Case Report

Safety and efficacy of video DLT (VDLT) for lung isolation during the COVID-19 pandemic

Sathish Kumar Dharmalingam, Gladdy George, Kirubakaran Davis, Balaji Kuppuswamy, Birla Roy Gnanamuthu[1], Raj Sahajanandan

Departments of Anaesthesiology and [1]Cardio Thoracic Surgery, Christian Medical College, Ida Scudder Road, Vellore, Tamil Nadu, India

ABSTRACT

One lung ventilation (OLV) with collapse of the ipsilateral lung is a prerequisite for most thoracic surgical procedures. Double-lumen tube (DLT) is still the preferred method to isolate the lungs and fiberoptic bronchoscopy (FOB) is the gold standard for the confirmation of correct placement of the DLT. However, both these procedures are considered as a high-aerosol-generating procedures and are hazardous to the health workers, particularly at this time of the COVID-19 pandemic. We did nine thoracic surgery cases categorized as essential, requiring OLV during the ongoing period of the COVID-19 between April 2020 and May 2020 where we used Full view DLT for lung isolation. We present our case series which shows that the Full view VDLT can minimize or circumvent the use of FOB during OLV, and reduce the time taken to isolate the lungs thus reducing aerosol in the theater. None of the nine patients required FOB for confirmation of initial positioning nor for diagnosis of intraoperative malposition. The time taken to isolate the lungs was significantly less and the surgical positioning was done under real-time monitoring by visualizing the blue cuff distal to carina at all times. The real-time monitoring by the Full view VDLT offers the additional advantage of detecting any malposition even before it results in loss of isolation or desaturation. We conclude that the Full view VDLT is an efficient and safe alternative for lung isolation at this time of the COVID-19 pandemic.

Keywords: Aerosol, cost effective, fiber optic bronchoscope, malposition, video DLT

Address for correspondence: Dr. Raj Sahajanandan, Department of Anaesthesia, Christian Medical College, Vellore 632004, Tamil Nadu, India.
E-mail: rajsahajanandan@gmail.com

Submitted: 17-Sep-2020 **Accepted:** 06-Jan-2021 **Published:** 21-Jan-2022

OBJECTIVE

The aim of this study was to evaluate the efficacy of full view video double-lumen endotracheal tube (VDLT) as a safe alternative to the conventional double-lumen endotracheal tube (DLT) for thoracic surgery during COVID-19 pandemic.

INTRODUCTION

Double lumen tube (DLT) is the gold standard for lung isolation in thoracic surgical centers around the world. DLTs are often preferred to bronchial blockers (BBs).[1,2] This is because DLT ensures faster collapse of the ipsilateral lung, less prone to displacement and also reduces the chances of contamination of the contralateral lung.

Fiberoptic bronchoscopy (FOB) is not only the gold standard for confirming the initial placement of DLT, but is also used to diagnose malposition after the lateral decubitus positioning of the patient or during surgical manipulations.[3] FOB is a high-aerosol-generating procedure and its use requires a certain amount of expertise.

Access this article online	
Quick Response Code:	Website: www.annals.in
	DOI: 10.4103/aca.aca_239_20

How to cite this article: Dharmalingam SK, George G, Davis K, Kuppuswamy B, Gnanamuthu BR, Sahajanandan R. Safety and efficacy of video DLT (VDLT) for lung isolation during the COVID-19 pandemic. Ann Card Anaesth 2022;25:107-11.

As the world is facing the global COVID-19 pandemic, the "new normal" has to be adapted by all health-care workers. The respiratory tract may contain a high concentration of SARS (Severe Acute Respiratory Syndrome) COV 2 virus, and the requirement of aspiration of broncho-alveolar lavage fluid during procedures poses a major health hazard to the anesthetist and the personnel involved in the maintenance of the equipment. The management of thoracic surgical patients during the COVID-19 pandemic requires modifications to normal practice. The risk from aerosol-generating procedures must be reduced wherever possible to ensure the safety of patients and healthcare staff.

