A Feasibility Study Using the VivaSight Single Lumen™ to Intubate the Trachea Through the Fastrach Laryngeal Mask Airway: A Preliminary Report of 50 Cases

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BACKGROUND: The VivaSight Single Lumen™ (SL) is a new endotracheal tube with a video camera and a light source in its distal portion enabling continuous visual observation of the trachea. In this study, we assessed the feasibility of endotracheal intubation with a VivaSight-SL through the Fastrach Laryngeal Mask Airway® (FT-LMA).

METHODS: We studied 50 patients with normal airways, scheduled for elective surgery during general anesthesia requiring endotracheal intubation. The FT-LMA was inserted and adequate ventilation was achieved. The VivaSight-SL was passed through the FT-LMA into the trachea, with visualization of the carina. The following criteria were used to score the laryngeal view: grade 1: the arytenoids and glottis; grade 2: epiglottis; arytenoids and glottic opening are partly visible; grade 3: dark areas indicating an open space; and grade 4: no part of the larynx can be identified.

RESULTS: The FT-LMA was placed successfully in 49 patients at the first attempt. One patient was excluded from the study after 2 failed attempts to ventilate with the FT-LMA. All 49 patients were successfully intubated with the VivaSight-SL. (95% confidence interval [CI] 0.89–0.99), 47 patients at the first attempt (95% CI, 0.83–0.98) and 2 patients at the second attempt. (95% CI, 0.004–0.13). The time to achieve an effective airway with the FT-LMA was 15.4 ± 6 (mean ± SD) seconds. The time to achieve a laryngeal view with the VivaSight-SL was 28.8 ± 5 seconds. Correct position of the VivaSight-SL was confirmed with visualization of the carina. Time of successful intubation with VivaSight-SL from picking up the VivaSight-SL to observing a end-tidal CO₂ curve was 45 ± 7 seconds. After introducing the VivaSight-SL through the intubating channel of the FT-LMA, a grade 1 view was obtained in 18 patients; grade 2 in 18 patients, grade 3 in 4 patients, and grade 4 in 9 patients.

CONCLUSION: The high first-attempt intubation success rate using the VivaSight-SL to intubate the trachea through a FT-LMA makes this technique an attractive and promising concept. (Anesth Analg 2013;116:00–00)

The VivaSight Single Lumen™ (SL; ETView Ltd, Misgav, Israel) is a polyvinyl chloride single use endotracheal tube (ETT) with an embedded complementary metal–oxide–semiconductor video camera and a light source in its distal portion enabling continuous airway visualization1,2 (Figs. 1 and 2). The internal diameter of the VivaSight-SL is similar to the standard 7.5 and 8 mm ETT, and it can be used with a stylet to adjust the shape of the tube. According to the manufacturer, the resistance to airflow is similar to a standard ETT (unpublished data).

Images of the airway are continuously projected onto a portable monitor screen through a cable that carries the video signal from the camera. It also has a port that enables saline injection to clear the video camera. The VivaSight-SL is currently available in 3 sizes: 7.0, 7.5, and 8.0 mm. Thus far, the VivaSight-SL was used to verify the ETT position once it was in the trachea, during percutaneous nephrolithotomy and lung lobectomy as well as to exclude mainstem intubation.1,2 We evaluated the VivaSight-SL for initial tracheal tube placement through the Fastrach Laryngeal Mask Airway® (FT-LMA; LMA North America, Inc., San Diego, CA). The FT-LMA has gained a well-established role in the management of the difficult airway.3,4 It serves as a conduit for blind, fiberoptically guided or lightwand tracheal intubation.3,5,6 However, blind intubation frequently
VivaSight Single Lumen fails despite corrective mask positioning maneuvers and multiple attempts at intubation. Although fiberoptically guided intubation through the FT-LMA has a very high success rate, the technique is time consuming. We describe the use of VivaSight-SL to facilitate endotracheal intubation through the FT-LMA.

METHODS

This study was approved by the local Human Ethics Committee at Bnai-Zion Medical Center, Haifa, Israel, and written informed consent was obtained from all patients. Subjects included 50 patients, aged 20 to 80 years, ASA I and II, between 155 and 180 cm height, 50 and 100 kg weight with normal airways, scheduled for elective surgery during general anesthesia requiring endotracheal intubation. The criteria to define a normal airway were: Mallampati classes I and II, thyromental distance >6.5 cm, interincisor distance >3 cm, ability to extend mandibular incisors anterior to maxillary incisors, ability to touch chin to chest or to extend the neck, and absence of overbite. Exclusion criteria included known esophageal disease, gastroesophageal reflux disease, pulmonary disease, and pregnancy.

