Paediatric Double Lumen Tubes

Giuseppe A. Marraro, MD

Ass. Prof. of Anesthesia & Intensive Care
University of Milan – Italy
f. Director Of Anesthesia and Intensive Care
and Pediatric intensive Care
 Fatebenefratelli and Ospedalieri Hospital Milan - Italy

Separate lung ventilation

Aim

- To ventilate only one lung maintaining the contra-lateral expanded or collapsed
- Different mode of ventilation in each lung
- Use of selective PEEP in each lung
**Separate lung ventilation**

**Indications**

- One lung ventilation during cardio-thoracic surgery
- Re-ventilation of collapsed lung after cardio-thoracic surgery
- Ventilation of unilateral lung disease in ICU
- Ventilation of lung complicated by bronchial fistula, pneumothorax, etc.
- Isolation of secretions of infected pulmonary areas

**Selective bronchial intubation**

**Double lumen tubes**

- Left bronchial intubation
- Right bronchial intubation
Selective bronchial intubation

Methodology

- Bronchial intubation using conventional tracheal tube
- Bronchial blockade
- Univent® Tube
- Double lumen tube

Selective bronchial intubation

Bronchial blocker

- Fogarty embolectomy catheter
- Arterio-septostomy catheter
- Pulmonary artery catheter
Selective bronchial intubation

Bronchial blocker

Disadvantages
- Difficulty in lung collapse
- Ischemia of bronchial mucosa
- Dislocation during surgery
- Difficult re-expansion of collapsed lung
- Requires fiberscope
- High cost

Univent® tube

Advantages
- Total lung exclusion

Disadvantages
- Severe ischemia of bronchial mucosa
- Difficulty in re-expanding collapsed lung
- Requires fiberscope
Double-lumen tube

- Left and right selective bronchial intubation

From: G. Marraro

Selective bronchial intubation

In pediatric age

- Over six years of age it is possible to use a cuffed double lumen tube similar to that used in adults (25-27 Fr)
Selective bronchial intubation

- Broncho-cath Mallinckrodt® 26-28 Fr
- Broncho-port Rusch® in children >8 yrs

From: G. Marraro

Giuseppe A. Marraro, MD

Double-lumen tube

- Left selective bronchial intubation

From: G. Marraro

Giuseppe A. Marraro, MD
Selective bronchial intubation

In pediatric age

- What is possible to use under 3 years?

Independent Lung Ventilation

Unilateral lung pathology

Giuseppe A. Marraro, MD
Independent Lung Ventilation

Aims in Intensive Care
- To ventilate or re-ventilation the two lungs separately
- Ventilate more aggressively compromised lung and reduce lung over expansion in less damaged lung

Severe chest trauma: unilateral lung pathology
Independent Lung Ventilation

Two cases of aspiration syndrome: unilateral lung pathology

Selective bronchial intubation

Bronchial intubation using two single tubes

Personal observation

Giuseppe A. Marraro, MD
Double-lumen tube

- Marraro Bilumen Tube Prototype

Selective bronchial intubation

- Personal observation
Double-lumen tube

Giuseppe A. Marraro, MD

Technical characteristics

Table 1
Calibre suggested for Marraro Paediatric Bilumen Tube at different ages

<table>
<thead>
<tr>
<th>Age</th>
<th>Calibre suggested</th>
<th>Reference code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premature baby</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1400-2500 g</td>
<td>2 + 2</td>
<td>109/193/040/200</td>
</tr>
<tr>
<td>Newborn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2500-4000 g</td>
<td>2.5 + 2</td>
<td>109/193/045/200</td>
</tr>
<tr>
<td>or 2.5 + 2.5</td>
<td>109/193/050/200</td>
<td></td>
</tr>
<tr>
<td>1 month</td>
<td>2.5 + 2.5</td>
<td>109/193/050/200</td>
</tr>
<tr>
<td>6 months</td>
<td>3 + 2.5</td>
<td>109/193/055/200</td>
</tr>
<tr>
<td>12 months</td>
<td>3.5 + 3</td>
<td>109/193/065/200</td>
</tr>
</tbody>
</table>

These measurements may vary according to the anatomical differences of a child.
Double-lumen tube

Technical characteristics

![Graph showing technical characteristics](image)

Selective bronchial intubation

Left selective bronchial intubation in different ages

![X-rays showing selective bronchial intubation](image)
Double-lumen tube

**Technical characteristics**

- The double lumen tube allows one lung ventilation, independent lung ventilation of both lungs and the possibility to collapse and re-expand the lung in an easy way.

