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Case Report

Fluoroscopic-guided extraluminal placement of pediatric endobronchial blocker for lung isolation for thoracotomy in a small child: A case report

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ABSTRACT

One lung ventilation (OLV) is essential for adequate visualization and surgical exposure for thoracic surgeries. However, it is challenging in small children due to limited choice of instruments and anatomical and physiological differences of airway from adults.

Patient concerns: A 4-year-old male child (weight: 12 kg, height: 95 cm) presented with fever with chills and breathing difficulty for one month.

Diagnosis: Contrast-enhanced computed tomography (CECT) revealed loculated pleural collection in the left upper lobe with suspicion of empyema with two cavitary lesions with air-fluid level in the left upper lobe.

Interventions: The child was scheduled for left thoracotomy. To ensure successful OLV, we used a microcuff endotracheal tube (ETT) with a pediatric bronchial blocker placed extraluminally and parallel to ETT during laryngoscopy. The final endobronchial placement, due to the unavailability of a smaller diameter fibreoptic bronchoscope of bronchial blocker, was done by injecting a diluted iodinated dye into the bronchial blocker (BB) lumen under fluoroscopic guidance.

Outcomes: We performed a successful OLV using a microcuff ETT and a pediatric bronchial blocker placed under fluoroscopic guidance. The surgery was completed with good lung isolation without any adverse events, such as hypoxemia or dislodgment.

Conclusion: In case of unavailability of an appropriate sized FOB, lung isolation for thoracoscopic surgeries in small children can be done using the fluoroscopic guided placement of pediatric bronchial blocker. In case the BB does not have a radio-opaque line/marker; an iodinated dye in small and diluted amount can be used to assist BB placement in main stem bronchus.

1. Introduction

One lung ventilation (OLV) for thoracic surgeries poses a variety of challenges to the anesthesiologist. It requires a thorough understanding of developmental changes in cardiopulmonary anatomy and physiology and knowledge of proposed surgical intervention.[1]

Various methods have been used to achieve OLV, like the use of double-lumen tubes (DLT), endobronchial blockers (BB) and single-lumen tubes, univent tubes, Fogarty embolectomy balloons, etc. A fiber optic bronchoscope (FOB) is often used to confirm the placement of these tubes for OLV. Achieving isolation of lungs for ventilation with OLV is often a challenge in pediatric patients due to the limited availability of different sizes of both these special tubes as well as pediatric size bronchoscopes.

We present a case of a 4-year-old child with empyema thoracis posted for thoracotomy. Single lung isolation was provided using a pediatric bronchial blocker under fluoroscopic guidance.

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2. Case Report

A four-year-old male child (weight: 12kg, height: 95cm) was admitted with a history of recurrent episodes of fever with chills, cough, and breathing difficulty for one month. Contrast-enhanced computed tomography (CECT) revealed a loculated pleural collection with pleural thickening along the anterolateral pleural surface in the left upper lobe suggestive of empyema and two cavitary lesions with an air-fluid level in the left upper (7.5x4.3 cm) and lower lobe (7.3x1.4 cm) (Figure 1).

Figure 1: CECT thorax: Empyema of left upper lobe

A week prior to surgery he was started with intravenous antibiotics, intercostal drain (ICD) was inserted and intra pleural streptokinase was administered to the patient. The child was posted for left thoracotomy. He had undergone cleft palate surgery at 15 months of age.

On routine laboratory evaluation, hemoglobin was 12.2 g/dl, leukocyte count was 12000/cu.mm, and platelets were 329 x 103/cu.mm. Serum electrolytes, serum creatinine, and liver function tests were within normal limits. A preoperative echocardiogram ruled out any cardiac congenital heart disease. The child was nebulized with salbutamol before shifting to the operating room. An intravenous cannula of 22 g was secured in the left upper limb, and maintenance intravenous fluid was started.