Anesthesia was induced with 2 mg/kg propofol and 2 µg/kg fentanyl. After confirming adequate mask ventilation, muscle relaxation was achieved with 0.6 mg/kg rocuronium. Patients lungs were ventilated for 3 minutes with oxygen (FIO₂ = 1), and then the reusable FT-LMA lubricated with water-soluble jelly on the posterior surface was inserted according to the manufacturer’s recommendations. A size 4 FT-LMA was used for patients weighing 50 to 70 kg, and a size 5 for patients weighing >70 kg. The cuff of the FT-LMA was inflated to a pressure of 60 cm H₂O using a manometer (VBM Medizintechnik GmbH, Sulz, Germany), and the breathing circuit was connected to the FT-LMA. Adequate ventilation was assessed by proper chest expansion, bilateral auscultation of the lungs, and the presence of a CO₂ waveform on the capnograph. If adequate ventilation was not possible, the FT-LMA was removed and a second attempt was allowed. If ventilation was inadequate after the second attempt, endotracheal intubation was performed using a GlideScope (Verathon Inc., Bothell, WA) and the case excluded from the study.
Once adequate ventilation was achieved, the VivaSight-SL was passed through the FT-LMA into the trachea under visual control. (Video 1, see Supplemental Digital Content 1, http://links.lww.com/AA/A502). The VivaSight-SL size 7.5 mm was used to intubate the trachea for a size 4 FT-LMA and a size 8.0 mm for a size 5 FT-LMA. The VivaSight-SL was inserted with a concave orientation (Figs. 3 and 4) in an attempt to increase intubation success according to the technique described by Ye et al.12 The VivaSight-SL was then advanced until the epiglottic elevator bar was pushed up and a laryngeal view was obtained. We obtained reversed insertion of the FT-LMA. If a grade 1 view was obtained, the VivaSight-SL was passed into the trachea under direct vision and the correct position confirmed approximately 3 cm above the carina. If a grade 2 or higher was obtained, one or more of the following maneuvers were performed to obtain optimal alignment of the FT-LMA ventilation aperture with the glottis opening: (a) up-down maneuver of the FT-LMA under vision, (b) side-to-side maneuver (sagittal movement) with no change in the depth, (c) hyperextension of the head, (d) external manipulation of the larynx, or (e) injection of normal saline through the external port of the VivaSight-SL to clean the embedded video camera. If no glottic visualization was possible, these patients were then excluded and intubated using a GlideScope.

Once the optimal glottic view was achieved, the second step Chandy maneuver (FT-LMA slightly lifted and moved away from the posterior oropharyngeal) was performed under vision, to improve the alignment of the ventilation orifice of the FT-LMA with the glottis.6 The VivaSight-SL was then inserted under videoscopic observation of the trachea. A stabilizing rod was used during the removal of the FT-LMA.

Two attempts to perform endotracheal intubation were allowed. All intubations were performed by 2 experienced attending anesthesiologists.

The following data were recorded: the time for insertion of the FT-LMA (defined as the time from facemask removal to observing an end-tidal CO2 curve), the time required to obtain a laryngeal view with the VivaSight-SL, number of attempts at endotracheal intubation, time to achieve endotracheal intubation (defined as the time from picking up the VivaSight-SL to observing an end-tidal CO2 curve), and number and type of adjusting maneuvers. The patients were questioned postoperatively regarding symptoms of a sore throat, hoarseness, dysphonia, or dysphagia in the postanesthesia care unit and again 24 and 72 hours postoperatively by a blinded observer.

The sample size was determined to be 42 patients, based on data from previous studies,13,14 for a 2-sided significance level of 5%, power of 80%, and range of the first attempt success rate of 75% to 96%. Anticipating that some cases might be excluded, we chose to study 50 patients.

RESULTS
Patients’ characteristics and are presented in Table 1. The FT-LMA was placed successfully in 49 patients at the first attempt. One patient was excluded from the study after 2 failed attempts to ventilate with the FT-LMA, and his trachea was intubated with a standard ETT using a GlideScope. All 49 patients were successfully intubated with the VivaSight-SL, (95% CI, 0.89–0.99) 47 patients at the first attempt (95% CI, 0.83–0.98) and 2 patients at the second attempt (95% CI, 0.004–0.13). The times to achieve an effective airway with the FT-LMA and VivaSight-SL, as well as the time required to obtain a laryngeal view with the VivaSight-SL, are described in Table 2.

After introducing the VivaSight-SL through the intubating channel of the FT-LMA, a grade 1 view was obtained in 18 patients, grade 2 in 18 patients, grade 3 in 4 patients and grade 4 in 9 patients. The number and type of adjusting maneuvers are described in Table 3.

Eight patients complained of sore throat after surgery in the postanesthesia care unit. Sore throat disappeared after 24 hours with the exception of 1 patient. In this patient, the sore throat disappeared after 3 days. Two patients complained of dysphonia which disappeared after 24 hours.

