

CLINICALLY-GUIDED PLACEMENT OF FOGARTY CATHETER FOR LUNG ISOLATION IN VIDEO-ASSISTED THORACOSCOPIC SURGERY FOR SPONTANEOUS PNEUMOTHORAX

Ahmed El-Agaty*, Tarek Mohsen#

**Assistant professor of Anesthesiology, #Assistant professor of Cardiothoracic Surgery
Faculty of Medicine, Cairo University, Cairo, Egypt*

Background:

Over the past decade, video assisted thoracic surgery (VATS) has changed the way spontaneous pneumothorax (SP) is managed. During VATS one-lung ventilation (OLV) is strictly indicated. Successful use of Fogarty occlusion embolectomy catheters has been reported. This study aimed to evaluate the efficiency and safety of Fogarty catheters as bronchial blockers for patients undergoing VATS for spontaneous pneumothorax and using the fiberoptic bronchoscope to assess the successful placement of such catheters when inserted depending on clinically-guided technique including initial temporary deliberate endobronchial intubation.

Methods:

Eleven patients with SP for VATS bulectomy and pleural abrasion were enrolled. All patients received standardized balanced general anesthetic technique and VATS technique by a single anesthesiologist and surgeon. The lung isolation technique depends on deliberate temporary intubation of the main bronchus in the ipsilateral surgical side with a single-lumen endotracheal tube and advancing a 8/22F Fogarty catheter past the tip of the endobronchial tube. The endobronchial tube is then removed and a new endotracheal tube is placed alongside the Fogarty catheter. We measured the success rate and time needed to achieve placement of the Fogarty catheter. We also confirmed proper positioning with fiberoptic bronchoscope and recorded results. Verbal analog scale was used to describe the surgical satisfaction about lung isolation.

Results:

One left sided case failed to be intubated without bronchoscopy. Success was significantly higher in right sided cases (100% versus 80% in left sided) and needed significantly shorter time to be achieved (328.2±23.2 seconds versus 757.9±51.5 seconds respectively). Verbal analog scale scored a mean of 78.5±13mm out of 100mm.

Conclusion:

This study showed that Fogarty catheter can be placed in a clinically-guided technique safely with satisfactory lung isolation in patients undergoing video-assisted thoracoscopic surgery for spontaneous pneumothorax.

Keywords: *Fogarty Catheter, Bronchial blockers, Lung Isolation, Video-assisted Thoracoscopic Surgery, Spontaneous Pneumothorax*

Introduction:

Over the past decade, video assisted thoracic surgery (VATS) has changed the way spontaneous pneumothorax (SP) is managed.⁽¹⁾ Several video-assisted techniques have been used to treat primary spontaneous pneumothorax (PSP).⁽²⁾ Videothoracoscopic bullectomy and pleural abrasion is a reliable and safe method to treat primary spontaneous pneumothorax and results have been proved to be stable in the long term^(2,3)

During VATS one-lung ventilation (OLV) is strictly indicated to allow proper visualization of the operative field and permit adequate resection.⁽⁴⁾

In general, three types of devices are available for providing one-lung ventilation during anesthesia: double-lumen endotracheal tubes (DLT), bronchial blockers, and endobronchial tubes.⁽⁵⁾

Successful use of Fogarty occlusion embolectomy catheters as bronchial blockers for lung isolation and OLV has been documented.^(6,7)

The current study was designed to evaluate the efficiency and safety of Fogarty catheters as bronchial blockers for patients undergoing VATS for spontaneous pneumothorax and using the fiberoptic bronchoscope to assess the successful placement of such catheters when inserted depending on clinically-guided technique including initial temporary deliberate endobronchial intubation.

Methods

Eleven adult patients scheduled for VATS for spontaneous pneumothorax were included after obtaining written informed consent from every patient and local institutional Ethics and Research committee approval. The study was done in the cardiothoracic surgery operation suite in Cairo University Hospitals.

