POSITIONING OF DOUBLE-LUMEN ENDOBRONCHIAL TUBES
Correlation between clinical and bronchoscopic findings
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SUMMARY
The aim of this study was to determine if fiberoptic bronchoscopy after blind placement of left sided double-lumen endobronchial tubes (Portex) improved positioning. 25 adult patients undergoing thoracotomy were studied. Clinical criteria suggested good positioning in all cases, however subsequent bronchoscopy revealed malposition in 4 cases. Bronchoscopic findings included bronchial cuff herniation and obstruction of the left upper lobe bronchus.

Keywords: Double-lumen endobronchial tubes, Malposition, Fiberoptic bronchoscopy.

Introduction
Correct placement of double-lumen endobronchial tubes is essential during one lung anaesthesia in the setting of thoracic surgery in order to optimise oxygenation and ventilation. A correctly positioned double-lumen endobronchial tube should not obstruct any conducting airway.

The correct positioning of double-lumen endobronchial tubes has traditionally relied on clinical assessment, that is by observing the expansion of the chest and by auscultation. However some authors have recommended that fiberoptic bronchoscopy is also indicated.1,2 All these studies are from western countries and there is no published literature regarding this on Indian patients to our knowledge.

The aim of this study was to assess whether clinical findings allow accurate confirmation of adequate position with left double-lumen endobronchial tubes. This study was limited to left sided double-lumen endobronchial tubes because these are the most commonly used ones in current clinical practice.

Methods
After institutional approval, twenty-five adult patients undergoing thoracotomy, which required the use of double-lumen endobronchial tubes, were studied. All patients were premedicated with tab diazepam 0.2 mgKg⁻¹ on the night before surgery and also on the morning of surgery. Inj. glycopyrrolate 0.2 mg was given intramuscularly one hour before surgery. Anaesthesia was induced with thiopentone 4-6mgKg⁻¹, fentanyl 2-4 microgramKg⁻¹ and midazolam 0.05mgKg⁻¹. Neuromuscular blockade was achieved with 0.15mgKg⁻¹ of pancuronium and patients were ventilated with oxygen and isoflurane 0.4 to 1% according to the haemodynamics. After spraying the cords with 4% lignocaine an appropriately sized left sided double-lumen endobronchial tube (Portex sizes 35,37,39and 41) was introduced after direct laryngoscopy.

Following intubation, both cuffs were inflated with air. The ability to isolate each lung was then assessed by alternately clamping the tracheal and bronchial limbs and noting the presence or absence of movement and breath sounds in each hemithorax. Also the presence of moisture during exhalation in each of the transparent proximal limb of double-lumen endobronchial tube and catheter mount was noted. Anaesthesia was maintained with oxygen and isoflurane during bronchoscopy and later on with oxygen, nitrous oxide, isoflurane with additional doses of fentanyl and pancuronium. Monitoring included ECG, pulse oximetry, capnography, invasive blood pressure and arterial blood gases.

With the patient in supine position, fiberoptic bronchoscopy (Pentax fiberoptic bronchoscope size 3.5) was performed to determine whether the bronchoscopic findings confirmed the clinical impression of successful placement of the tube. The fiberoptic bronchoscope was first introduced to the tracheal lumen of the tube and the following points were observed.

1. Tracheal carina should be viewed without obstruction and no herniation of the bronchial cuff over the carina.
2. Unobstructed view of the Rt main bronchus.
3. Visualisation of the left bronchial tube or bronchial cuff immediately below the tracheal carina.
The fiberoptic bronchoscope was then introduced to the bronchial lumen of the left double-lumen endobronchial tube and an unobstructed view of the left upper lobe bronchus was noted.

Results

The demographic data of 25 patients studied are given in table I. There were seven females and eighteen males. Nine patients had thoracotomy on the right side and sixteen patients on the left. Fifteen patients underwent lobectomy, five underwent pneumonectomy, three were operated for mediastinal tumours and two had repair of thoraco abdominal aneurysm (table II).