We planned general anesthesia with a micro-cuff pediatric endotracheal tube (ETT) of 4.5 mm internal diameter (ID) and a pediatric 5 Fr bronchial blocker (BB) for lung isolation. However, during the simulation, to physically check the fit, we found that it was very difficult to pass the fiber-optic bronchoscope or the pediatric bronchial blocker through the lumen of the tracheal tube despite adequate lubrication. As the smallest available pediatric bronchoscope was 3.8 mm, we decided to insert the bronchial blocker under fluoroscopic guidance. We also decided to pass the BB extra-luminal to avoid the reduction in ETT lumen and to avoid any damage to the BB balloon while passing it through ETT.

The child was pre-medicated with intravenous 0.8 mg midazolam and 80 mcg of glycopyrrolate in the preoperative holding area. In the operating room, the patient was monitored using a pulse oximeter, ECG, and non-invasive blood pressure (NIBP). The baseline parameters were recorded. Anesthesia was induced using intravenous Propofol 2 mg/kg and Fentanyl 2 mcg/kg. Cisatracurium 0.2 mg/kg served as a neuromuscular blocking agent. Under video laryngoscopy, the bronchial blocker was introduced through the vocal cords down into the trachea, and then the 4.5 no. microcuff ETT was introduced under video laryngoscopic guidance, parallel to the blocker tube, till the microcuff was just beyond the vocal cords. The microcuff was inflated, and the ETT position was confirmed by bilateral chest auscultation and end-tidal CO_2 waveform. The bronchial blocker was not visualized under fluoroscopy due to the lack of any radio-opaque line. Hence, we injected 0.3 ml of double diluted radio-opaque iodinated dye Ultrapaque® 76 (Diatrizoate meglumine and diatrizoate sodium) into the lumen of the bronchial blocker while its distal tip was still in the tracheal lumen. The dye delineated the tracheobronchial tree when seen under fluoroscopy. (Figure 2) The microcuff of ETT was gently deflated, and the bronchial blocker cuff and tip were then guided into the left main bronchus under fluoroscopic guidance. The bronchial blocker cuff was inflated with 3 ml of air. The microcuff of ETT was re-inflated with 1ml air. The presence of breath sounds was confirmed on the right side, and the absence of breath sounds on the left side was noted. The microcuff ETT was fixed at 12 cm at the angle of the mouth. The entire right lung field, including the apex, exhibited clear breathing sounds.

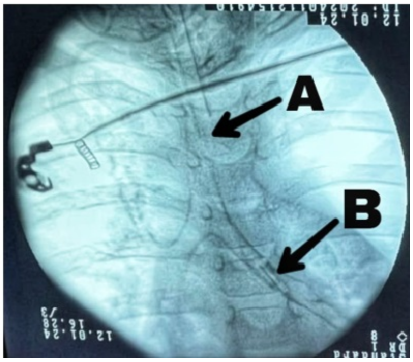

Figure 2: A: Tip of ET tube, B: Tip of bronchial blocker

After induction, a 22 g cannula was placed in the right radial artery to monitor arterial blood pressure and blood gases. Good ventilation of the right lung and collapse of the left lung was achieved throughout the procedure without any episodes of desaturation. At the end of the surgery, the bronchial blocker cuff was deflated and withdrawn from the trachea after temporary deflation of the microcuff of

ETT. Ventilation was confirmed on both sides of the lung. Postoperative analgesia was provided by continuous left erector spinae block through an 18g catheter placed under ultrasound guidance. After the reversal of neuromuscular blockade, extubation was performed, and the patient was shifted to the intensive care unit after 1 hour of observation in recovery without any complications. He was discharged on postoperative day 5.

3. Discussion

One lung ventilation and isolation are classically employed for surgical field isolation and prevention of spillage from the infected lung to the healthy lung. The standard method to achieve one lung isolation is using double-lumen tubes or FOB-guided lung isolation devices. In children below eight years of age, OLV is challenging due to technical issues such as the non-availability of DLT and untrained anesthesiologists.[1,2]

OLV is essential for thoracotomies, where it provides better surgical exposure, access to the target lung, and prevention of contamination of the contralateral lung with blood or secretions.[3]

The anesthesiologist planning pediatric lung isolation must have proficient knowledge and understanding of tracheobronchial anatomy and physiology for optimal placement of lung isolation devices.[4]

OLV for pediatric patients can be achieved with single-lumen endobronchial intubation, a balloon-tipped bronchial blocker, or an appropriate-sized double-lumen tube.

