

Paediatric Anaesthesia 2° National Conference

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Paediatric Double Lumen Tubes

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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

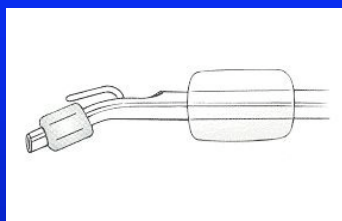
- One lung ventilation during cardio-thoracic surgery
- Re-ventilation of collapsed lung after cardio-thoracic surgery
- Ventilation of unilateral lung disease in ICU
- Ventilation of lung complicated by bronchial fistula, pneumothorax, etc.
- Isolation of secretions of infected pulmonary areas

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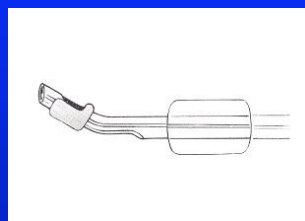


Selective bronchial intubation

Double lumen tubes



Left bronchial
intubation



Right bronchial
intubation

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Selective bronchial intubation

Methodology

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

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Selective bronchial intubation

Bronchial blocker

- Fogarty embolectomy catheter
- Arterio-septostomy catheter
- Pulmonary artery catheter



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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

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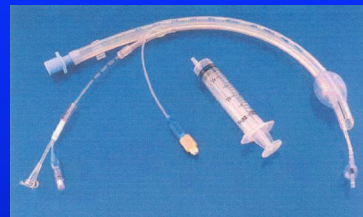


Selective bronchial intubation

Univent[®] tube

Advantages

- Total lung exclusion



Disadvantages

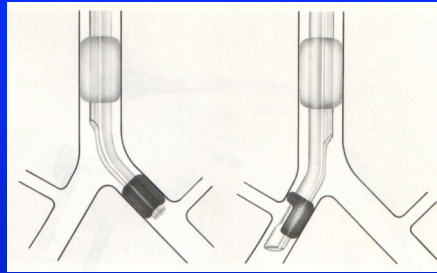
- Severe ischemia of bronchial mucosa
- Difficulty in re-expanding collapsed lung
- Requires fiberscope

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Double-lumen tube



- Left and right selective bronchial intubation

From: G. Marraro

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Selective bronchial intubation

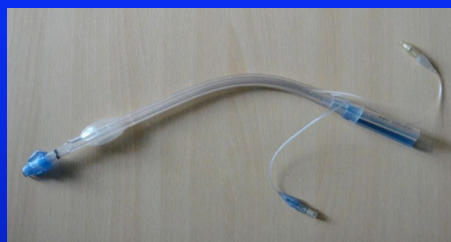
In pediatric age

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

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Selective bronchial intubation



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

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Double-lumen tube



- Left selective bronchial intubation

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Selective bronchial intubation

In pediatric age

- What is possible to use under 3 years?

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Independent Lung Ventilation



Unilateral lung pathology

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Independent Lung Ventilation

Aims in Intensive Care

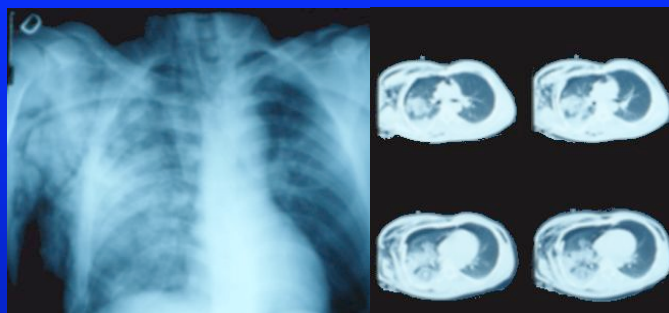
- To ventilate or re-ventilate the two lung separately
- Ventilate more aggressively compromised lung and reduce lung over expansion in less damaged lung

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Independent Lung Ventilation



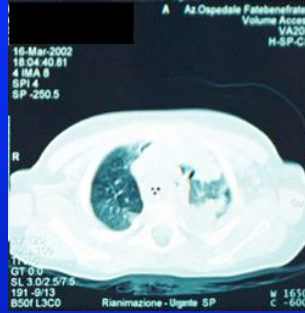
Severe chest trauma: unilateral lung pathology

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A frontal chest X-ray showing bilateral pleural effusions, which appear as hazy, white areas at the bases of the lungs. A large, dense, central mass is visible in the mediastinum, obscuring the heart silhouette. The bony structures of the ribs and spine are visible.



