold standard method of fiberoptic visualization, but it can be used as a supplement in small patients where the size and use of the fiberoptic scope can be problematic.

The novel use of the Arndt pediatric bronchial blocker with radiocontrast dye in this patient allowed a critically ill neonate to be spared from either lung resection or ECMO placement. In the future, this treatment method may be considered for other small patients to help avoid more invasive treatment techniques.

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