Table I: Characteristics of 25 patients.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Male (18)</th>
<th>Female (7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>45 ± 15.61</td>
<td>30 ± 3.65</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>61 ± 9.39</td>
<td>51 ± 8.09</td>
</tr>
</tbody>
</table>

Table II: Operations performed.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lobectomy</td>
<td>15</td>
</tr>
<tr>
<td>Pneumonectomy</td>
<td>5</td>
</tr>
<tr>
<td>Mediastinal tumour excision</td>
<td>3</td>
</tr>
<tr>
<td>Thoraco abdominal aneurysm</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>25</td>
</tr>
<tr>
<td>RIGHT THORACOTOMY</td>
<td>9</td>
</tr>
<tr>
<td>LEFT THORACOTOMY</td>
<td>16</td>
</tr>
</tbody>
</table>

In all patients left sided double-lumen endobronchial tubes (Portex size 35,37,39,41) were used. The size and distribution of double-lumen endobronchial tubes among males and females are shown in table III.

Table III: Distribution of DLTs.

<table>
<thead>
<tr>
<th>SIZE</th>
<th>MALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>37</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>39</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Of the seven females five were intubated with a 35 F tubes and the rest with 37 F double-lumen endobronchial tubes. Ten of the men studied received 39 F tubes, six received 41 F tubes and two had 37 F double-lumen endobronchial tubes.

In all 25 cases, selective isolation of each lung was possible and chest expansion was considered satisfactory. Auscultation over each hemithorax suggested that air entry to all areas of lungs was adequate.

Bronchoscopic findings are shown in table IV. In the present study, using chest expansion and auscultation as indicators of correct placement of the tube, we found that positioning was satisfactory in all 25 patients. However bronchoscopy revealed malposition in 4 cases.

Table IV: Bronchoscopic findings.

<table>
<thead>
<tr>
<th>Tracheal lumen</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Carina visible</td>
<td>21 (84%)</td>
</tr>
<tr>
<td>Clear view of the right bronchus</td>
<td>21 (84%)</td>
</tr>
<tr>
<td>View of the proximal bronchial cuff</td>
<td>6 (24%)</td>
</tr>
<tr>
<td>View of the left bronchial tube</td>
<td>15 (60%)</td>
</tr>
<tr>
<td>Bronchial cuff herniation</td>
<td>4 (4%)</td>
</tr>
<tr>
<td>Carina not visualised</td>
<td>4 (16%)</td>
</tr>
<tr>
<td>Bronchial lumen</td>
<td></td>
</tr>
<tr>
<td>Clear view of the distal bronchial tree</td>
<td>22 (88%)</td>
</tr>
<tr>
<td>Blocking of the left upper lobe bronchus</td>
<td>3 (12%)</td>
</tr>
</tbody>
</table>

Bronchoscopy revealed that the double-lumen endobronchial tube to be in unsatisfactory position in 4 (16%) cases. In 3 patients the left bronchial lumen was blocking the left upper lobe bronchus and in one patient herniation of the bronchial cuff over the tracheal carina had occurred. In all those 4 patients the carina was not observed through the tracheal lumen. Out of the 21 (84%) cases in whom the double-lumen endobronchial tubes were in correct position, 15 (60%) patients had the tube in the most distal acceptable position and the rest had in the most proximal acceptable position.

Discussion

The deleterious consequences of a malpositioned double-lumen endobronchial tube can become even life threatening. As a result of malpositions, gas exchange can be significantly impaired, the dependent lung (non operated lung) can be difficult to ventilate, and the operative lung may not collapse on initiation of one lung ventilation. Benumof JL had recommended routine confirmation of double-lumen endobronchial tubes position in all cases by fiberoptic bronchoscopy.³

Malposition occur in approximately 25% of cases when Robertshaw double-lumen endobronchial tubes are used.⁴ Much lower incidence of malpositions were reported with the newer p.v.c double-lumen endobronchial tubes.⁵ However both studies were done without confirmation with bronchoscope.
There is a very high incidence of malpositions, as determined by fiberoptic bronchoscopy, when the double-lumen endobronchial tube is introduced blindly. Smith et al had reported a 48% incidence of malpositions. In another study, fiberoptic bronchoscopy after auscultation resulted in repositioning of 78% of left sided double-lumen endobronchial tubes. In a third study, 38% of all double-lumen endobronchial tubes were malpositioned. The authors of the last two studies concluded that auscultation is an unreliable method of confirming the position of double-lumen endobronchial tubes and bronchoscopic assessment of final positon should be performed in every instance.