DISCUSSION
This study describes the successful use of the VivaSight-SL to intubate the trachea through the FT-LMA. The camera located on the VivaSight-SL’s

Table 1. Patients’ Demographic Data
| Age (y) | 57 ± 12 |
| Weight (kg) | 80.8 ± 15 |
| Height (cm) | 172 ± 7 |
| Body mass index | 27.4 ± 3 |
| Sex, M:F | 38/12 |
| ASA I:II | 6/44 |

Values are numbers or mean and SD.

Table 2. Insertion Times for FT-LMA and VivaSight-SL

| Time to insert the FT-LMA (s) | 15.4 ± 6 |
| Time to achieve laryngeal view with the VivaSight-SL (s) | 28.5 ± 5 |
| Time of successful intubation with the VivaSight-SL including visualization of the carina (s) | 45 ± 7 |

Values are numbers or mean and SD. FT-LMA = Fastrach Laryngeal Mask Airway; SL = Single Lumen.

Table 3. Adjusting Maneuvers

<table>
<thead>
<tr>
<th>Adjusting maneuver</th>
<th>Grade 2</th>
<th>Grade 3</th>
<th>Grade 4</th>
<th>Number of maneuvers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up-down maneuver</td>
<td>2</td>
<td>12</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>Side-to-side maneuver</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Hyperextension of the head</td>
<td>1</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>External manipulation of the larynx</td>
<td>4</td>
<td>4</td>
<td></td>
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SL = Single Lumen.
VivaSight Single Lumen tip allowed videoscopic visualization of the laryngeal structures and enabled adjustment of the FT-LMA position to align the VivaSight-SL with the glottic opening. The first attempt endotracheal intubation rate was 47 of 50 attempts (95% CI, 0.004–0.13), and ultimate success rate was 49 of 50 attempts (95% CI, 0.83–0.98).

To improve the first attempt success rate to intubate the trachea through the FT-LMA, various “under vision” techniques have been used such as fiberoptically assisted intubation and the recently withdrawn C-trach.8,13–15 Another technique used to facilitate endotracheal intubation through the FT-LMA is the lightwand.16 The main disadvantages of using a fiberoptic scope are its high purchase price and maintenance cost as well as its fragility. The VivaSight-SL is a single use device; however, its high cost is also a disadvantage.

We found a relatively low incidence (37%) of grade 1 laryngeal view. Despite the low incidence of initial proper alignment of the FT-LMA ventilation aperture with the glottic opening, a normal capnograph trace was obtained in most cases. In these cases, there is a potential risk of damaging the surrounding tissue, if intubation is performed blindly. This strengthens the importance of visual control of the anatomical structures during endotracheal intubation.

The preformed polyvinyl chloride VivaSight-SL is more rigid than the dedicated silicone tracheal tube designed by Dr. Brain to be used with the FT-LMA. Thus, it is more difficult to manipulate and causes a greater angle (67°) when emerging the ventilation aperture of the FT-LMA. By inserting the VivaSight-SL with the reversed curve technique, the emersion angle is approximately 20°, similar to the reusable dedicated silicone-tipped ETT, facilitating the insertion of the ETT into the glottis.12

Similar to other videoscopic techniques, one of the drawbacks is blurred visualization by secretions and/or blood and fogging. The irrigation channel of the VivaSight-SL helped overcome visualization problems caused by secretions.

The major limitation of this study is that only patients with normal airways have been studied and the effectiveness of this technique should also be investigated in patients with difficult airways. Despite these disadvantages, the high first-attempt intubation success rate and the potential to avoid tissue trauma by blind intubation make this technique an attractive and promising concept.

**Figure 5.** Scoring of the laryngeal view: grade 1: full view of the arytenoids and glottis; grade 2: epiglottis, arytenoids, or glottic opening are partly visible, the structure of cords is difficult to see; grade 3: dark areas indicating an open space; grade 4: no part of the larynx can be identified.

**Video 1.** Insertion of the VivaSight Single Lumen (SL) into the trachea through the Fastrach Laryngeal Mask Airway (FT-LMA) under visual control.
DISCLOSURES

Name: Luis A. Gaitini, MD.
Contribution: This author helped design and conduct the study, and prepare the manuscript.
Attestation: Luis A. Gaitini has approved the final manuscript, reviewed the original study data and data analysis.
Conflicts of Interest: Dr. Gaitini has received equipment support from VBM Medizintechnik, Mercury Medical and ET view Ltd.
Name: Boris Yanovski, MD.
Contribution: This author helped design and conduct the study, and prepare the manuscript.
Attestation: Boris Yanovski has approved the final manuscript, reviewed the original study data and data analysis.
Conflicts of Interest: None.
Name: Sonia J. Vaida, MD.
Contribution: This author helped design and prepare the manuscript.
Attestation: Sonia J. Vaida has approved the final manuscript, reviewed the original study data and data analysis.
Conflicts of Interest: None.
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