Recently, a video-assisted, left-sided DLT (Full view VDLT, Jiangxi Norgas Science and Technology) with an integrated camera at the distal end of the tracheal lumen [Figure 1a] has become available in our Centre. The external features, dimensions, and intubation of this VDLT are similar to the conventional left-sided DLT and it is available in four sizes 35, 37, 39, and 41 Fr. In addition it comes with a port to clean the lens of the camera, if it is obscured by secretions or by fogging either by direct suction or using saline flush. It has a monitor display [Figure 1b] connected to the integrated camera with a USB cable system which enables good visualization of the trachea and carina continuously during intubation and also during the entire surgical procedure. Thus it eliminates the need of FOB during initial placement and during patient positioning and manipulations. In addition, as the video DLT permits continuous visualization of the carina, it helps the attending anesthesiologist to recognize the adequacy of bronchial cuff inflation and identifies the malposition early and thus prevents hypoxia.[4] Another potential advantage of the Full view VDLT is the inbuilt clamping system, which helps to avoid the use of an external clamp to isolate the lungs [Figures 2a and 2b]. Thus the VDLT circumvents the use of additional instruments near the airway which can be contaminated by aerosols.

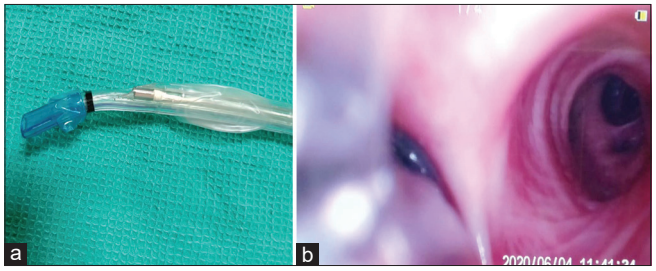

Figure 1: (a) The position of the embedded camera between the tracheal and bronchial lumen (b) Monitor displaying the visualization of carina and the bronchial tube in the left main bronchus

During the period of April 2020 to May 2020, when India was in a lockdown on account of COVID-19, our center successfully used VLDT for lung isolation for nine suspected COVID patients who needed semi emergent thoracic surgical procedures. Due to unavailability of testing kits, COVID testing could not be done and it was decided that the team takes a cautious approach and considers every patient undergoing surgery as potentially positive for infection.

All these cases were managed by an experienced cardiothoracic anesthesiologist. None of the patients required FOB during the full course of the procedure, neither for confirmation of position nor to troubleshoot any malposition intraoperatively. We present this case series, demonstrating the safety and efficacy of VDLT in reducing the time taken to isolate the lungs, and preclude the need for FOB during OLV. None of the patients had anticipated difficult airways.

CASE REPORTS

Nine essential thoracic surgical procedures requiring OLV inclusive of 7 lung cases and two cases of esophageal malignancy requiring resection and gastric pull through were performed during the ongoing COVID-19 pandemic between April 2020 and May 2020. The Full view VDLT was used to isolate the lungs to provide OLV in these patients.

The appropriate size of the left side DLT in all these patients was selected based on patient's height and the left bronchial diameter from their CT thorax [Table 1].

All nine patients had standard ASA monitoring. Two wide bore peripheral cannulas and a radial arterial line were inserted. In view of the risk of aerosol generation; all patients had rapid sequence induction with i.v Fentanyl 2 mcgs/kg, inj propofol 2 mg/kg, and succinylcholine 2 mg/kg. All patients were intubated with the appropriate size left VDLT by using Mac-Intosh laryngoscope. The insertion of left VDLT is similar to conventional left DLT with the added advantage of being able to continuously visualize the tracheal rings and primary carina with the help

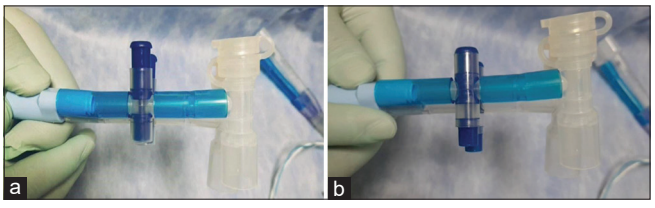

Figure 2: (a) Inbuilt clamping system with the clamp off (b) Inbuilt clamping system with the clamp on