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Bronchial intubation using two single tubes



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Double-lumen tube

➤ Marraro Bilumen Tube Prototype



Personal observation

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Selective bronchial intubation



Personal observation

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Double-lumen tube

Pediatric Anaesthesia 1986; 4: 255-258

Equipment
Selective endobronchial intubation in paediatrics:
the Marraro Paediatric Bilumen Tube

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Keywords: paediatric; bilumen tube; intubation; bronchial

Selective ventilation of the two lungs is required in different clinical situations in anaesthesia and respiratory care. Because no bilumen tube suitable for newborn babies, infants, and children was available on the market, two single tubes were used. The first was positioned in the trachea and the second in the bronchus. The use of a suitable (calibre and length) single tube, introduced into the bronchus, has been described in cases in which unilateral lung ventilation was applied.

A bilumen prototype tube, developed in the Department of Anaesthesia and Intensive Care of Monza Hospital, was presented at the IV International Congress on Paediatric Anaesthesia and Intensive Care in Naples, June 1984, and details subsequently were published. The new tube simplified selective bronchial intubation and allowed the development of independent lung ventilation (B.V.) in paediatrics (Marraro 1985).

After extensive experimentation the Marraro Paediatric Bilumen Tube is now available, produced by Pinter Ltd, Hythe, UK (Figure 1).

Description and characteristics

The bilumen tube is made of radiopaque blue line PVC. It consists of two separate coiled tubes of different length, attached laterally to each other. Each tube is circular along its whole length.

Construction: Dr. G. Marraro, Ospedale Endoanestesiologico e Otorinolaringoiatria, Istituto di Anestesiologia e Rianimazione, Centro Paolo Poma 25, Milano 20122, Italy.

The bronchial tube, longer than the tracheal tube, ends in a lip-shaped facing network with a Murphy's eye facing outwards that helps to prevent occlusion of the upper lobar bronchus. A few millimetres before this hole, the tube is bent at an angle of about five degrees, to facilitate bronchial occlusion.

The tracheal tube, the shorter one, is attached along its whole length to the bronchial tube, except for a short free section at the beginning. This tube also ends in a lip shape, facing in the opposite direction to the tip of the bronchial tube.

The bilumen tube has no spur for anchoring to the cord.

Different calibres, suitable for treating premature babies—weighing from 1200 g (the treatment of a premature baby weighing 1250 g has already been described in fore-previous work) are available (Table 1) (Marraro 1986, 1987).

Selective bronchial intubation

The introduction of the bronchial lumen of the tube through the vocal chords takes place under direct laryngoscopy control.

The tube is pushed through the vocal chords to allow the second tube to pass through. After passing the vocal chords, the tube is rotated to the right or the left, depending on which principal bronchus is being selectively intubated.

The manoeuvre is performed **cautiously**; the subject intubated and **ventilated**.

The correct positioning of the bilumen tube must

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Double-lumen tube

Technical characteristics

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

Age	Calibre suggested	Reference code
Premature baby		
1400–2500 g	2 + 2	109/193/040/200
Newborn		
2500–4000 g	2.5 + 2 or 2.5 + 2.5	109/193/045/200 109/193/050/200
1 month	2.5 + 2.5	109/193/050/200
6 months	3 + 2.5	109/193/055/200
12 months	3.5 + 3	109/193/065/200

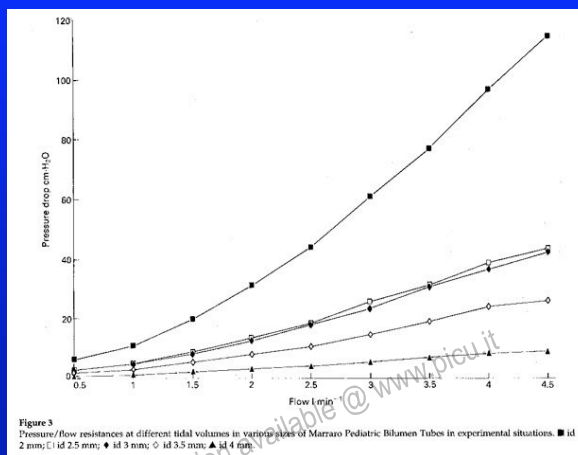
These measurements may vary according to the anatomical differences of a child.

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Double-lumen tube

Technical characteristics



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Selective bronchial intubation

Left selective bronchial intubation in different ages



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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

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Double-lumen tube

Technical characteristics

- One lung ventilation
- Collapse and re-expansion of the lung
- Independent lung ventilation

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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

