One Lung Ventilation in Children

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• Physiology of OLV
• Devices available to block one lung
• Relevant management issues
Lateral decubitus position

• Spontaneous ventilation
  – Dependent diaphragm has greater concavity (doming effect)
  – It undergoes greater excursion
  – Ventilation favors the dependent lung
  – Perfusion better in the dependent lung
  – Good V/Q matching
Effects of lung blockade

- Ventilation of top lung ceases
- Ventilation of dependent lung increases
- Shunt fraction increases
- FiO2 of 1: PaO2 drops from 400 mm of Hg to 200 in 30 min.
- Shunt fraction decreases over time
  - Hypoxic pulmonary vasoconstriction
  - Mechanical small vessel obstruction
  - Hypoxia and hypercapnia ↑HPV
Indications of OLV

• To facilitate surgical exposure and quite operative field
  • Thoracoscopic procedures
  • Thoracic nonpulmonary surgery: TEF, ASF
  • CCAM, Pulmonary sequestration

• To facilitate gas exchange
  • Brochocutaneous or Bronchopleural fistula
  • Unilateral cyst or bullae

• To prevent contamination of the contralateral lung
  • Infection
  • Hemorrhage
Various OLV Techniques

• Single lumen ETT
• Balloon tipped bronchial blockers
  • Fogarty embolectomy catheter
  • Arndt endobronchial blockers (WEB)
  • Uniblocker
  • EZ blocker
• Univent tubes
• Double lumen tubes
Single lumen ETT

• Intentionally intubate the desired main stem bronchus
Balloon Tipped Bronchial Blockers
Fogarty embolectomy catheter
(Edwards Lifesciences, Arrow International)

• Fogarty thru-lumen (TL) embolectomy catheter-sizes 3 to 7 Fr
• Placed along side the ETT or thru ETT
• Size 3 or 4 for a child < 1 year
Fogarty embolectomy catheter

Pros

- Can be used in **infants**
  - < 6 months of age (3 Fr)
  - > 6 months of age (4 Fr)
- Postop ventilation: No ETT change needed

Cons

- Dislodgement into the trachea
- Low volume - high pressure balloon
- Overinflation can damage bronchial wall
Arndt Endobronchial Blocker

(Cook critical care products, 1999)
Uniblocker (Fuji Sys. Corp., distributed by LMA North America)

High volume, GB (Gas Barrier) cuff is made of silicone

Gas barrier properties to reduce diffusion of gas into or out of the cuff.

Shaft incorporates a metallic, radio-opaque mesh allowing for smoother Torque control blocker shaft, which is malleable and easy to direct.

<table>
<thead>
<tr>
<th>O.D. (mm)</th>
<th>Cuff length (mm)</th>
<th>Effective Length (mm)</th>
<th>Maximum Cuff Volume (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7 (5Fr)</td>
<td>8</td>
<td>300</td>
<td>3</td>
</tr>
<tr>
<td>3.0 (9Fr)</td>
<td>22</td>
<td>510</td>
<td>8</td>
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</table>
EZ- Blocker

(AnaesthetIQ BV, Rotterdam, The Netherlands),

- 7 Fr., 4 lumen, 75 cm long
- Quick and easy positioning
- Minimal risk of dislocation
- Optimal lung collapse
- Polyurethane cuffs guarantee up to 8 hours inflation
- Postop ventilation no re-intubation
- Easy handling in case of bilateral procedures
Univent Tubes
(Fuji systems Corp. 1982))

- Conventional ETT with a second lumen containing a smaller tube that can be advanced
- Outer Diameter (mm): ID + 4.5-5.0 (mm)
- For children over 6 Years of age
- Torque control blocker (TCB)
Double lumen tubes

- Two tubes of unequal length molded together
- Only for older children and adults
- Smallest cuffed DLT-26F (OD 8.7 mm) for 8-10 years or older
Selection of OLV technique

- Age of the patient
- Need for post op ventilation
- Normal / difficult airway
- Skill and comfort of the anesthesiologist
Ventilatory Settings

**FiO₂**
- Start with 100% O₂
- Reduce as tolerated after 20 minutes

**Tidal Volume**
- Recommended: 8-10 ml/Kg
- Excess TV (15ml/Kg) detrimental
- Worsens oxygenation:
  - ↑ PVR
  - ↑ shunt
  - Lung injury

**PEEP to the Ventilated Lung**
- Minimizes alveolar collapse
- Recommended 5 - 10 cm of H₂O
- Higher PEEP ↑ PVR and ↑ shunt

**CPAP to the Surgical Lung**
- Maintains alveolar patency and O₂ delivery
- Start at the end of inspiration (recruited lung)
- Recommended 2 - 5 cm of H₂O
- Too much (>10) CPAP interferes with surgery

Managing hypoxia with OLV

- 100% Oxygen
- Check position of DLT/Blocker
- CPAP to nondependent lung: 2-5 cm H2O
- PEEP to dependent lung: 5-10 cm H2O
- Maintain adequate cardiac output
- Low inhaled agent conc. (1 MAC acceptable)
- IV agents better for HPV
- Revert to two lung ventilation
To facilitate lung collapse

- Inflate blocker at the end of expiration
- Give 100% O2 a few minutes prior to blocker inflation
- Gentle intermittent suction to the blocker lumen
Conclusion

• Imp to understand the physiology of OLV
• Familiarity with various lung blocking techniques
• Practice is essential