Editorial

The video double-lumen tube: does it have a future?

Bryan E. Marchant^, Benjamin N. Morris, Roger L. Royster

Department of Anesthesiology, Section on Cardiothoracic and Vascular Anesthesia, Wake Forest University School of Medicine, Winston-Salem, NC, USA

Correspondence to: Roger L. Royster, MD. Department of Anesthesiology, Wake Forest University School of Medicine, Medical Center Boulevard, Winston-Salem, NC 27157, USA. Email: rroyster@wakehealth.edu.

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Technological advances facilitate the ability of physicians to provide new or improved care with greater safety for our patients. Thoracic surgery often requires lung isolation to provide optimum operating conditions for the surgeon. Double-lumen tubes (DLT) have been the standard of care for many years for lung isolation, though bronchial blockers have added value to lung isolation in certain conditions where DLTs were either difficult or impossible to position. Single lumen tubes with bronchial blockers were developed with the blocker incorporated into the construction of the tube or with connectors designed to facilitate the passage of a fiberoptic bronchoscope and blocker both within the tube. Bronchial blockers may also be placed extra-luminally, a technique that allows for use of a smaller single lumen tube. However, the DLT remains the most popular choice for lung isolation for most physicians, especially in adults.

A DLT with a video scope (VDLT) attached has been available for several years. An increasing number of studies have attempted to assess its value in patient care. This device may make the positioning of the DLT easier and more expeditious for the physician. It also may eliminate the need for a fiberoptic bronchoscope to access proper positioning of the DLT, and it can provide real time continuous visualization of the DLT in case lung isolation problems develop during surgery. However, the video scope can increase the temperature of the tracheal mucosa and with a larger diameter tube, can potentially injure tracheal mucosa. When one takes into account only the device itself and not the necessary fiberoptic bronchoscopy equipment the VDLT is more expensive than a traditional DLT.

In a recent issue of this journal, Palaczynski *et al.* (1) performed a randomized study comparing the DLT and VDLT to assess whether "intubation with the VivaSight double-lumen tube would be easier and faster than with a standard DLT". After identical anesthetic inductions, each patient was intubated with their randomly assigned tube. While the specific moment timing begins is not described in the methodology, one would assume that it was the same for all the tubes and would not alter the comparison between tubes. The investigators intentionally did not utilize fiberoptic bronchoscopy during placement for positioning DLTs but used auscultation and capnography. However, they state that they did use fiberoptic bronchoscopy "in all cases after anaesthesia induction to confirm the proper tube position. Only fiberoptic bronchoscopy evaluations that lead to repositioning were noted". Since intubation time was not defined, it makes it difficult to know exactly what contributed to the longer time in the DLT group. Fiberoptic bronchoscopy was used in 21% of DLT patients either during intubation, after patient repositioning, or intraoperatively.

In the intervention arm, the author's report no utilization

^ ORCID: 0000-0003-1984-5348.

of a fiberoptic bronchoscope during placement of the VDLT. However, there was a greater difference in tube repositioning after patient repositioning which was of marginal significance. While technically true that a separate fiberoptic bronchoscope may not have been utilized for placement, the videoscopic properties of the VDLT make it a functional equivalent to a fiberoptic bronchoscope. One could argue that instead of 0% percent fiberoptic bronchoscope utilization as reported in the article, 100% of the VDLT placement utilized a bronchoscopic equivalent. While the statistical analysis would be changed, the overall clinical message would be identical if the authors acknowledged this—VLDTs are faster than DLTs. But, as mentioned above, the lack of defining intubation time for either group raises questions about true difference in speed of insertion.

Finally, the authors provide a thorough examination of the trachea via laryngeal mask airway- (LMA-) assisted fiberoptic bronchoscopy after extubation. Given that most trauma is probably clinically silent, this approach provides a better insight to the true incidence and degree of injury from bronchial tube use. The authors acknowledge a significant difference between groups with respect to sizing of tubes, with the VDLT having a larger percentage of 37/39 French tubes. While not powered to detect the difference, there is a suggestion that it may not matter, as there were no differences in tube morbidity during the study related to lung isolation.

The first clinical efforts at single lung isolation were performed by Gale and Waters in 1932 (2). Lung isolation was achieved by blindly advancing a molded rubber tube into the main bronchus; however, there were numerous complications and malposition events. In 1949, Carlens introduced the precursor to the modern DLT. Bryce-Smith made several design modifications to Carlens (3) and improvements in single lung ventilation have been continuously sought since that time. A 2015 meta-analysis of studies comparing DLTs to bronchial blockers found that although there was no significant difference in overall quality of isolation; bronchial blockers took longer to place and required more frequent repositioning (4). A survey of anesthesiologists from the United Kingdom found DLTs were overwhelmingly (98%) the first choice for lung isolation (5). Regardless of method of isolation used, one constant is the requirement for fiberoptic bronchoscopy to confirm proper positioning. In this article, Palaczynski *et al.* (1) have moved the discussion from method of isolation to improvements on DLTs in the spirit of Bryce-Smith with the Vivasight-DL, which integrates a disposable camera into the DLT obviating the need for postintubation bronchoscopy. The authors hypothesized that the Vivasight-DL would offer advantages in speed of placement, necessity of fiberoptic bronchoscopy, and frequency of repositioning events as compared to traditional DLTs at a comparable or better overall cost.