Double-lumen tube

**Technical characteristics**

- One lung ventilation
- Collapse and re-expansion of the lung
- Independent lung ventilation
Double-lumen tube

Technical characteristics

- Two separate uncuffed tubes of different length, connected each other
- Tracheal tube, the shorter one is attached along its whole length to the bronchial tube

- Bronchial tube presents, at a suitable distance from the tip, a oval hole “Murphy’s eye” to prevent exclusion of the upper right lobar bronchus in case of selective right bronchial intubation
Double-lumen tube

- Left selective bronchial intubation
  From: G. Marraro

Double-lumen tube

- Right selective bronchial intubation
  From: G. Marraro
Double-lumen tube

Technical characteristics

- The two sections of the bilumen tube are circular along the whole length in order to facilitate the introduction of a suctioning catheter and to perform broncho-aspiration.

---

Double-lumen tube

Technical characteristics

- Radiopaque line run the length of the length of one, the longer, or both tubes for correct location in chest x-ray.
Double-lumen tube

- Left selective bronchial intubation

From: G. Marraro

Giuseppe A. Marraro, MD

Presentation available at www.picu.it

Double-lumen tube

Technical characteristics

- Manufactured from PVC, the tube is thin-walled but kink-resistant, light-weight and thermo sensitive, conforming readily to a child’s broncho-tracheal anatomy
- It is disposable (it is possible to re-use, costs must be reduced)
Double-lumen tube

Technical characteristics

- A metal stylet of same length of longer tube must be disposable in order to maintain the suitable shape

- It is easily linked by connectors to manual ventilation system, ventilators and anesthetic equipment
**Double-lumen tube**

**Technical characteristics**
- Different sizes are available to suit the child’s age and tracheo-bronchial anatomy

**Selective bronchial intubation**

**Positioning of Marraro Double Lumen Tube**

Personal observation
### Technical and anatomical considerations
- The tube is positioned perpendicularly to the vocal chords.

### Side effects
- Tube obstruction
- Easy dislocation
- Increase in resistance due to size and length of the tube
- Trachea, carina and bronchial trauma
Selective bronchial intubation

Main indications in anesthesia
- Thoracotomy (at open thorax)
- Thoracoscopy and video-assisted thoracoscopy
- Treatment of pathologic processes
  - Lung
  - Hearth
  - Others intra-thoracic organs (mediastinum, trachea, bronchi and oesophagus)

Selective bronchial intubation

Thoracoscopy and video assisted thoracoscopy

Before surgery

Courtesy of Dr. R. Nathani et coll.
Selective bronchial intubation

Indications at the end of anesthesia

- Collapsed lung does not re-expand homogeneously during manual ventilation
- Lung distension should be carried out with caution
- Ventilation with PEE is necessary to stabilize bronchioles and alveoli

Selective Bronchial Intubation and ILV

Indications

In cardiothoracic surgery

- One lung ventilation
- Re-expansion of collapsed lung
- Aspiration of empyema or pleural effusion
- Need for frequent collapse and re-expansion of lung during surgery

Giuseppe A. Marrano, MD
Selective Bronchial Intubation and ILV

Indications

In the post-operative care
- Lung re-expansion after cardiac surgery
- Correction of V/Q mismatch of dependent lung
- Treatment of pulmonary complications, e.g. pneumothorax or aspiration syndrome

Indications

In intensive care
- Treatment of unilateral lung pathology, e.g. pneumonia, atelectasis, emphysema, etc.
- Treatment of lung pathology complicated by atelectasis, pneumothorax, broncho-tracheal fistula, etc.
- Broncho-alveolar lavage
- Selective drug administration
Selective Bronchial Intubation and ILV

Complications

- Inexperience to intubate
- Exclusion of right upper lobe
- Dislodgement and obstruction of double-lumen tube
- Trauma to trachea and bronchi
- Difficult bronchosuctioning

At present limitations

- Complexity of methodology
- Need for large experience in artificial ventilation and skilled operators
- Reduced availability of tubes for selective intubation on the market
Thank you for your attention

Giuseppe A. Marraro, MD

Paediatric Anaesthesia
2° National Conference
Bangalore 20 – 21 February 2010