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One-lung Anesthesia for Pediatric Thoracic Surgery: A New Use for the Fiberoptic Bronchoscope

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One-lung anesthesia is rarely attempted in pediatric patients because of difficulties with the endobronchial blocker or tube placement; however, many of the same indications for endobronchial intubation during thoracic surgery in adults also exist in pediatrics. We wish to report a case in which the pediatric fiberoptic bronchoscope (Olympus BF3C4) facilitated the conduct of one-lung anesthesia during thoracic surgery in a child.

REPORT OF A CASE

A two-year-old, 19.5-kg girl was admitted for right thoracotomy and resection of a sequestered segment of the right lung. There was no history of heart failure or cyanosis. Exercise tolerance, physical examination, and chest roentgenogram were normal.

Anesthesia was induced with halothane and 70 per cent nitrous oxide. Paralysis was induced with 0.1 mg/kg pancuronium and the trachea was intubated using an oral approach under direct vision. A 5-mm ID Portex tube was inserted easily into the trachea with a slight leak during positive pressure ventilation. Several attempts were made to place the endotracheal tube in the left main bronchus by angling the curve of the tube to the left and with the head, neck and shoulders in various positions. All attempts were unsuccessful and the child was positioned for a right thoracotomy.

When the chest was opened, repeated attempts failed to place the endotracheal tube in the left main bronchus. The 3.7-mm flexible pediatric fiberoptic bronchoscope (Olympus BF3C4®) was passed into the endotracheal tube via a ventilating adapter and the endotracheal tube was inserted into the left division of the first bifurcation identified below the tip of the endotracheal tube. Inspection of the operative field showed that the middle and lower lobes of the right lung had been isolated. During halothane anesthesia and oxygen, the pH_a was 7.32, Pa_{O_2} 186 mmHg, and Pa_{CO_2} 54 mmHg. The bronchoscope was inserted again and the shadow of the left mainstem bronchus was identified through the wall of the endotracheal tube. After the tube was withdrawn to a higher location, the left mainstem bronchus was intubated to a position above the bifurcation into upper and lower divisions using the bronchoscope as a guide. Secretions were suctioned from the left upper and lower division and the bronchoscope was withdrawn. No adverse hemodynamic changes were noted throughout bronchoscopy.

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The surgeon then observed that the right lung could be collapsed and that it was no longer being ventilated. Analysis of arterial blood gases showed improvement in the oxygenation (Pa_{O_2} = 295). When the segmental resection was completed, the endobronchial tube was withdrawn to a tracheal position and the lung re-expanded prior to closure of the chest. The perioperative course was uneventful and postoperative chest roentgenograms demonstrated good expansion of both lungs.

DISCUSSION

Isolation of one lung by endobronchial intubation or placement of a bronchial blocker can be of value during thoracic surgery for infants and children.[1,2] This has not become routine practice due to difficulty inserting tubes in the appropriate mainstem bronchus and because the distance from the carina to the location of the right upper lobe orifice is so short that obstruction is likely to occur.[3] In this case, use of the pediatric fiberoptic bronchoscope enabled us to achieve left bronchial isolation when several blind attempts had failed. This included an attempt with the surgeon guiding the tube towards the left bronchus from the right hemithorax.

Methods used to achieve selective bronchial intubation in children have included blind techniques (turning the head away from the bronchus to be intubated, angulation of the endotracheal tube towards the side to be intubated, and utilization of an angled catheter to direct the endotracheal tube into the appropriate bronchus) and direct visualization techniques (rigid bronchoscopy and flouroscopy).[1-5]

With selective endobronchial suctioning, the left mainstem bronchus usually cannot be catheterized more than 50 per cent of the time despite head positioning and catheter tip angulation.[6,7] Since the angulation of the bronchi in infants and small children has been reported to be more nearly equal,[8] left mainstem bronchial intubation should be less difficult than in adults. Despite repeated attempts to achieve left main bronchial intubation in this child by conventional means, we were unsuccessful.

Rao *et al.*[5] have recently described the use of a rigid fiberoptic telescope to facilitate selective bronchial blockade or endobronchial intubation in the pediatric population. The telescope was passed via a ventilating bronchoscope and thus required a separate surgical procedure. Use of this technique may prolong laryngoscopy, increase trauma to the upper airway, and may not permit precise localization of an endobronchial tube. It may, however,

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be the only way to achieve selective bronchial blockade in small infants. Matthew and Thach[9] have reported successful endobronchial intubation of critically ill infants with bullous emphysema using fluoroscopic control. We feel that the routine use of fluoroscopy for endobronchial tube positioning in the operating room would expose children to unnecessary radiation. Nevertheless, it may become necessary under difficult circumstances when direct airway manipulation is not tolerated and selective intubation is imperative. An operative routine requiring either fluoroscopy or rigid bronchoscopy would be cumbersome, time-consuming, and impractical in most clinical settings.