In 2015, Massot *et al.* (6) conducted a single center, prospective study in France to evaluate placement accuracy. The study was ended due to an issue where a camera overheated and melted the end of an endotracheal tube *in vitro*. The Vivasight-DL was found by post placement fiberoptic bronchoscopy to be initially correctly positioned in 76 of 77 patients. That same year Levy-Faber *et al.* (7) compared time to intubation for VDLTs vs traditional DLTs in a similarly sized study. The authors found that VDLTs took an average of 51 seconds for successful intubation, while utilization of a traditional DLT took on average 264 seconds (7). The time discrepancy was due to preparing the fiberoptic bronchoscope, adjusting focus, clearing secretions, and additional visual inspections for repositioning.

While Palaczynski *et al.* (1) studied the use of VDLTs in elective surgery, they postulated that the improvement in time to lung isolation would be beneficial in emergent situations. It is unlikely that significant clinical differences would have an impact on patient care in routine cases, as the total time for positioning a traditional DLT with fiberoptic bronchoscopy on average does not surpass 3–4 minutes (7,8). This is especially true given that most tube dislodgements occur during patient positioning (8,9). Heir *et al.* additionally showed an improvement in time from surgical positioning to final confirmation of lung isolation of 60 seconds (9), but is this clinically relevant? The true value of the VDLT system is the continuous monitoring of the airway to evaluate tube dislodgement and facilitate rapid corrections to maintain lung isolation. Indeed, comparison trials between VDLTs and traditional DTLs have consistently shown a greatly reduced requirement for fiberoptic bronchoscopy to evaluate tube position intraoperatively (6,8,9). As mentioned by Templeton *et al.*, this would be of particular benefit in cases where the tube becomes dislodged multiple times in a case and when an anesthesiologist skilled in fiberoptic bronchoscopy is not immediately in the room leading to a delay (10).

The Vivasight-DL was designed with a flush port that allows for clearance of secretions obscuring the camera. In one trial, researchers found that clearance of secretions was necessary and effectively utilized the port in 30% of cases (7).

This feature would likely save time in the operating room, as a fiberoptic scope would need to be removed, cleaned, the ETT suctioned and then the scope replaced. However, Onifade *et al.* were unable to clear secretions more than 50% of the time despite multiple flushes with air and saline resulting in the use of fiberoptic bronchoscopy to evaluate tube position (8). Others have reported significantly more secretions when a VDLT is used as opposed to a DLT but with a >90% success rate in removal of these secretions with the port (9).

The overheating incident that led to termination of the Massot study is concerning (6). The manufacturer, ETView Medical, Ltd., appended a statement to Massot's article following this sentinel event outlining the extensive evaluation of their product to reproduce this issue. Ultimately, they determined it to be an issue with the integrated camera manufacturing. While corrective action was taken, they did note that 23,000 Vivasight-DL units had been used without a similar report of melting and that the same camera was used in their single lumen tube line, which increased uses without incident to 46,000 (6). Of the several comparisons of VDLTs to traditional DLTs published, Palaczynski *et al.* (1) is the only one to make mention of tracheal temperature. While they found overall higher temperatures in the VDLT group, they noted that these were never noted to exceed a hazardous level. Continuous monitoring during the operation could explain the increase in tracheal temperature seen over time, which surpassed that of the DLT group (temperatures for this group increased as well over the course of the operation, though at a slower rate). One solution would be to only have the camera on when there was a question of tube position to prevent overheating.

VDLTs appear to offer an improvement to traditional DLTs, at least in regards to time to lung isolation and number of repositioning events. The question then becomes one of cost. While costs vary widely from institution to institution, the Vivasight-DL is significantly more expensive than a traditional DLT. The difference, therefore, comes in the expense of using, cleaning, and maintaining equipment for fiberoptic bronchoscopy. A recent cost-effectiveness analysis in Denmark determined the overall cost of using a VivaSight-DL to be 299.96 USD per procedure as compared to a cost of 347.61 USD for a traditional DLT with durable fiberoptic bronchoscope (11). Interestingly, in this study, Larsen *et al.* noted a need for fiberoptic bronchoscopy to confirm positioning in 6.6% of cases where the VDLT was utilized (11). This finding is promising; however, it is important to note that this study was sponsored by the supplier of VivaSight-DL. While noting that costs vary between institutions, Heir *et al.* found that at their institution the cost of a VivaSight-DL was $225 such that its utilization incurred an increased cost of about $88 above a traditional DLT placed with a non-disposable fiberoptic bronchoscope, but represented a cost savings of $78 dollars when a disposable fiberoptic bronchoscope was utilized (9).

Avoiding routine fiberoptic bronchoscopy, at least with a durable bronchoscope, may have the additional benefit of less infectious risk exposure to the patient. A recent direct observational study by Ofstead *et al.* examined clinically used bronchoscopes after manual cleaning and high-level disinfection. Here, the researchers found that despite strict adherence to cleaning guidelines greater than half of the bronchoscopes (58%) were contaminated with mold and bacterial pathogens including *E. Coli* and *S. Maltophilia* (12). Although these results come from a single center, they certainly argue for a move towards the use of disposable bronchoscopes. Given this, overall cost savings could likely be met with use of the Vivasight-DL without routine bronchoscopy but with a disposable fiberoptic bronchoscope on standby in the event one is needed. This would especially make sense for institutions that already maintain a monitor for video laryngoscopy that is also capable of bronchoscopy.

Does the Vivasight-DL have a future? At present, only a handful of comparison studies exist, each with less than 100 patients. As with most emerging technologies, more exposure with studies on this device is warranted. Video laryngoscopy, which initially was reserved for difficult intubations, has now been shown in a large meta-analysis to reduce failed intubation attempts and complications when used routinely (13), leading to some calls for its universal use. Might this one day be true for VDLTs? While it will likely never completely supplant the need for fiberoptic bronchoscopy, there certainly seems to be a role for VDLTs in the thoracic anesthesiologist's armamentarium.

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Footnote

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