The most commonly used method for lung isolation is DLT. DLT can provide successful OLV in multiple ways. It can be easily placed and provides the fastest and absolute lung isolation. It has ease of conversion from one lung to two lungs whenever needed. The transparency of the tube allows inspection of isolated secretion and suctioning of both the right and left lungs.[5]

The smallest DLT available is 26 Fr, which is suitable for use in children above 8 years of age, 130 cm in height, and weight of 30kg. Hence, DLT was not suitable for our case in the 4-year-old child (weight: 12 kg, height: 95 cm). Under 8 years of age, endobronchial intubation or bronchial blockers are used for lung isolation. Marraro pediatric endobronchial bi-lumen tubes, though not easily available, have been reported to be effective for lung isolation in children less than 3 years old.[6]

Lung isolation with endobronchial intubation is simple and rapid. It does not require any modern equipment and confirmation with a fibreoptic bronchoscope.[5] However, with endobronchial intubation, suction, oxygen, and continuous positive airway pressure (CPAP) cannot be applied to the operative lung if needed.[7] In the case of right endobronchial intubation, the cuff may obstruct the right upper lobe bronchus and cause hypoxemia.[2,5]

Balloon-tipped bronchial blockers are most commonly used in infants and children less than 6 years of age. It can be inserted intraluminal or extraluminally into the ETT. It provides a complete blockade of the bronchus and hence produces predictable lung collapse.[5],[7] Since most of them are closed-tipped, the operative lung cannot be suctioned or placed under CPAP.[8,9]

However, newer available bronchial blockers are designed with the patent lumen and are open-tipped. With these BB we can suction the operative lung, provide oxygen insufflation and CPAP adequately.

We planned the extraluminal placement of BB to avoid a reduction in ETT lumen and to avoid any damage to the BB balloon while passing it through ETT. The smallest bronchoscope available to us was 3.8mm, which means we could not pass through the lumen of 4.5 no ETT in our preoperative check. So, we decided to introduce the BB parallel to ETT under fluoroscopy guidance.

FOB is the gold standard for confirming the position of DLT and bronchial blocker. Real-time (RT) fluoroscopy may provide a valuable tool when confirmation with FOB is difficult due to limited instrumentation, anatomical variations in the airway, bleeding, or secretions.[10] The use of RT fluoroscopy in the present case allowed manipulation of the bronchial blocker under direct vision and successful lung isolation.

V. Ponde et al. reported a case series of C Arm guided lung isolation in 15 pediatric patients undergoing VATS using conventional un-cuffed ETT for endobronchial intubation.[3]

N. Panidapu et al. reported a case of a 31-year-old female patient posted for lobectomy where real-time fluoroscopy was successfully used to position the universal size bronchial blocker (Coopdech™) after failed attempts of using FOB.[10]

In our case, on performing fluoroscopy, we found that the pediatric bronchial blocker had no radio-opaque line/marker. Hence, we injected 0.3ml of diluted Ultrapaque®dye into the blocker lumen. The dye delineated the lower end of the trachea and main stem bronchus. This helped us position the BB cuff in the left main bronchus using real-time fluoroscopy. As the dye amount was negligible and diluted, no allergic reactions or side effects were noted even after 24 hours of observation.

We did not find in the literature review any report of dye injection in a BB for its placement.

4. Conclusion

We describe a novel approach to lung isolation in pediatric patients using the fluoroscopic guided extra-luminal placement of pediatric bronchial blocker due to the unavailability of pediatric-size fibreoptic bronchoscope. Paediatric BB, when not visualized under fluoroscopy, can be guided for placement in the main bronchus after injecting a small amount of diluted iodinated contrast agent into the lumen of the bronchial blocker.

5. Source of Funding

None.

6. Conflict of Interest

None.

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