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Clinical Evaluation of a New Visualized Endotracheal Tube (VETT)

To the Editor:—Patients admitted to intensive care units (ICUs) often require prolonged ventilatory support.[1] Most patients airways are secured by cuffed endotracheal tubes (ETT), and two problems are typically encountered: tracheal tube placement and maintenance of correct ETT positioning, and timing and effectiveness of tracheobronchial suctioning.[2,3] A new visualized endotracheal tube (VETT) has been designed to provide fiberoptic control of ETT positioning and visual estimation of the amount of tracheobronchial secretions. In the following, we will present our experiences with the VETT system during the first clinical use in humans.

This study was approved by the Institutional Review Board (IRB) of the University of Vienna and the St. John of God Hospital in Vienna, Austria. According to Austrian guidelines and practice, sedated ICU patients were also included in the study and were informed about the study purpose after recovering from critical illness.

The VETT system (Pulmon$_x$ Palo Alto, CA; figs. 1 and 2) consists of a disposable PVC tube embedded with light and image transmitting fiberoptic bundles, a high volume, low pressure cuff, and a compact video monitoring system. Illumination fibers transmit light from a standard light source to the tip of the tube, and the image transmitting bundle equipped with a lens carries the image to a video monitoring system. An air flow lumen is integrated within the tube's wall, enabling rinsing the lens with normal saline in case of soiling with tracheal secretions. The system enables visualization of the airway during the intubation process and continuous observation of the lower airways. At present, VETTs are available in one size and for study purposes only (inner diameter, 7.0 mm; outer diameter, 10.4 mm). External diameter of VETT is 0.4 mm larger compared with conventional ETTs. Different sizes of the VETT will be available in 1998.

We first evaluated the VETT system in 20 patients undergoing anesthesia for elective surgery. VETT was found to be inserted easily and fiberoptic equipment worked satisfactory in all patients.

Thereafter, 40 consecutive ICU patients requiring prolonged ventilatory support were randomly assigned to either VETT group (n = 20) or conventional ETT group (n = 20). No differences concerning patients age, height, weight, and duration of intubation were observed between the groups. The VETT system provided adequate illumination and enabled fiberoptic visualization of the airway during intubation. The VETTs were positioned in the trachea with their tips approximately 5 cm above the carina (distance estimated visually). In patients assigned to the conventional ETT group, chest radiographs were performed after intubation to evaluate ETT position. Although all VETTs were placed correctly, tube malpositioning (*e.g.*, ETT at the carina or down a main stem bronchus) was observed in two patients assigned to the conventional ETT group.

Tracheal suctioning was performed in the VETT group when excessive amounts of secretions were observed in trachea and main stem bronchi. In the standard ETT group, need for "blind" suctioning was assessed indirectly by auscultation, observation of expiratory flow tracings, and changes in airway pressures or tidal ventilation. According to these criteria, patients in the VETT group were suctioned significantly less often than conventional ETT patients (4.7 ± 2.3 *vs.* 6.3 ± 2.5 suctionings/day, $P < 0.05$; Student's t test). Visual assessment of the amount of tracheal secretions and selective suctioning of the right and left lung were possible. In all but one patient, VETT provided a clear view of the trachea until extubation, which was performed after a mean of 137 ± 44 h. Rinsing of the lens was necessary at an average of 4 ± 2 times/24 h. In one patient, fiberoptic vision through the VETT deteriorated and could not be improved despite repeated lens rinsing. Poor vision was caused by dried secretions covering the lens, which was confirmed after-tube removal.