It is very well known that using a right sided double-lumen endobronchial tube can cause right upper lobe obstruction, and this has resulted in increased use of left double-lumen endobronchial tubes. In the present study we used left sided double-lumen endobronchial tubes for all thoracotomies.

It is important to know about the margin of safety of positioning left sided double-lumen endobronchial tubes before doing the fiberoptic bronchoscopy. Benumof et al have defined the margin of safety as the length of tracheobronchial tree over which it may be moved or positioned without obstructing a conducting airway. The most proximal acceptable position of a left sided tube is when the left endobronchial cuff is just below the tracheal carina. With the tube in this position the fiberoptic bronchoscope in the tracheal lumen will show the proximal part of the bronchial cuff to the left of the tracheal carina.

The most distal acceptable position of a left sided tube is when the tip of the left lumen is at the proximal edge of the left upper lobe bronchial orifice. The fiberoptic bronchoscope introduced through the tracheal lumen will show the left bronchial tube to the left of the carina instead of the proximal part of the bronchial cuff. If the tip of the left lumen is placed in a more distal position, then the tip of the left lumen would progressively obstruct left upper lobe bronchial orifice.

In this study, using expansion of the chest and auscultation as indicators of correct placement of the tube, in all 25 patients positioning of double-lumen endobronchial tubes was satisfactory. However subsequent fiberoptic bronchoscopy revealed malposition in 4 (16%) cases. In 3 cases, view through the bronchial lumen showed tip of the left lumen occluding the left upper lobe (yet air entry on auscultation) and in these 3 cases carina was not properly visualised through the tracheal lumen, and also the bronchial cuff or bronchial tube could not be visualised. This is because the opening of the tracheal lumen of the double-lumen endobronchial tube was at the carina. These findings were suggestive of double-lumen endobronchial tubes too far advanced in the above-mentioned 3 cases. In one case there was herniation of bronchial cuff over the tracheal carina, which was observed through the tracheal lumen of double-lumen endobronchial tube.

In the 3 patients, where left upper lobe bronchus was not visualised, the double-lumen endobronchial tubes were withdrawn by one centimetre. It is important to note that, in all these 3 patients breath sounds on the left hemithorax were considered satisfactory. Left upper lobe bronchial obstruction can lead to failure of ventilation of the left upper lobe or failure of left upper lobe to collapse. All these can lead to hypoxia and it may not be detected if right thoracotomy is the planned procedure.

One patient had herniation of the bronchial cuff over the tracheal carina. Clinical signs did not detect this abnormality. This malposition if not detected could lead to many complications. First the endobronchial limb may slip out of the left bronchus, more possibly during positioning the patient in the lateral decubitus position. Secondly, herniation can also cause obstruction of the unintubated bronchus (right bronchus) making ventilation of right lung difficult. Thirdly it may prevent escape of air from the right lung.

In conclusion, clinical observations are good enough to determine the correct placement of double-lumen endobronchial tubes, and will detect gross malpositions. Accurate diagnosis of upper lobe obstruction by auscultation alone is not usually possible because breath sounds are transmitted from the ipsilateral lower lobe and across the mediastinum from the contralateral lung. This study shows that clinical observations are unreliable in malpositions leading to obstruction of left upper lobe bronchus and to detect bronchial cuff herniation. We conclude that fiberoptic bronchoscopy allows accurate confirmation of position of double-lumen endobronchial tubes and helps in easy repositioning of a malpositioned tube.

References

CONFERENCE CALENDER 2003

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2) CME/Workshop on “Anaesthesiology & Criticare-2003”
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4) XIX Annual Conference of ISA KISACON 2003
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   Contact: Dr. B. Devanand, Org. Secy.
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5) Indian Society of Anaesthesiologists Tamil Nadu &
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   16th – 17th August 2003
   Contact: Dr. S. Rajasekaran, Org. Secy.
   Pondicherry: 7C, D.S. Part View Aparts, 13, Nagendra Nagar,
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7) Joint Annual Conference of 10th Assam Branch of ISA & 13th
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   10th -12th October, 2003
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9) Asian Society of Paediatric Anaesthesiologists of ISA.
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10) 51st Annual Conference of ISA ISA CON 2003
    26- 30th December, 2003
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11) XIX Annual Conference of the Indian Society for
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    23rd, 24th, 25th January 2004
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