Reliability of auscultation in positioning of double-lumen endobronchial tubes

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Auscultation is a well-established technique to confirm the position of double-lumen endobronchial tubes (DLTs). However, some authors have recommended that fibreoptic bronchoscopy (FOB) is also indicated. The aims of this study were to determine first if bronchoscopy after blind placement of DLTs improved positioning; and second if preoperative bronchoscopy could detect difficult intubation. Twenty-four patients undergoing aortic or lung surgery were studied. After intubation with a single-lumen tube, an initial FOB was performed by an independent observer to check the airway anatomy. Then, the single-lumen tube was replaced by a DLT using a classical "blind" intubation method. Subsequent FOB was performed first by the independent observer to record the DLT position and next by the investigators for improvement or correction of their positioning under visual control. Fibreoptic bronchoscopy after blind placement of DLTs resulted in repositioning 78% left-sided DLTs and 83% right-sided DLTs. Preoperative bronchoscopy did not always detect an airway abnormality which might lead to difficult positioning of the DLTs. In conclusion, auscultation is an unreliable method of confirming the position of DLTs and should be followed by fibreoptic bronchoscopy.

L'auscultation pratiquée pour vérifier la position de la sonde à double lumière est une technique bien établie. Cependant plusieurs auteurs recommandent l'emploi de la fibroscopie. Les objectifs de la présente études sont les suivants : premièrement de déterminer si un contrôle fibroscopique après la mise en place de la sonde permet d'en améliorer la position; deuxièmement, si la bronchoscopie préopératoire permet d'identifier l'intubation difficile. Vingt-quatre patients programmés pour une chirurgie thoracique, aortique ou pulmonaire furent étudiés. Ils furent d'abord intubés avec une sonde endotrachéale simple pour permettre la réalisation par un observateur neutre d'une première fibroscopie dans le but d'évaluer l'anatomie des voies aériennes. Ce tube fut ensuite remplacé par une sonde à double lumière en utilisant la méthode classique d'intubation. Un nouvel examen fibroscopique permit à l'observateur neutre de vérifier le positionnement de la sonde et aux auteurs de le corriger sous contrôle visuel si nécessaire. Le contrôle fibroscopique après la mise en place de la sonde par la méthode auscultatoire a permis de repositionner 78% des tubes gauches et 83% des tubes droits. La fibroscopie préopératoire ne détecta pas toujours les anomalies des voies aériennes capables d'expliquer les erreurs de position des sondes endobronchiques. En conclusion, l'auscultation ne permet pas vérifier de façon précise la position de la sonde à double lumière et devrait suivie d'un contrôle fibroscopique.

Key words
ANAESTHESIA: thoracic;
ANAESTHETIC TECHNIQUES: bronchoscopy, endobronchial;
EQUIPMENT: tubes, endobronchial;
INTUBATION: technique.

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The use of double-lumen endobronchial tubes (DLTs) is well accepted in lung surgery[1] and is valuable in other fields of thoracic surgery.[2,3] The advantages of such an anaesthetic technique are well known, allowing selective isolation, suctioning and/or ventilation of either lung. It facilitates surgery by improving exposure and avoids lung retraction. The dependent lung is protected from contamination or spillover of secretions, blood or pus from the nondependent lung.[4,5] However, the benefits of DLTs must be weighed against several complications such as tube malposition and/or dislodgment, hypoxaemia, unsatisfactory lung deflation and trauma to the tracheobronchial tree.[5,6]

Auscultation is the most widely used method of assessing the position of DLTs,[5,7,8] but recent literature suggests that fibreoptic bronchoscopy (FOB) should be performed to confirm DLT position and to avoid complications.[9–12]

This prospective study was conducted in patients

undergoing thoracic aortic aneurysm resection or lung surgery. The aims of the study were to determine:

1 If FOB after blind DLT placement improved positioning;
2 If preoperative FOB could identify patients in whom DLT positioning might be difficult.

Methods

Hospital Ethics Committee approval and patients' informed consent were obtained. Twenty-four patients were studied. A left-sided DLT was inserted in patients who were to undergo left thoracotomy for elective thoracic aortic aneurysm resection (TAA patients). In patients presenting for lung resection the mainstem bronchus on the non-operated side was intubated (LUNG patients). The tubes used were disposable PVC Mallinckrodt DLTs-Bronchocath® – size 39 in women and 41 in men.

