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A Case Report

Anaesthetic Challenges in a Toddler for Video Assisted Thoracoscopic Decortication - A Case of Empyema Thoracis

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Abstract-

Video assisted thoracoscopic surgery (VATS) has lesser operative complications, lesser postoperative pain and shortened hospital stay, making it a favourable approach in paediatric patients. These advantages have led to an increase in its usage in the past few years. Furthermore, the indications for VATS in children have also increased exponentially. However, it demands an efficient technique for one lung ventilation. A thorough knowledge of the associated pathophysiological changes, adequate monitoring and planning renders safe provision of anaesthesia in this procedure. This article focuses on VATS for decortication performed in a toddler with empyema thoracis and the various strategies adopted for optimising oxygenation during single lung ventilation.

Keywords: Anaesthetic,Thoracoscopic Decortication,Empyema Thoracis

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Introduction

A less intrusive method of doing thoracoscopic surgery is called video-assisted thoracoscopic surgery (VATS). Because of its reduced postoperative discomfort and shorter hospital stay, VATS is advantageous in the paediatric population [1]. Interests are currently shifting towards eschewing advancements in paediatric lung isolation technique with the following: (a) a "quiet" surgical field with sufficient exposure, (b) avoiding contamination of the normal lung, and (c) preventing harmful complications for the young patients, such as hypoxemia [2]. For stage II pulmonary empyema, the American Thoracic Society has recommended the use of VATS [2].

A properly completed single lung ventilation is necessary for a successful VATS (SLV). Compared to adult lung, paediatric lung faces different difficulties. The work of breathing increases as a result of their decreased compliance and increased airway resistance, which is compounded further if the child is to be placed in the lateral decubitus posture with SLV, as in the case of VATS [3, 4]. In our facility, a 3-year-old patient with empyema thoracis underwent video-assisted thoracoscopic decortication.

Case report

A 3-year-old female child weighing 28 kg presented with fever, chest pain and abdominal pain for more than a week. She was awake but worn out when examined; her heart rate was 142/min, her breathing rate was 56/min, and her oxygen saturation level was 93% at room air. In the left mammary, axillary, infra axillary, and infrascapular regions, air entry was decreased.

On a chest X-ray, there was consolidation in the left lower lobe and a rightward displacement of the trachea.

CT thorax revealed thick loculated pleural effusion on the left side with collapse and consolidation of the left lung. Ultrasound suggested restricted diaphragmatic movements on the left side. The child was also evaluated for obesity-associated syndromes, but the results were within normal limits.

In the pre anaesthetic evaluation, the child was on nasal oxygen (2 liters/min), an SpO_2 of 96%, a heart rate of 140 beats per minute, and a respiratory rate of 42 beats per minute. On auscultation, air entry was reduced on the left side. Blood tests came back within expected ranges. As the child was obese and had a short neck, the possibility of a difficult airway was also a concern.

After obtaining informed consents for surgery and anaesthesia, we shifted the child to the operating room (OR). In the OR, standard monitoring with a pulse oximeter, heart rate monitor, and non-invasive blood pressure monitors were initiated. The operating room temperature was maintained at 23 ^{o}C. As the child already had intravenous (I.V.) access, anaesthesia was induced with I.V. Fentanyl 40 mcg, 50 mg Propofol, and 15 mg Atracurium to facilitate intubation. The child was intubated with a cuffed endotracheal tube (size 4.5) using a McIntosh No. 1 blade. SLV was attained by advancing the single-lumen endotracheal tube (ETT) into the right bronchus. The left lung isolation was confirmed by auscultation, and the tube was fixed at 19 cm from the lip. Anaesthesia was maintained on O_2/Air at 50:50 and sevoflurane to achieve a MAC of 1.2.

A donut was used to hold the child's head as they were positioned in a right lateral posture and supported by axillary rolls and a bean bag. Once more, the location of ETT was verified. The tidal volume was fixed at 100–120 ml, and the mechanical ventilation rate was set at 24/min. Throughout the surgery, SpO2 was constant at 99–100%. End tidal CO_2 increased from 22 to 44 after 2 hours and went upto a value of 74 after 4 hours. We accepted the hypercapnia. We employed fentanyl boluses totalling 50 mcg and a 500-mg intravenous infusion of paracetamol for the intraoperative analgesia. The administration of 300 cc of crystalloid totalled.

