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Case Report

Pediatric Lung isolation in a limited resource setup: a case report

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Abstract

Rationale: Pediatric lung isolation is a great challenge to anesthesiologists. Despite various advances in techniques and equipment in lung isolation, most of the sophisticated devices are unavailable in remote setups. Blind techniques have been used, but they have a low success rate. **Patient concerns**: Here we report a case of a five-year-old male child who had cough and fever for one month. CT scan of the chest revealed right-sided empyema thoracis for which decortication was planned under general anesthesia with one lung ventilation. Double lumen tube for this patient was not commercially available and we did not have a pediatric fiberoptic bronchoscope, which would fit inside the endotracheal tube necessary for the patient. **Interventions**: After anesthesia induction, an adult fiberoptic bronchoscope was used as an aid for insertion of bougie into the left mainstem bronchus followed by railroading the endotracheal tube over the bougie for lung isolation. **Outcomes**: Surgery then proceeded in the left lateral position with a right thoracotomy under a quiet surgical field. **Conclusion**: In the case of unavailability of pediatric fiberoptic bronchoscope, an adult fiberoptic bronchoscope and a bougie can aid in successful lung isolation in pediatric patients.

Keywords: Bougie; fiberoptic bronchoscope; lung isolation; pediatric anesthesia

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Introduction

Pleural infections represent one of the most important causes for the need to perform a thoracotomy and decortication.[1] Although lung isolation is not always necessary for these surgeries, there has been an increase in the interests in lung isolation techniques to provide a quiet surgical field with good exposure and prevention of contamination of normal lung. Moreover, when compared with an adult, pediatric lung isolation can be more difficult because of the limitation of available lung isolation devices.[2] Currently, lung isolation in infants and children includes the use of single lumen endotracheal tube (ETT), balloon-tipped bronchial blockers (BB) and univent tubes; these devices usually require a pediatric fiberoptic bronchoscope for proper placement.

However, except for single lumen endotracheal tubes, most of these sophisticated devices are not available in developing countries like ours.

Case report

A five years old male child, weighing 12 kg was brought to the pediatric department with complaints of cough and fever for one month. After the relevant investigations including computed tomography (CT) scan of the chest, the child was diagnosed to have right-sided empyema thoracis and was planned for surgical decortication under general anesthesia with one lung ventilation. As double lumen tube for children below eight years is unavailable commercially and we did not have bronchial blockers and pediatric fiberoptic bronchoscope, we planned for left-sided endobronchial intubation by using an adult fiberoptic bronchoscope, a 10 F bougie and 4 mm Internal Diameter single lumen endotracheal tube. After a detailed discussion with the surgeon, we decided to proceed with the surgery with both lung ventilation with low tidal volume and high frequency in case we fail to achieve lung isolation.

Timeline

5 years old child
Diagnosis: Right Sided Empyema Thoracis
Surgical Plan: Decortication
Anaesthetic plan: General anesthesia with one lung ventilation

Sedated with ketamine before being brought to the theatre

Preoxygenation: Three minutes

Induction of anesthesia: Fentanyl, Propofol and Vecuronium

Conventional laryngoscopy with Macintosh laryngoscope

Insertion of the fiberoptic bronchoscope into trachea would take less time when inserted by laryngoscopy than without laryngoscopy

Insertion of adult fiberoptic bronchoscope into the trachea

Insertion of a bougie bent at about 45 degrees to the left at the tip into the trachea up to its bifurcation

Turning bougie about 90 degrees to the left and insertion to the left mainstream bronchus under fiberoptic guidance

Withdrawal of bronchoscope

The railroading of endotracheal tube through the bougie into left mainstem bronchus and cuff inflation

