C Arm confirmation of lung isolation in pediatric patients undergoing video-assisted thoracoscopic decortication: A retrospective case series

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Abstract

Video-assisted thoracoscopic surgery (VATS) is a frequently performed procedure in children which requires an efficient technique for lung isolation. Unavailability of appropriate size double-lumen tubes (DLT) for children and fiber optic scopes inspired us to create our own technique for lung isolation. This retrospective case series aims to describe our technique of C arm-aided endotracheal tube (ETT) placement for one-lung ventilation in these patients. 15 patients, aged 3 months to 10 years posted for VATS were recruited. Standard monitoring, general anesthesia and Lung isolation done as per the described protocol. Mean, standard deviation, and 95% Confidence interval was used. The mean age and weight was 43.93 months was 16.4 kg respectively. All right bronchus intubations were achieved in the first attempt. Of the 8 left bronchus intubations, 4 needed more than one attempt with a stylet inserted with a gentle J-shaped curve. Mild desaturation, seen in 2 patients during surgery was corrected with neck extension and increasing the FiO₂. None of the cases required withdrawal of the tube into the trachea. One-lung anesthesia was achieved successfully in all the cases using C Arm with routine ETT.

Keywords: C Arm, One lung ventilation, thoracoscopy

Introduction

One lung ventilation (OLV) is often required for video-assisted thoracoscopic surgeries (VATS). It aids surgical procedure, provides a comfortable field of operation, and increases space for maneuvering instruments in thoracic cavity. DLTs and bronchial blockers used for OLV require fiberscope for confirmation while the availability of appropriate size tubes is a practical problem due to the variety required in pediatric patients. Hence, alternate options for pediatric one-lung anesthesia still require exploration. Baraka A(1) has used a similar technique with ordinary endotracheal tube in children with hydait cyst excision. However, they had high frequency of right upper lobe collapse in cases of selective right bronchial intubation. We could vanquish this issue was by real time fluoroscopy confirmation of the right upper lobe ventilation.

We present a case series of 15 children with empyema thoracis posted for VATS. Successful one-lung anesthesia was provided using a conventional uncuffed endotracheal tube (ETT) with clinical and C arm-guided confirmation.

Case Report

The institutional ethical committee approval was obtained.
15 patients; 3 months to 10 years, for VATS were included. Table 1 shows the demographics.

Informed consent was obtained from the parents. After pre-oxygenation and standard ASA monitoring, intravenous Glycopyrrolate 4 mcg/kg, Propofol 2 mg/kg and Atracurium 0.5 mg/kg were given. After direct laryngoscopy, an appropriate size ETT (a size smaller than the age-appropriate tube and the visual impression of the vocal cord size) was inserted. The markings at the teeth indicated endotracheal intubation. In case of any intraoperative desaturation, it was planned to withdraw the ETT till this mark.

For the Left VATS [Figure 1] the tube was advanced to intubate the right bronchus. Confirmation of correct placement was done by (a) Breath sounds exclusively on right side (b) Absence of breath sounds on the left side (c) Chest rise on ventilation on the right side. Right lung ventilation was seen under continuous fluoroscopy to rule out upper lobe collapse and ETT placement was confirmed.

For right-sided VATS Left bronchus was intubated by passing the tip of the ETT past the glottis and turning the head of the patient to the right side. Simultaneously the tube was turned towards the left (by 90 degrees) and gently passed till mild resistance was felt. Confirmation was by (a) Breath sounds heard exclusively on left side (b) Absence of breath sounds on the right side. (c) Left chest rise on ventilation. Left-sided ETT placement was confirmed on C Arm [Figure 1] and the thoracoscopic visualization of the collapsed lung was noted. Analgesia was provided by a continuous thoracic epidural catheter.

During the procedure surgeons were asked about comfort related to operative field and the tube was withdrawn into the trachea at the end of the procedure.

There were 7 right-sided and 8 left-sided VATS. All 15 patients were successfully given one-lung anesthesia. All 8 right-sided endobronchial intubations were achieved in a single attempt. In 4 of the 7 patients requiring left bronchial intubations, more than 1 attempt was needed to establish single-lung anesthesia. In 2 patients, left endobronchial intubations were accomplished in second attempt and in the other 2, the left bronchus was intubated on the third attempt with the help of stylet. Stylet traumas are known and we recommend caution. In our study, we did not encounter any complications.

No desaturation during intubation was noted. Intraoperatively, 2 patients showed transient decrease in oxygen saturations to 85 to 88%. Saturation improved with extension of the neck in lateral position and increasing the FiO₂. EtCO₂ was in the range of 20 to 45 mm Hg. None required intraoperative withdrawal of the ETT in the trachea.

**Discussion**

As per our study, it is possible to achieve one-lung anesthesia for VATS using a simple ETT and C arm and should be mandatory as the differing auscultatory findings as a result of the underlying disease might hamper confirmation using only clinical correlation. This also gives a comfortable surgical field with the help of regular routine equipment in a resource-limited OT setting. In our study, we did not encounter any complications.

Baraka A[2] studied 13 consecutive patients with hydatid cyst of lung requiring one-lung anesthesia used age-appropriate cuffed tube and chest radiograph to confirm placement. They had a high frequency of right upper lobe collapse due to natural anatomy. We used uncuffed ETTs with C arm confirmation. Right upper lobe collapse was ruled out by real-time ventilation fluoroscopy.

Paquet C[3] described a two-tube assembly for pediatric lung isolation. The reported disadvantages were potential for vocal cord edema, stridor, or mucosal damage and need to downsize the tube was noted due to hoarseness. In our study, since we worked with a single age-appropriate tube (a size smaller) we did not have any such complication. This caused minimal peri tubal leak with no clinical issues.

The smallest size of available gadgets can be used only up to a specific age group, (e.g. conventional double-lumen tube is 26 Fr
suitable for children >8 years, Univent tube® 3.5 mm internal diameter can be used for >6 years of age, Arndt pediatric endobronchial blocker 5 Fr is suitable for children >2 years requiring at least a 4.5-mm internal diameter ETT). Marraro pediatric endobronchial bi-lumen tube has been reported to be effective for OLV up to 3 years.[1,4,8] These are not easily available.

Methods described also include ultrasound confirmation as well as printed three-dimensional airway model-assisted planning.[9-11] We could have confirmed the respiratory lung movement and one-lung ventilation with ultrasound to prevent radiation. We intend to take this up in subsequent cases.

A potential limitation here is that the standard double-lumen tube allows a switch to one-lung ventilation only when needed. With our method only the chosen healthier single lung is ventilated but we did not find any adverse effects related to this in our study. We believe this may not be a problem, especially in largely unilateral parenchymal disease.

The ergonomics for positioning the C arm and the operation table compatibility are practical issues that should be planned beforehand with the space-consuming thoracoscopy equipment in mind.

The advantage of using our method for single-lung ventilation is that it does not require any specialized training and gadgets to achieve one lung anesthesia. This may result in more widespread usage of OLV in these patients especially in limited resources. The outcomes of the study with respect to surgeon comfort further strengthen our belief that this method of lung isolation should be more widely used in children.

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Conflicts of interest
There are no conflicts of interest.

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