Anesthetic Technique

Patients received a standardized general anesthetic technique. On arrival to the operation suite patients received supplemental oxygen via face mask and were premedicated with 2mg intravenous midazolam. Monitors included 5-lead ECG, pulse oximetry, capnography, noninvasive blood pressure, invasive arterial blood pressure

which was connected, to a radial arterial cannula inserted after induction and frequent blood gases and electrolytes withdrawn as clinically needed. After adequate preoxygenation anesthesia was induced by administration of 1-2 mg/ Kg propofol and fentanyl 3µg/Kg. Atracurium 0.6mg/ Kg was given to facilitate intubation and an infusion of 0.6 mg/Kg/h was given as maintenance till the end of surgery. After intubation and proper lung isolation was confirmed as discussed in detail under the title Lung Isolation Technique mechanical ventilation was adjusted at tidal volume 6-8ml/Kg and rate of 10-12 breath/min to maintain end-tidal CO₂ below 40 mmHg and peak airway pressure below 35cmH₂O. Isoflurane was given 1-1.5 % and FiO₂ 1.0 was maintained

Lung Isolation Technique

- *Step1.* Initially the trachea was intubated using a regular single lumen endotracheal tube internal diameter 7.5 mm (Mallinckrodt Medical, Cornamaddy, Athlone, Westmeath, Ireland). Placement of the tube is clinically confirmed by chest inspection and auscultation and capnography.
- *Step2.* Then the tube is deliberately advanced inwards to cannulate the ipsilateral mainstem bronchus on the operative side. In right-sided pneumothorax cases this was achieved by advancing the tube inwards and turning the head to the other side while in left-sided cases rotating the tip of the tube 180 degrees to face the concave surface posteriorly, is also needed to facilitate the cannulation of the left mainstem bronchus. Again the tube position is assessed clinically by chest inspection and auscultation.
- *Step3.* A Fogarty balloon-tipped catheter size 8/22F (French) (Fogarty Occlusion Catheter, Baxter Healthcare Corporation, Irvine, CA) is advanced inside the single lumen endobronchial tube just distal to the tip of the tube (which was premeasured and marked on the catheter prior to endotracheal intubation).⁽⁸⁾ This ensured that the tip of the Fogarty catheter is situated in the ipsilateral main bronchus. Then the balloon of the catheter is inflated with 5 cc. of air.⁽⁸⁾

- **Step4.**The endobronchial tube is withdrawn and the catheter is fixed in place by adhesive tape. The trachea is reintubated along the side of the catheter using a new endotracheal tube positioned above the level of the carina. The position of the bronchial blocker is rechecked clinically Whenever possible the lungs are ventilated when the tip of the endotracheal tube is above the level of the carina.

In case of failure of any of the above mentioned steps or development of episode of desaturation (oxygen saturation less than90%) a double lumen endotracheal tube was an available alternative to abort the technique and the case would be reported and excluded.

Fiberoptic bronchoscope (FOB) size 4.0 mm outer diameter (Intubation Fiberscope LF-2, Olympus Optical Co. Ltd., Tokyo, Japan.), was used to confirm optimal position of the bronchial blocker.

Surgical Technique:

The VATS was performed for all patients by a single surgeon and in a standardized procedure including pleural abrasion and bullectomy. All patients with recurrent spontaneous pneumothorax were placed in the lateral position. The first port 15mm was placed in the 7th intercostal space mid axillary line. The camera was first introduced to explore the chest cavity, the lungs with respect to the size and site of bulleas. Accordingly, the other two ports are planned to allow for lung inspection, manipulation and stapling of any bullae.

Usually the second and third ports are placed in the 3rd anterior axillary and 5th scapular line respectively. The second and third ports are the path for a lung grasper forceps allowing manipulation and inspection. In some cases adhesion is present and both sharp and blunt dissection is needed to free the lung from the chest wall.

The bullae are identified, and freed using sharp and blunt dissection if they were adherent to the chest wall. Using endo-staple (GIA 30 stapler, Auto Suture Company Division, United States Surgical Corporation, Norwalk, Conn), bullectomy and aerostasis is achieved. Apical pleural abrasion using a pleural abrader was done in all patients. Two chest drains are left and in all patients removed within 24 hours.