In the operating room the ECG and pulse oximeter (Datex-Oscar) were attached and a radial arterial catheter was inserted. After induction of anaesthesia with flunitrazepam (0.03 $mg \cdot kg^{-1}$) sufentanyl (5 $\mu g \cdot kg^{-1}$) and pancuronium (0.1 $mg \cdot kg^{-1}$) in TAA patients or with flunitrazepam (0.03 $mg \cdot kg^{-1}$) fentanyl (2 $\mu g \cdot kg^{-1}$) etomidate (0.25 $mg \cdot kg^{-1}$) and pancuronium (0.1 $mg \cdot kg^{-1}$) in LUNG patients, the tracheas were first intubated with a single-lumen tube (Portex PVC 8 or 9F) and the lungs were ventilated with a tidal volume of 8 $ml \cdot kg^{-1}$ at a frequency of 12 min^{-1} (Siemens-Elema Servo 900B); $FiO_2 = 1$. An initial FOB was performed by an independent observer (CJ), familiar with the use of the flexible bronchoscope (Olympus BF 1T20, 4.0 mm), to check the airway anatomy, looking for wall deformation, mucosal oedema, airway deviation and tracheal or bronchial obstruction.

After removal of the single-lumen tube, a DLT was inserted using a classical method of intubation without bronchoscopy.[5] Both cuffs were inflated to seal leaks and correct positioning of the DLT was performed by the investigators (AB and DT), using auscultation and chest wall movement on bilateral ventilation and after clamping of each lumen.[5] Once considered to be optimal, the position of the DLT was recorded by FOB by the independent observer not involved in positioning the DLT, using the following criteria:[13]

1 via the tracheal lumen: an unobstructed view of the tracheal carina and the non-intubated bronchus, and an endobronchial cuff positioned just below the carina, without herniation;
2 via the bronchial lumen: an absence of narrowing of the lumen by an overinflated bronchial cuff and an unobstructed view of the distal bronchial tree.

Final adjustments to obtain proper tube positioning were performed by the investigators with the help of bronchoscopy. In all patients, FOB was repeated in the lateral position.

TABLE I Relation between auscultation and fibreoptic bronchoscopy

Side of DLTs	*Left n = 18*				*Right n = 6*		
Auscultation	NC 5		OK 13		NC 0	OK 6	
Fibreoptic bronchoscopy	OK 1	MP 4	OK 3	MP 10		OK 1	MP 5
Repositioned		4		10			5
	14/18 = 78%				5/6 = 83%		

(NC = not conclusive; OK = correct position; MP = malposition).

TABLE II Relation between preoperative fibreoptic bronchoscopy and blind placement

Blind placement	*Preoperative bronchoscopy*		*n*
	Deformation	*No deformation*	
Possible	2	17	19
Impossible	2	3	5
n	4	20	24

Results

Twenty-three men and one woman were included in this study. Ages ranged between 28 and 81 yr (mean: 61.6), height between 157 and 186 cm (mean: 171.8) and weight between 58 and 100 kg (mean: 73.8). Twelve patients underwent a thoracic aortic aneurysm resection, six a left pulmonary resection and six a right pulmonary resection. In eighteen patients the tracheas were intubated with a left-sided DLT and in the remaining six with a right-sided DLT (Table I).

In patients intubated with a left-sided DLT, auscultation to confirm the proper position failed in five (28%). Using FOB, one DLT appeared to be correctly positioned and in the four others it needed to be repositioned. In the remaining 13 patients, although on auscultation DLT position was deemed to be satisfactory, FOB implicated adjustments in ten (77%). Consequently 78% of left-sided DLTs needed FOB to obtain proper placement. Using a right-sided DLT, FOB confirmed correct position in one patient while repositioning was necessary in the remainder (83%) (Table I).

The preoperative FOB down the single-lumen tube revealed an abnormality in four patients (16.7%) (Table II).

Discussion

When the trachea was intubated with a left-sided DLT, correct blind insertion was not possible in five patients (28%) despite several attempts (Table III). In four, auscultation revealed absent left lung ventilation because of right mainstem intubation. Correct positioning was performed by FOB. In the fifth patient auscultation revealed correct

TABLE III DLTs positions observed at fibreoptic bronchoscopy after blind placement

	Left-sided	*Right-sided*
Auscultation failure:	*n* = 5	
– contralateral mainstem intubation	4	–
– bronchial obstruction	1	–
Correct auscultation:	*n* = 13	*n* = 6
– correct position:	2	1
– DLT not far enough:	2*	–
– DLT too far inserted:	9	5
– bad cuff visualization	9	5
– upper lobe orifice obstruction	7	5
	18	6

*One DLT could not be repositioned by FOB (see text).