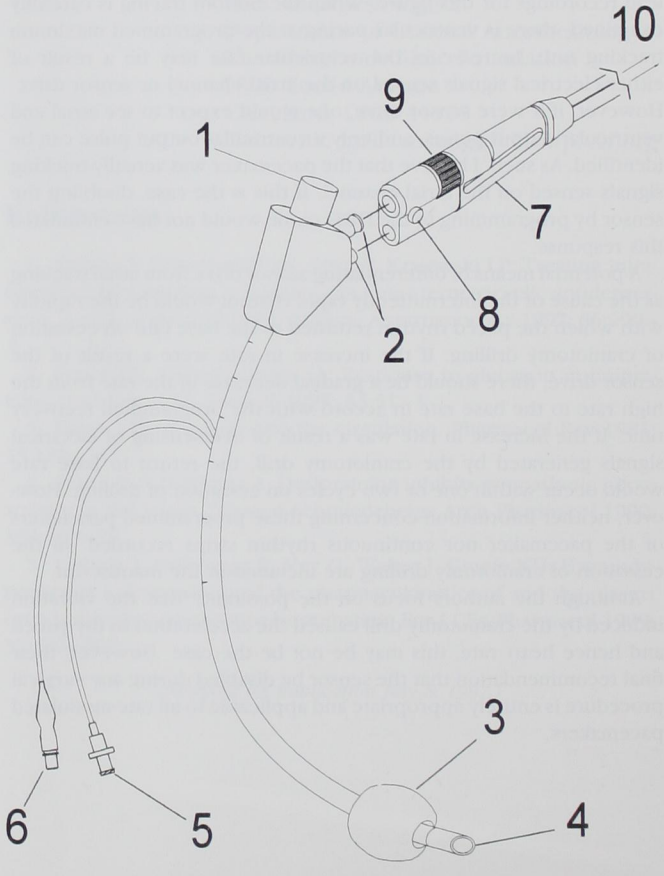

Fig. 1. Visualized endotracheal tube with unibody video handpiece. (1) Ventilator connector, (2) Image/light connection, (3) High volume/low pressure cuff, (4) Distal end, (5) Air flow connector, (6) Cuff inflation port with pilot balloon, (7) Handpiece, (8) Push button lock/release, (9) Focusing ring, (10) To video system.

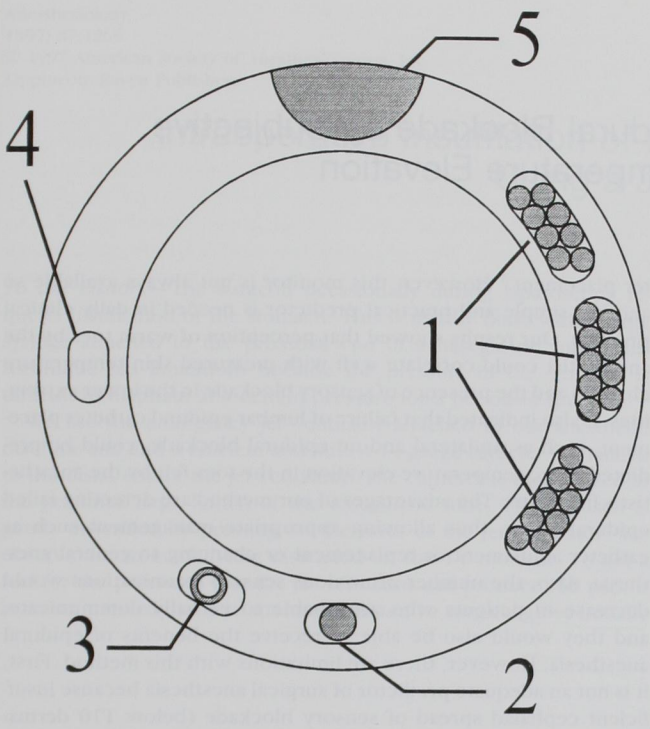

Fig. 2. Cross-section VETT. (1) Illumination fibers, (2) Image fiber, (3) Air flow lumen, (4) Inflation lumen, (5) Radiopaque stripe.

The VETT system enables visualization of laryngeal structures and trachea during the entire intubation procedure, thereby probably facilitating tracheal intubation. The tube can be directed through the glottic opening even when direct laryngeal exposure using a laryngoscope blade is inadequate. Another advantage of the VETT system is the prompt recognition and confirmation of tracheal placement of the tube. Esophageal malpositioning of the tube can be corrected immediately before inflation of air into the gastrointestinal tract. A third benefit of VETT in mechanically ventilated patients is online information about tube insertion depth and the relation of VETT tip to the carina without the need for chest radiography.

In VETT patients, the amount of tracheobronchial secretions was monitored online, and when excessive, secretions were suctioned and cleared. Selective suctioning of the right or left lung was possible in all but one patient. Quality of suctioning might be improved and number of suctionings reduced. Because every suction maneuver bears a certain risk of injury to the tracheal mucosa, any reduction in the frequency of tracheal suctioning and the elimination of regularly scheduled suctioning procedures might result in a lower risk for tracheal injury, hypoxemia, or atelectasis formation.[2-5] However, we cannot exclude a failure to suction VETT patients despite retained secretions simply because secretions have not be visualized fiberoptically.

In summary, VETT provides an adequate fiberoptic view of the trachea and main stem bronchi. VETT may facilitate the verification of tracheal tube placement or positioning and might help in defining the need for tracheal suctioning. Further studies are warranted to establish the advantages and especially the cost-effectiveness of the VETT system in the fields of anesthesia and intensive care medicine.

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Drs. Frass and Ovassapian serve on the medical advisory board of Pulmon$_x$.

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