Measurements:

The following parameters are recorded:

- Success of placement of the Fogarty catheter in the technique mentioned from step1 to4.
- Time needed to achieve lung isolation from step1 to 4.
- Result of assessment of the catheter position using FOB.
- Verbal analog scale from 0 to 100 mm to describe the surgeon's satisfaction with lung isolation, where zero denotes very bad lung isolation while 100 means extremely satisfactory isolation. .⁽⁹⁾
- Incidence of desaturation, catheter displacement or any clinical event requiring abortion of the technique.

Statistical Methods:

Data were expressed as range median, ratio and percentage whenever appropriate.Body weight, time to lung isolation and verbal analog scale results were expressed as mean ± standard deviation (SD). Chi-square test was used to compare between right and left side success rates while Student's T test was used to compare their times .P value <0.05 was considered statistically significant.

Results:

Eleven patients took part in this case series.The demographic data regarding age, gender and body weight as well as the patient's characteristics including side of operation and history of smoking; diabetes and hypertension were shown in table1.

Table1: Showing patients characteristics

Age (years)	range	median
	26-55	48
Gender(Male/Female)	8/3	
Side (Right/Left)	6/5	
Body weight (Kg)	mean	SD
	79	±11.4
	ratio	percentage
Smoking	7/11	63.64%
Diabetes mellitus	3/11	27.27%
Hypertension	4/11	36.36%

Successful placement of the Fogarty catheter as a bronchial blocker in the clinically-guided technique described in steps1 to4 was achieved in ten

patients. One patient with left spontaneous pneumothorax was unsuccessful due to failure to intubate the left main bronchus, despite of all the maneuvers to direct the endotracheal tube tip to the left side. Therefore FOB was introduced to insert the Fogarty catheter, and a separate endotracheal tube along its side. This case was excluded from the further measurements in the study.

Table2: Success of clinically-guded Fogarty catheter placement

Successful cases	Ratio	percentage
Right side	6/6	100%
Left side	4/5*	80%*
Total	10/11	90.9%

*P value <0.05 compared with right side using Chi-square test The time needed to achieve clinically-guided placement of the Fogarty catheter and produce lung isolation was significantly longer in the left sided cases,757.9±51.5 seconds versus 328.2±23.2seconds in the right sided cases with p value<0.05 as seen in table3

Table3: Time to lung isolation from step1 to 4

Successful cases	Mean (sec)	SD
Right side	328.2	±23.2
Left side	757.9*	±51.5*

* P value <0.05 compared with right side using Scores of the verbal analog scale that described the satisfaction of the surgeon with lung isolation denoted a mean of 78.5±13mm out of 100mm as shown in table4.

Table4: Verbal analog scale for surgical satisfaction with lung isolation

	Mean (mm)	SD
Verbal analog scale 0-100	78.5	±13

FOB did not indicate repositioning of the Fogarty catheter in any of the ten patients who completed the study. Also none of these patients were reported to suffer oxygen desaturation or clinical problems mandating abortion of the study technique.

Discussion:

There is no consensus on the best technique for lung isolation for thoracic surgery. (9). There is a large series of >200 cases by a single author in which the Fogarty occlusion catheter was preferentially used for a left-sided thoracic surgery with apparently positive results(7) .Some reports documented its use in cases with difficult airway for lung isolation (8,10-12). Campos reports (6) that there is a lack of a communicating channel in the centerof the catheter which delays lung collapse and cannot allow suctioning or oxygeb insufflation. However in this case series the problem of lung collapse was not important due to the pathophysiology of spontaneous pneumothorax which includes lung collapse and. Also the technique which involves the use of a single-lumen endotracheal allowed oxygenation and ventilation of the patient at intervals to interrupt the technique of Fogarty catheter placement, thus avoiding desaturation.

Success of lung isolation is reflected in the high verbal analog scale scored (78.5±13mm out of 100 mm) by the technique as described by the surgeons reflecting good degree of satisfaction with lung isolation. The reported disadvantage of air leak caused by coaxial placement of the bronchial blocker inside the lumen of the independent separate endotracheal tube (6) was not seen in our case series because the catheter was along the endotracheal tube.

A major advantage of this study is the economic aspect and the practical value. This can be clearly understood when the cost of the double-lumen tube, which is the technique most commonly applied for lung isolation (13) is compared to that of the Fogarty catheter. The cost of the former is about five folds the latter.