Table 1: Baseline characteristics of study population

Patient no:	1	2	3	4	5	6	7	8	9
Age (yrs)	60	15	24	20	25	48	62	26	46
Gender	M	M	M	F	M	F	F	M	M
Height (cm)	165	170	172	160	166	156	152	163	162
Weight (kg)	61	47	59	59	55	40	55	60	80
BMI	22.4	16.3	20	22.9	20	16.4	23.8	23.4	30.5
Diagnosis	Carcinoma Esophagus	Right Empyema	Left TB Pyo -pneumothorax	AMM + Right Empyema	Metastatic Ewings sarcoma left chest	Left upper lobe carcinoid + SVC obstruction	Solitary lung mets	Left lung bronchiectasis	Carcinoma Lower third Esophagus
Comorbid problems	Smoker	TB	TB	NIL	NIL	HT Asthma	NIL	COPD TB	DM Ex-smoker
Left main bronchus diameter (mm)	14.88	11.42	11.62	10.55	12.54	14.48	10.12	13.63	13.99
SURGERY	Ivor Lewis Esophagectomy	Decortication of Right lung	Decortication of left lung	*Tumor excision and lobectomy	Wedge resection of LLL and partial excision of diaphragm	Left carinal Pneumonectomy	Radical right lower lobectomy	Left pneumonectomy	Mc Keown's Oesophagectomy

*Right thoracotomy and decortication + sternotomy and anterior mediastinal tumor excision + wedge resection of middle and upper lobe + Superior vena cava and Subclavian vein repair. BMI – Body mass index, AMM – Anterior mediastinal mass, TB – Tuberculosis, SVC – Superior vena cava, mets – metastasis, LLL – Left lower lobe, TB – tuberculosis, HT – Hypertension and DM – Diabetes mellitus

Table 2a: Intubation characteristics

Patient no	1	2	3	4	5	6	7	8	9
Time from laryngoscopy to isolation (Seconds)	50	48	54	66	45	52	48	56	39
DLT Size used	39	37	39	35	39	37	35	39	39
Attempts	1	1	1	2	1	1	1	1	1

of inbuilt camera system which is connected to the monitor display. After intubation the patients were positioned either right or left lateral decubitus position depending upon the side of the surgery. Monitor display of the Full view DLT offered continuous monitoring of DLT position during positioning and during surgical manipulations and enables the anesthetist to diagnose malposition if any. Anesthesia was maintained with air, oxygen, isoflurane, vecuronium, and morphine up to 0.1 mg/kg. At the end of the surgery before closure, the surgeon infiltrated the paravertebral space at multiple levels using local anesthetics 20 ml 0.25% bupivacaine. All patients received 15 mg/kg of paracetamol during the procedure and at the end all of them were extubated after adequate reversal of muscle paralysis using neostigmine and glycopyrollate. Morphine dorsifusor infusion (approximately 1 mg/hr) is the standard postoperative analgesia in our institution.

All the patients were intubated and lungs were isolated on the first attempt except for one patient (Case no 4) where we had to use a smaller size left DLT #35 Fr as second attempt because of difficulty in passing # 37 Fr left DLT beyond the glottis. None of the nine patients required FOB during the entire surgical procedure. More importantly, in our case series, the time from intubation to isolating the lungs was less than one minute, with a mean duration of 50.9 seconds (range 39 to 66 seconds) [Table 2a]. It was only for the patient that we had to change to a smaller size tube that the time went above one minute. In two of the patients in our case series, there was retraction of endobronchial cuff into the trachea after lateral positioning, even though there were no clinical signs such as increased airway pressure and desaturation. As VDLT provided a real-time image of the carina, it was possible to identify the malposition and correctly re-position the bronchial tube without the use of FOB.

The port for camera lens cleaning had to be used in two patients when the secretions impaired the view during intraoperative malpositioning and in the patient where the anesthetist had to use a smaller size tube in the second attempt [Table 2b].