In contrast, fiberoptic intubation is a procedure which many anesthesiologists have utilized under difficult circumstances.[10,11] Extensive experience with the technique has demonstrated its potential advantages and complications in both surgical and medical patients.[12,13] With a basic understanding of the anatomy and some experience, the fiberoptic bronchoscope can be used for endobronchial tube placement.[14] Using the 3.7-mm bronchoscope, effective positive pressure ventilation may be provided via a 5.0-mm endotracheal tube. Endobronchial tube position can be achieved or verified without interrupting ventilation or surgery after the trachea has been intubated orally and the patient has been positioned for thoracotomy. Also, balloon occlusion of selected tracheobronchial segments can be achieved via the bronchoscope suction channel.[15]

The only problem which we encountered with the technique in this case was an initial confusion of the division between the upper lobe bronchus and the bronchus intermedius with the carina. In retrospect, the upper lobe trifurcation and absence of the posterior membranous portion of the trachea confirmed our anatomic mistake and enabled us to correctly identify the necessary structures for endobronchial intubation.

In addition to allowing selective intubation, this technique enabled us to precisely locate the endotracheal tube so that it did not obstruct either division of the left main bronchus. We also found it useful for clearing secretions which had accumulated during intubation of the bronchus intermedius and after withdrawal of the tube to a position above the carina when the resection was completed.

The 3.7-mm bronchoscope will allow us to safely and reliably obtain endobronchial intubation in patients who accommodate a 5.0-mm or larger tube. The technique also may be employed for routine assessment of the postoperative anatomy of the operated lung and trachea. Although flexible fiberoptic bronchoscopy has not been reported for pediatric thoracic surgery, we have had extensive experience with the technique in adults, whether awake or anesthetized, and we suggest that the same principles of safe practice should guide the clinician who wishes to use this technique in a pediatric population.

Addendum

Since the preparation of this case report the use of a 1.8-mm ultrathin prototype bronchoscope has been reported for verification of endotracheal tube position in neonates.[16]

References

1. Cullum AR, English CW, Branthwaite MA: Endobronchial intubation in infancy. Anesthesia 28:66–70, 1973
2. Hogg CE, Lorham PH: Pediatric bronchial blocking. ANESTHESIOLOGY 33:560–562, 1970.
3. Brown TCK, Fisk GC: Anesthesia for Children Including Aspects of Intensive Care. Oxford, Blackwell Scientific Publication, 1979, p. 152
4. McLellan I: Endobronchial intubation in children. Anesthesia 29:757–758, 1974
5. Rao CC, Krishna G, Grosfeld JL, et al: One-lung pediatric anesthesia. Anesth Analg (Cleve) 60:450–452, 1981
6. Salem MR, Wong AY, Mathrubhutham M, et al: Evaluation of selective bronchial suctioning techniques used for infants and children. ANESTHESIOLOGY 48:379–380, 1978
7. Shapiro SF, Bowe EA, Klein EF, et al: Selective bronchial suctioning. (Letter to the editor.) Crit Care Med 9:560, 1981
8. Cleveland RH: Symmetry of bronchial angles in children. Radiology 133:89–93, 1979
9. Matthew OP, Thach BT: Selective bronchial obstruction for bullous emphysema. J Pediatr 96:475–477, 1980
10. Murphy P: The fiberoptic laryngoscope. ANESTHESIOLOGY Review 8:23–27, 1981
11. Taylor PA, Towey RM: The bronchofiberscope on an aid to endotracheal intubation. Br J Anaesth 44:611–612, 1972
12. Lindholm C, Ollman B, Snyder J, et al: Flexible fiberoptic bronchoscopy in critical care medicine: diagnosis, therapy and complications. Crit Care Med 2:250–261, 1974
13. Sackner MA, Wanner A, Landa J: Applications of bronchofiberoscopy. Chest 62(5):70S–78S, 1972
14. Shapiro SF, Watson CB, Bowe EA, et al: Bronchoscopic placement of the double-lumen endotracheal tube for independent lung ventilation. (Abstract.) Crit Care Med 9:189, 1981
15. Ratliff KL, Hill JD, Fallatt, et al: Endobronchial control of bronchopleural fistulae. Chest 71:98–99, 1977
16. Vigneswaran R, Whitfield JM: The use of a new ultra-thin fiberoptic bronchoscope to determine endotracheal tube position of the sick new born infant. Chest 80:174–177, 1981