Also the described technique could be achieved without mandatory applying the fiberoptic bronchoscope which remains mandatory in the conventional method of bronchial blocker placement while its role with double-lumen tube, particularly left-sided, remains controversial whether mandatory(14) or just.beneficial (15) The fact that theexpertise and equip,emt needed for FOB is not available in every clinical situation in

developing countries may add to the value of our proposed technique especially in right sided spontaneous pneumothorax where the technique was significantly more successful 100% compared to 80% respectively. And required shorter time to be achieved 328.2 ± 23 , 2 seconds versus 757.9 ± 51.5 seconds respectively

However the small number of patients needs further studies with larger size to support its results.. Also comparative studies are needed to evaluate the reliability of this technique.

Conclusion:

This study showed that Fogarty catheter can be placed in a clinically-guided technique safely with satisfactory lung isolation in patients undergoing video-assisted thoracoscopic surgery for spontaneous pneumothorax.

References:

1. Ng CS, Lee TW, Wan S, Yim AP. Video assisted thoracic surgery in the management of spontaneous pneumothorax: the current status. *Postgrad Med J.* 2006 Mar; 82(965):179-85.
2. Gossot D, Galetta D, Stern JB, Debrosse D, Caliandro R, Girard P, Grunenwald D. Results of thoracoscopic pleural abrasion for primary spontaneous pneumothorax . *Surg Endosc.* 2004 Mar; 18(3):466-71. Epub 2004 Feb 2.
3. Lang-Lazdunski L, Chapuis O, Bonnet PM, Pons F, Jancovici R. Videothoracoscopic bleb excision and pleural abrasion for the treatment of primary spontaneous pneumothorax: long-term results. *Ann Thorac Surg.* 2003 Mar; 75(3):960-5.
4. Cohen E. Methods of lung separation. *Minerva Anesthesiol.* 2004 May; 70(5):313-8.
5. Benumof J, Alfery D: Anesthesia for thoracic surgery. In: Miller R. *Anesthesia*, 5th ed. Churchill Livingstone, 2000, pp 1689.
6. Campos J H. An Update on Bronchial Blockers During Lung Separation Techniques in Adults *Anesth Analg* 2003;97:1266-1274
7. Ginsberg RJ. New technique for one-lung anesthesia using an endobronchial blocker. *J Thorac Cardiovasc Surg* 1981; 82: 542–6.[Abstract]
8. Nino M, Body SC, Hartigan PM. The use of a bronchial blocker to rescue an ill-fitting double-lumen endotracheal tube. *Anesth Analg* 2000; 91: 1370–1.
9. Narayanaswamy M, McRae K, Slinger P, Dugas G, Kanellakos GW, Roscoe A, Lacroix M. Choosing a lung isolation device for thoracic surgery: A randomized trial of three bronchial blockers versus double-lumen tubes. *Anesth Analg.* 2009 Apr;108(4):1097-101
10. Capdeville M, Hall D, Koch CG. Practical use of a bronchial blocker in combination with a double-lumen endotracheal tube. *Anesth Analg* 1998; 87: 1239–41.
11. Otruba Z, Oxorn D. Lobar bronchial blockade in bronchopleural fistula. *Can J Anaesth* 1992; 39: 176–8.
12. Amar D, Desiderio DP, Bains MS, Wilson SR. A novel method of one-lung isolation using a double endobronchial blocker technique. *Anesthesiology* 2001; 95: 1528–30.
13. Lewis JW, Serwin JP, Gabriel FS, et al. The utility of a double-lumen tube for one-lung ventilation in a variety of noncardiac thoracic surgical procedures. *J Cardiothorac Vasc Anesth* 1992; 6: 705–10.
14. Cohen E. Double-lumen tube position should be confirmed by fiberoptic bronchoscopy *Curr Opin Anaesthesiol.* 2004 Feb; 17(1):1-6.
15. Brodsky JB. Fiberoptic bronchoscopy need not be a routine part of double-lumen tube placement. *Curr Opin Anaesthesiol.* 2004 Feb; 17(1):7-11.