left-lung ventilation upon tracheal clamping but on clamping the bronchial tube no breath sounds were heard either on the right or on the left side. Correct positioning with FOB showed an adequate DLT position and the absent right-lung ventilation was due to tumour obstructing the right mainstem bronchus. Finally, although blind placement of left-sided DLTs appeared to be correct in 13 patients, only two were found to be correctly positioned at FOB. A third, although not inserted far enough, was accepted because it could not be modified: FOB showed herniation of the bronchial cuff over the carina, but the left-lumen tip was already at the proximal edge of the left upper lobe bronchial orifice and the bronchial cuff did not compromise ventilation to the right mainstem bronchus. Thus, ten of the 13 DLTs were repositioned under direct bronchoscopic control. Nine were withdrawn from 5 to 30 mm to visualize the endobronchial cuff just below the carina to assure patency of the left upper lobe bronchial orifice which was obstructed seven times. One was inserted more distally (20 mm) because of bronchial cuff herniation with obstruction of the right mainstem bronchus. Repositioning of left-sided DLTs required FOB in 78% of the patients. Using a right-sided DLT, auscultation suggested satisfactory position of the DLT in all six patients. However, FOB showed only one to be correctly inserted. In the remaining five, the lack of sufficient bronchial cuff visualisation and right upper lobe bronchial orifice obstruction led to repositioning with the bronchoscope.

Anatomical considerations make it easier the right than the left intubate to mainstem bronchus.[14] Moreover, left mainstem bronchus intubation becomes more difficult and hazardous if airway deviation[6] or airway obstruction[15,16] exists and may eventually lead to airway rupture.[17] However, such an abnormality was found at the preoperative FOB in only two of the five patients in whom blind placement was not possible.

Data on fibreoptic control of DLT positioning in large series are scarce. Das *et al.*[3] suggested the use of DLTs in ten patients for repair of descending thoracic aortic aneurysms: no fibreoptic control was performed because this was not available (1970). Burton *et al.*[6] report a 4% incidence of complications using 136 PVC-DLTs, including two patients who became hypoxaemic and one tube malposition. However, there was no FOB and some tubes may have been malpositioned but not recognized. Only two studies of bronchoscopic control after blind placement of PVC-DLTs have been reported. Smith *et al.*[11] found 48% malposition when using 23 left-sided DLTs and Mc Kenna *et al.*[9] 89% malposition when using nine right-sided DLTs.

Malposition of right-sided DLTs increases the risk of right upper lobe bronchial orifice obstruction. Benumof *et al.*[10] report 4% and 11% incidences of left and right upper lobe bronchial obstruction despite optimal placement with FOB. There are several recommendations to minimize the risk of DLTs malpositioning. It has been suggested that left-sided DLTs be used for both left and right intrathoracic surgical procedures.[6–10] Surprisingly, our results indicated that malposition of left-sided DLTs was as important as with right-sided DLTs. It has been recommended that the largest tubes that can be placed should be used.[7,8,10] However, in our study, the largest DLTs were used and the incidence of malposition was as high as that of Smith[11] who used smaller tubes. Careful auscultation over the area of the upper lung fields should be performed to identify upper lobe obstruction.[7,8] However, we found a discrepancy between correct auscultation and patency of bronchial orifice in 62% (8/13 left-sided) and 83% (5/6 right-sided), respectively for left and right upper fields. In instances of severe hypoxaemia or failure to collapse the upper lobe some authors consider that "simply withdrawing" the tube 1–2 cm is sufficient.[7,8] We experienced one case where a left-sided DLT despite correct auscultation appeared to be too proximally inserted at FOB. "Blind withdrawal" of this tube could lead to displacement with severe complications, e.g., endobronchial dislodgment, contralateral bronchial obstruction with potential gas trapping, spillover of blood or secretions.[18]

Difficulties in positioning a DLT may be caused by vascular or parenchymal tumours. Preoperative FOB revealed such abnormalities in four patients (16.7% – Table II). In two, blind placement was not possible but this also failed in three other patients with normal preoperative FOB. Airway deformation did not necessarily implicate difficult intubation. Conversely, intubation may be unsuccessful when preoperative FOB is normal which is in disagreement with others.[8,9,13,15,16]

In conclusion, the discrepancy between auscultation and FOB for placement of both left- and right-sided DLTs suggests that auscultation is an unreliable method of establishing the correct position. Fibreoptic bronchoscopy is the only technique providing certain DLT positioning. Preop-

erative FOB does not allow recognition of airway deformation which could lead to difficult positioning of DLTs. Conversely, the absence of deformation cannot guarantee ease of intubation. We recommend FOB whenever DLTs are to be used.

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