The procedure took four hours. With the exception of the permissive hypercapnia mentioned previously, the intraoperative vitals were steady. After the surgery, 0.2% ropivacaine was injected into the port locations. Patient was lying on back with the ETT pulled back until equal breath sounds were heard on both sides, which was at a distance of 14.5 cm from the lip. The results of the arterial blood gas study were within normal bounds. There was 99–100% oxygen saturation. We opted for elective mechanical ventilation .Once her end-tidal CO2 was within the usual range, she was shifted to the paediatric ICU on mechanical ventilation.

She remained stable in the ICU and was extubated on postoperative day 3.

Discussion

The most reliant area of the lungs in both adults and children has the highest levels of ventilation (V) and perfusion (Q). Pressure gradients and gravitational pull are to blame for this. Both elements (V and Q) ought to match each other properly. However, due to a reduction in functional residual capacity (FRC) and tidal volume during one lung ventilation in VATS, there are some factors that can exacerbate the V/Q mismatch. Inadequate patient placement, surgical retraction, general anaesthesia, and mechanical breathing can contribute to a V/Q mismatch [5].

Ventilation and perfusion are significantly impacted by the lateral decubitus position. When compared to adults, this mismatch is more pronounced in children. Due to the hydrostatic pressure difference between the two lungs and the gravity pull, placing an adult in lateral position with a healthy lung in dependent position results in adequate oxygenation [6]. While ventilating the dependent healthy lung during tidal breathing, children's soft, easily compressible lungs and their residual volume, which is closer to FRC, cause less lung compliance and an increase in airway closure [3, 4].

In order to avoid a V/Q mismatch, the hypoxic pulmonary vasoconstriction (HPV) reaction diverts blood away from the underventilated lung. This reaction is at its peak when pulmonary vascular pressure is normal and diminishes when it is high or low. Moreover, when partial pressure in venous blood (PvO2) is normal, one can achieve maximal HPV and experience a diminished response when PvO2 is high or low. Inhalational anaesthetics and other vasodilators, along with a high or low fraction of inspired oxygen (FiO2), will thereby reduce the HPV response [7]. Children and young adults can apply this rule [3]. The hydrostatic pressure gradient between the dependent and nondependent lungs has decreased in paediatric patients because of their tiny size. Hence, in the lateral decubitus posture during SLV, there is a lack of the beneficial response of boosting perfusion to the dependently ventilated side while decreasing perfusion in the diseased lung [8]. This increases vulnerability to hypoxia.

The non-operative bronchus should be properly sealed, the lung should collapse, secretions should not "spill over" into the healthy lung, and the contaminated lung should be able to be suctioned. Single-lumen ETT is still a viable choice in spite of this [9]. In our situation, these issues were not present, and the procedure was effective. We opted for single-lumen selective main stem intubation and proceeded with ETT into the right bronchus until left breath sounds disappeared [1, 9]. Although double lumen endobronchial tubes continue to be the standard treatment for SLV, individuals under 30 kg cannot utilise them because the smallest widely available DLT is size 28F [10]. Under the age of six, bronchial blockers can be used. Its drawbacks include the inability to suction the operating lung and the possibility of injury or possibly an airway rupture [4, 12].

Neuromuscular (NM) blocking and mechanical breathing, which exacerbate a pre-existing V/Q mismatch, are concerns during general anaesthesia. HPV is hampered by inhalational anaesthetics, while FRC is decreased by NM blocking. Several factors increase the child's risk of developing atelectasis. Moreover, thoracoscopy involves surgical retraction that affects V/Q mismatch and is carried out in the lateral decubitus position [9, 13].

Increased FIO2, lowered tidal volume, increased respiratory rate, maintenance of cardiac output, and maintenance of tidal volume in the ventilated lung to prevent atelectasis were the methods we used to overcome the aforementioned difficulties and improve oxygenation.

Conclusion

Together with surgical difficulties, VATS procedures are significantly complicated by physiological changes that occur during and after surgery. To administer VATS properly, it is vital to have a thorough understanding of these physiological changes and their potential consequences.

VATS is an alternative to open thoracotomy because it causes less discomfort, leaves fewer scars, promotes quicker healing, and has lower complication rates. The safety of the operation is increased by effective communication between the anesthesiologist and the surgeon.

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