Phenylephrine to treat hypoxemia during one-lung ventilation in a pediatric patient

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**Case**

- A 12-year-old, 35 kg girl was scheduled for anterior-posterior spinal fusion.
- Preoperative examination revealed idiopathic scoliosis with no history of cardiopulmonary disease.
- A thoracoscopic approach was planned for the anterior portion of the case.
- Smooth induction and intubation with a left-sided 32Fr double lumen tube (DLT).
- Correct DLT positioning confirmed with fiberoptic bronchoscopy.
- Maintenance anesthesia was infusions of propofol, remifentanil, and dexmedetomidine.
- One lung ventilation (OLV) started after lateral decubitus positioning:
  - FiO2 = 100%
  - TV = 8 mL/kg
  - PEEP = 5 mmHg
  - RR = 12 breaths/min
- After 10 minutes of uneventful OLV, O2 saturation rapidly dropped from 100% to 64%.
- Two lung ventilation immediately resumed with quick return of O2 saturation to 100%.
- Fiberoptic exam confirmed correct DLT placement.
- OLV resumed with settings of:
  - FiO2 = 100%
  - TV = 8-10 mL/kg
  - PEEP = 7 mmHg
- After 10 minutes, O2 saturation slowly falling 85-88%.
- Blow-by O2 0.5 L/min to non-dependent lung started with O2 saturation improving to 90-92%.
- Poor surgical visualization and discontinuation of blow-by oxygen, saturation 85-88%.
- Phenylephrine bolus of 50 µg – O2 saturation increase from 88% to 94%.
- Phenylephrine infusion started at 0.1 µg/kg/min.
- O2 saturation remained stable from 94-98% for the remainder of the case (2.5 hours).

**Traditional Management**

- One lung ventilation (OLV) creates an obligatory R→L shunt.
- When significant hypoxia occurs, intraoperative goals include:
  - Optimizing ventilation/perfusion of the dependent lung.
  - Increasing oxygen delivery to the collapsed lung.
- If hypoxemia is severe, transition to two lung ventilation may be necessary.
- Optimizing the dependent lung:
  - Confirm correct DLT position.
  - Use 100% FiO2.
  - Titrate PEEP.
  - Recruitment maneuvers.
  - Augmenting tidal volumes.
  - Inhaled nitric oxide or prostaglandin.
- Optimizing the collapsed lung:
  - Application of CPAP.
  - Low flow insufflation of oxygen.
- Reducing R→L shunt:
  - Surgical clamp of the pulmonary artery.
  - Covert to total intravenous anesthetic.
  - Pharmacologic augmentation of hypoxic pulmonary vasoconstriction.

**References**


**Almitrine**

- Almitrine, peripheral chemoreceptor agonist, has been shown to increase pulmonary vascular resistance without significant systemic hemodynamic consequence.
- Human studies have demonstrated almitrine’s ability to augment hypoxic pulmonary vasoconstriction (HPV) and improve oxygenation in OLV.
- Almitrine has also been associated with peripheral neuropathy after prolonged use and is not available in the United States.
- While almitrine is unavailable, the concept of augmenting HPV remains an interesting possibility.
- It has been suggested that nonselective vasoconstrictors could improve HPV and oxygenation.

**Phenylephrine**

- Phenylephrine is a α1-adrenergic receptor agonist with non-selective vasoconstricting properties on both the pulmonary and systemic circulation.
- Only one group of investigators has prospectively studied phenylephrine as a therapy for augmenting HPV in hypoxic patients.
- Doering et al. evaluated the effects of phenylephrine, iNO, and the combination of the two in the treatment of hypoxia in adults with adult respiratory distress syndrome (ARDS).
  - They concluded that phenylephrine alone can improve oxygenation in patients with ARDS. They also found that in certain patients, phenylephrine augmented improvements in oxygenation induced by inhaled nitric oxide.
  - The effect of phenylephrine may represent the enhancement of HPV and may be beneficial in improving oxygenation when ventilation-perfusion inequalities are present related to OLV.
- Although anecdotal, our experience demonstrates that phenylephrine should be considered to improve oxygenation during OLV when conventional techniques fail.