Confirmation of successful left sided endobronchial intubation

The child was given ketamine 25 mg iv and glycopyrrolate 0.1 mg iv in the patient holding area and then brought to the operating room. After attaching standard monitors, he was preoxygenated for three minutes and anesthesia was induced with propofol 30 mg iv, fentanyl 20 mcg iv and vecuronium 1 mg iv. Conventional laryngoscopy with Macintosh laryngoscope was done and adult fiberoptic bronchoscope with an outer diameter of 5 mm was inserted into the trachea. This was done to minimize time loss while inserting the bronchoscope into the trachea. Bifurcation of the trachea was identified with a fiberoptic bronchoscope and a 10F bougie that was bent at about 45 degrees to the left at the tip was inserted from the left side of the bronchoscope. On reaching the bifurcation, the bougie was turned about 90 degrees to the left and inserted to the left mainstream bronchus under fiberoptic guidance. The bronchoscope was then withdrawn and a 4 mm ID endotracheal tube was railroaded through the bougie into the left mainstream bronchus. The bougie was then withdrawn and the cuff was inflated with two millilitres of air. Auscultation of the chest revealed selective air entry into the left side and no air entry in the right side, confirming successful left side endobronchial intubation. Surgery then proceeded in the left lateral position with a right thoracotomy under a quiet surgical field. After completion of the surgery, the tube was withdrawn until equal air entry was heard on both the lungs, the right lung was recruited and the trachea was extubated without any significant events. The patient was then shifted to the Pediatric Intensive Care Unit, monitored there for three days, shifted to the pediatric ward later and discharged after 10 days of surgery. There were no significant events in the postoperative period.

Discussion

Pediatric lung isolation presents a great challenge to an anaesthesiologist for which various methods ranging from rotational technique to the use of double lumen tubes or bronchial blockers have been practiced.[3] As the angulation of the left mainstem bronchus is more acute than that of the right, left mainstem bronchus intubation is technically difficult as compared to the right mainstem bronchus.

Slinger has described 'ABC' for adult lung isolation: anatomy, bronchoscopy, and chest imaging.[4] However, for pediatric lung isolation, the addition of 'D' - the varying diameter of the pediatric airway with age should be considered.[2] Because of smaller airway size, a double-lumen tube (DLT) cannot be used in infants and small children for lung isolation. Though bronchoscopes come in various sizes, for a well-lubricated bronchoscope to fit inside the tracheal tube, the outer diameter of the bronchoscope should be <90% of the internal diameter of the tracheal tube and not all bronchoscopes of different sizes are available in all the hospitals. The other option for lung isolation includes blind mainstem bronchus intubation using single lumen endotracheal tube.[2]

Various techniques have been described for blind left mainstem bronchus intubation. One method is to curve the distal end of the tracheal tube to the left by the use of a stylet.[5] Next method is by the use of a distally curved rubber bougie that is directed blindly to the left bronchus, followed by railroading the tube over the bougie.[6] In another technique for left mainstem bronchus intubation, the bevel of the tube is rotated 180° while the head is turned to the right and the ETT is advanced into the bronchus until the right breath sound disappears.[7]

Intubation of left mainstem bronchus using a standard endotracheal tube with the rotational technique has been found to be less successful compared to right mainstem bronchus intubation.[8]

The estimated diameter of left mainstem bronchus of a five-year-old child is 5.3 mm.[9] Thus, a tube that fits the patient's left mainstem bronchus is a tube with an outer diameter less than 5.3 mm. This corresponds to a tube with an internal diameter 4mm.[10] Unfortunately, we only had an adult fiberoptic bronchoscope present in our institute that did not fit inside this tracheal tube. Thus, we used the adult fiberoptic bronchoscope to visualize the correct placement of the bougie and then railroaded the tube over the bougie. As a backup plan, we had decided to proceed with surgery with both lung ventilation with low tidal volume and high frequency in case we fail to achieve lung isolation.

Conclusion

Since pediatric fiberoptic bronchoscope may not be readily available, and the success rate of blind left mainstem bronchus intubation is low, guidance by an adult fiberoptic bronchoscope can be useful in lung isolation in such scenarios.

Conflict of interests All the authors have filled the ICMJE conflict of interest form and declare that they have nothing to disclose.

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