DISCUSSION

Health-care personnel involved in airway management are at risk of acquiring the novel coronavirus infection as

Table 2b: FOB Usage & Additional Intubation Data

Patient No	1	2	3	4	5	6	7	8	9
FOB for verification correct placement Yes/No	No	No	No	No	No	No	No	No	No
Dislodgement Yes/No	No	No	No	No	Yes	No	No	Yes	No
Dislodgement Occurrence Time									
During positioning	NA	NA	NA	NA	Yes	NA	NA	Yes	NA
During surgery					No			No	
Both									
Yes/No									
Lung isolation status upon dislodgement									
Adequate	NA	NA	NA	NA	Adequate	NA	NA	Adequate	NA
Lost									
FOB used to correct dislodgement									
Yes/No	NA	NA	NA	NA	N0	NA	NA	No	NA
Anesthesiologist able to forewarn dislodgement									
Yes/No/DNO (did not occur)	DNO	DNO	DNO	DNO	Yes	DNO	DNO	Yes	DNO
Effectively clear secretions									
Yes/No	NA	NA	yes	Yes	NA	NA	NA	NA	Yes
Flushing method									
Air/Saline/Suction	NA	NA	Suction	Saline	NA	NA	NA	NA	Suction

NA – Not applicable

it is a high-aerosol-generating procedure (AGP). Airway management is inclusive of bag and mask ventilation, intubation of the trachea, tracheal tube repositioning and extubation. In thoracic anesthesia, using the DLT for lung isolation, confirmation with FOB, suctioning the secretions, and troubleshooting during malposition and desaturation yield high levels of aerosols. International clinical societies recommend full personal protection equipment (PPE) and the involvement of minimum number of personal during these procedures.[5] A recent review article on airway management for thoracic surgery by the European Association of Cardiothoracic Anesthesiologist (EACTA) recommends adequate pre-oxygenation, rapid sequence intubation of DLT without cricoid pressure and either the use of disposable FOB with a tight fit swivel mount for confirmation of placement or the use of VDLT in order to avoid FOB.[6]

Intubating the trachea using a DLT requires more skill and expertise than a single lumen endotracheal tube intubation, due to the larger size and increased stiffness.[7] Correct positioning of the DLT is crucial, as its malpositioning may result in hypoxia, loss of lung isolation or high airway pressure, necessitating disconnection, suctioning, or FOB. All these maneuvers are high-aerosol-generating procedures and are undesirable during situations like the COVID-19 pandemic.[5,6] In addition, malposition and distortions are common in DLT due to various factors like inappropriate sizing requiring over-inflation of the bronchial cuff, airway issues like edema and tumors and due to surgical retraction.[8]

A study by Klein and his colleagues demonstrated that more than 35% of thoracic surgical cases that were confirmed only by auscultation had inappropriate positioning of DLT after blind insertion.[9] They eventually used FOB to confirm the malposition after intubation and surgical position. Thornton *et al*. reviewed the recommendations for airway management in clinical practice as endorsed by the Association for Cardiothoracic Anesthesia and Critical Care and the Society for Cardiothoracic Surgery in Great Britain and Ireland during the period of the COVID- 19 pandemic. They discuss the option of using only clinical confirmation in order to avoid aerosol-generating procedures, but agreed that due to the high incidence of malposition it may be desirable to do a bronchoscopy with special precautions.[6] They recommend using an additional HEPA (High-Efficiency Particulate Air) filter to the clamped tracheal lumen before opening it to the atmosphere. Ideally, this process must be repeated after surgical positioning of the patient.

In certain circumstances of intraoperative malpositioning, like the tube slipping out or entering the opposite bronchus where FOB will be necessary, they recommended doing adequate preoxygenation followed by bronchoscopy via the bronchial lumen. The review also suggests ensuring complete neuromuscular block with the tracheal cuff inflated and the bronchial cuff deflated to diagnose and perform corrective interventions during such events.

Data from our case series showed that VDLT is a great alternative to conventional DLT as it offers rapid real-time lung isolation and practically avoids the need of FOB for both initial placement as well as diagnosis and management of malpositions.

In our case series, the time from intubation to isolating the lungs was less than one minute, with a mean duration of 50.9 seconds (range 39 to 66 seconds). This was faster as compared to FOB confirmation, which has a mean duration of 79.4 secs (range 37 to 140 seconds).[10] Use of VDLT reduces the time taken for the procedure by 36% and it is statistically significant ($P < 0.001$). In addition, it was observed that all the four cardiac anesthesiologists who successfully intubated the VDLT in their first attempt, had never used this device before, but were familiar with the bronchoscopic anatomy and had trained on a manikin which suggests a shallow learning curve.