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Double-lumen tube

Technical characteristics

- 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

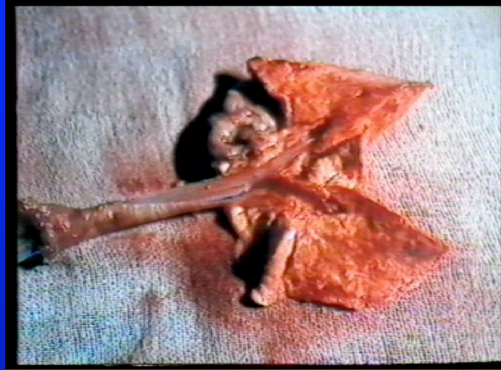


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Double-lumen tube



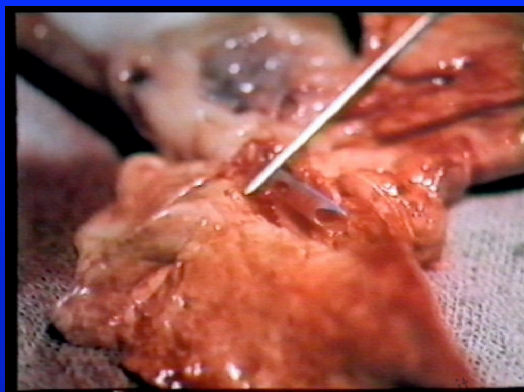
- Left selective bronchial intubation

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Double-lumen tube



- Right selective bronchial intubation

From: G. Marraro

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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



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Double-lumen tube

Technical characteristics

- Radiopaque line runs the length of one, the longer, or both tubes for correct location in chest x-ray

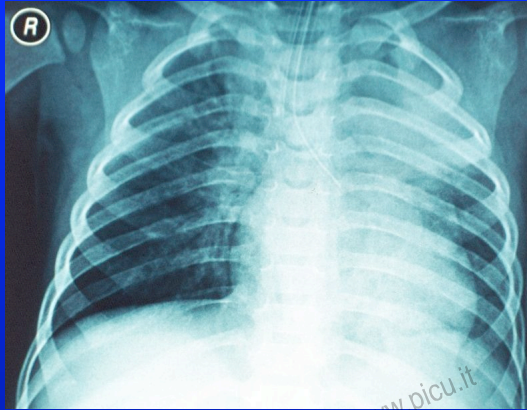


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Double-lumen tube



- Left selective bronchial intubation

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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)

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Double-lumen tube

Technical characteristics

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



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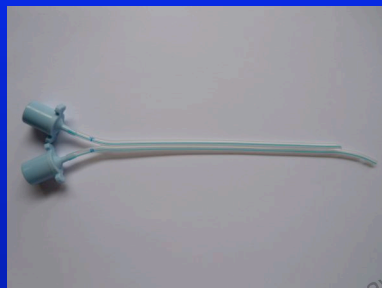
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Double-lumen tube

Technical characteristics

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



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Double-lumen tube

Technical characteristics

- Different sizes are available to suit the child's age and tracheo-bronchial anatomy



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Selective bronchial intubation

Positioning of Marraro Double Lumen Tube



Personal observation

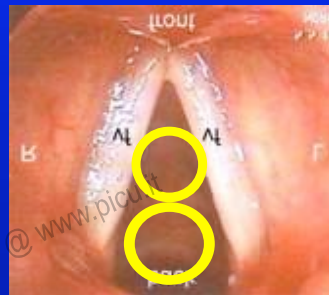
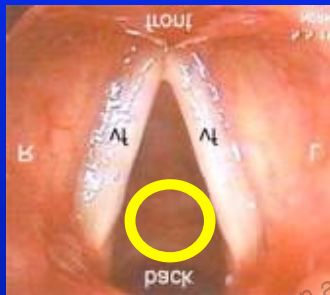
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Double-lumen tube

Technical and anatomical considerations

- The tube is positioned perpendicularly to the vocal chords



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Double-lumen tubes

Side effects

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

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Selective bronchial intubation

Main indications in anesthesia

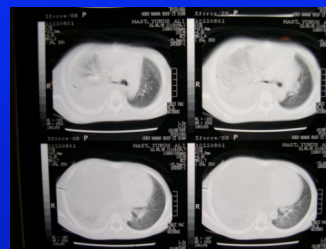
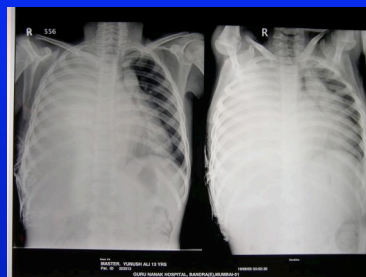
- Thoracotomy (at open thorax)
- Thoracoscopy and video-assisted thoracoscopy
- Treatment of pathologic processes
 - Lung
 - Heart
 - Others intra-thoracic organs (mediastinum, trachea, bronchi and oesophagus)

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Selective bronchial intubation

Thoracoscopy and video assisted thoracoscopy



Before surgery

Courtesy of Dr. R. Nathani et coll.

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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

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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

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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

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Selective Bronchial Intubation and ILV

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

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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

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Selective Bronchial Intubation and ILV

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

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Thank you for your attention

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