The insertion process is the same as a conventional DLT with real-time identification of landmarks, mainly tracheal rings and primary carina, which resulted in quick learning and a high success rate at the first attempt. The VDLT offers the additional advantage of monitoring cuff position after inflation. Although VDLT can visualize the primary carina, it cannot replace the FOB in ruling out situations of "DLT too in" where the secondary carina needs to be visualized. Additionally, when a right VDLT is used, the alignment of the slot with the right upper lobe cannot be done without the use of FOB.

As regards the financial comparison between the conventional DLT (INR 6000) and FOB (INR 2500) and the Full view DLT (INR 8500), the cost of equipment maintenance and cleaning is almost similar. Disposable FOBs like AMBU scope can be used, but are far more expensive (INR 32,000). Thus, given the crisis precipitated by the COVID- 19 pandemic, Full view VDLT remains a cost-effective option.

CONCLUSION

The COVID-19 pandemic has created an unprecedented health situation for both health-care personnel and patients alike. This case series shows that a Full view VDLT can be a safe and effective alternative to a conventional DLT for thoracic surgeries. It significantly avoids the risks involved in FOB. The real-time view that it offers aids the attending anesthesiologists to detect any malposition and loss of isolation before clinical desaturation happens. Thus, it remains an efficient tool to use during this period of crisis precipitated by the COVID-19 pandemic.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Neustein SM. Pro: Bronchial blockers should be used routinely for providing one-lung ventilation. J Cardiothorac Vasc Anesth 2015;29:234-6.
2. Brodsky JB. Con: A bronchial blocker is not a substitute for a double-lumen endobronchial tube. J Cardiothorac Vasc Anesth 2015;29:237-9.
3. European Centre for Disease Prevention and Control (ECDC): Infection prevention and control for the care of patients with 2019-nCoV in healthcare settings. 2020. Updated Feb 2020. [Last accessed on 2020 Apr 01].
4. Heir JS, Guo SL, Purugganan R, Jackson TA, Sekhon AK, Mirza K, *et al*. A randomized controlled study of the use of video double-lumen endobronchial tubes versus double-lumen endobronchial tubes in thoracic surgery. J Cardiothorac Vasc Anesth 2018;32:267-74.
5. Şenturk M, El Tahan MR, Szegedi LL, Marczin N, Karzai W. Thoracic anesthesia of patients with suspected or confirmed 2019 novel coronavirus infection: Preliminary recommendations for Airway Management by the European Association of Cardiothoracic Anaesthesiology Thoracic Subspecialty Committee. J Cardiothorac Vasc Anesth 2020;11:1-13.
6. Thornton M, Reid D, Shelley B, Steven M. Management of the airway and lung isolation for thoracic surgery during the COVID-19 pandemic: Recommendations for clinical practice endorsed by the Association for Cardiothoracic Anaesthesia and Critical Care and the Society for Cardiothoracic Surgery in Great Britain and Ireland. Anaesthesia 2020;75:1509-16.
7. Yoo JY, Chae YJ, Park SY, Haam S, Kim M, Kim DH. Time to tracheal intubation over a fibreoptic bronchoscope using a silicone left double-lumen endobronchial tube versus polyvinyl chloride single-lumen tube with bronchial blocker: A randomized controlled non-inferiority trial. J Thorac Dis 2019;11:901-8.
8. Heir JS, Purugganan R, Jackson TA, Norman PH, Cata JP, Kosturakis A, *et al*. A retrospective evaluation of the use of video-capable double-lumen endotracheal tubes in thoracic surgery. J Cardiothorac Vasc Anesth 2014;28:870-2.
9. Klein U, Karzai W, Bloos F, Wohlfarth M, Gottschall R, Frintz H, *et al*. Role of fiberoptic bronchoscopy in conjunction with the use of double-lumen tubes for thoracic anesthesia: A prospective study. Anesthesiology 1998;88:346-50.
10. Cheong KF, Koh KF. Placement of left-sided double-lumen endobronchial tubes: Comparison of clinical and fibreoptic-guided placement. Br J Anaesth 1999;82:920-1.