The Video-Intubating Laryngoscope

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Citation

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Abstract

A Macintosh intubating laryngoscope has been modified with a guide bore hole, leading from the bottom of the handle through the lateral flange of the blade to the blade tip. An ultrathin video-endoscope is inserted in the bore hole. It transmits the view from the distal blade tip directly onto a video-display and also provides airway illumination. Oxygen flowing at the tip of the video-endoscope protects the lens against fogging up and secretions and allows apnoic oxygenation during intubation.

The device can be used for routine direct laryngoscopy in the usual manner. Video-transmission of the view from the distal blade tip allows demonstration, teaching and monitoring tracheal intubation.

The video-view around the curvature of the blade provides a better visualisation of the cords than obtained by direct vision. Thus, the video-intubating laryngoscope is potentially helpful during difficult direct laryngoscopy to guide the endotracheal tube into the larynx using the video-view. Because the device can be used for both, routine as well difficult tracheal intubation, it may be a helpful tool to manage unanticipated difficult laryngoscopy.

INTRODUCTION

Difficulties with tracheal intubation are mostly caused by difficult direct laryngoscopy with impaired view to the vocal cords. ([1]) Unfortunately, despite of all the informations currently available, no single factor reliably predicts these difficulties. ([2,3]) Consequently, many difficult intubations will not be recognized until after induction of anesthesia. Unanticipated difficult intubation can lead to critical situations, especially in those patients who are at risk for gastric regurgitation, who are difficult to ventilate by mask or who have limited cardio-pulmonary reserves.

Many endoscopic intubation laryngoscopes such as the Bullard laryngoscope, the Upsher laryngoscope or the Wuscope have been designed to visualize the vocal cords "around the corner" looking through a proximal viewfinder. ([4,5,6]) Although they're useful devices, there're not suitable for direct laryngoscopy and therefore, they're not used for routine tracheal intubation.

I present a new device, the video-intubating laryngoscope (VIL), primarily designed for monitoring routine tracheal intubation, but also potentially useful to manage difficult laryngoscopy.

TECHNICAL DESCRIPTION

THE LARYNGOSCOPE

A plastic Macintosh laryngoscope has been modified with a guide bore hole for insertion of an endoscopic image and light transmitting system. The bore hole (inner diameter 3.0 mm) leads from the bottom of the handle through the handle and the flange of the blade and ends 30 mm before the blade tip. The laryngoscope itself contains no batteries, no light source and no additional light transmitting elements. The laryngoscope is thought to be disposable but it can be cleaned or desinfected with standard solutions (Fig. 1/2).

Figure 1

Fig. 1: Disposable standard Macintosh laryngoscope with bore hole

Figure 2

Fig. 2: Disposable angulated Macintosh laryngoscope with bore hole

THE VIDEO-ENDOSCOPE

A flexible, ultrathin, 2 meter long video-endoscope (Manufacturer : Volpi AG, Schlieren, Switzerland) has been designed for insertion into the guide bore hole of the plastic laryngoscope (Fig. 3/4). The video-endoscope (outer diameter 2.8 mm) carries optic fibres (10'000 pixels) for image transmission and light fibres for airway illumination. The distal lens of the video-endoscope has a 70° forward field view and a fixed focus of 40 mm. An integrated channel (internal diameter 0.7 mm) allows oxygen flowing at the lens. The video-endoscope is connected with the proximal plug to a video-monitor system and to an oxygen source.

The scope can be cleaned with standard desinfectants (excepted : acetone / formalin) or can

be sterilized with ethylene oxide or Steris (hydroxyperoxid liquid chemical sterilisation).

Figure 3

Fig. 3: Ultrathing video-endoscope carring image and light transmitting fibers and an oxygen channel

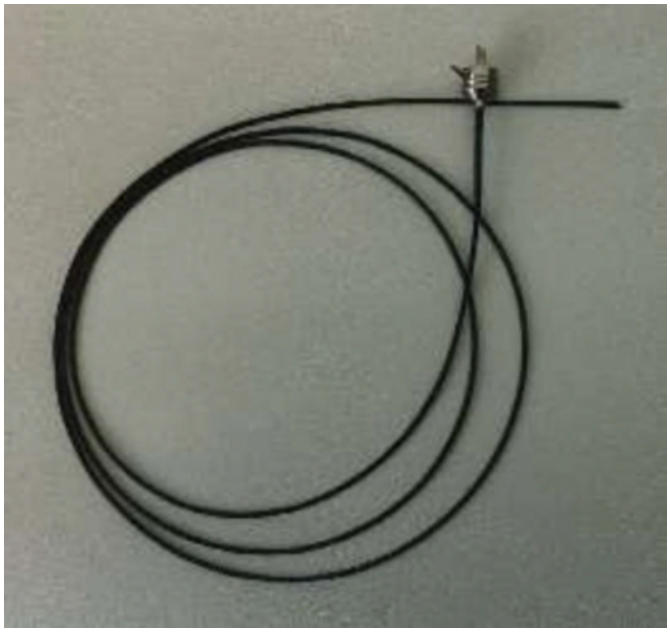


Figure 4

Fig. 4: Cross section through a plastic laryngoscope with inserted video-endoscope

THE ASSEMBLED DEVICE

The ultrathin video-endoscope is inserted into the guide bore hole of the laryngoscope. The video-endoscope is locked in the laryngoscope by just fitting in the laryngoscope's bore hole, avoiding rotational and longitudinal displacement.

The position and axis of the video-endoscope in the distal blade is designed so, that the video- display gives a view around the curvature (Fig. 5) respectively around the angulated tip (Fig. 4) of the blade. The transverse plane of the blade tip is seen at the upper board of the monitor screen. The video-endoscope leaves the bottom of the handle as a 1.7 meter long cable for connecting to the video-monitoring system.

Figure 5

Fig. 5: Assembled Macintosh video-intubating laryngoscope No 4

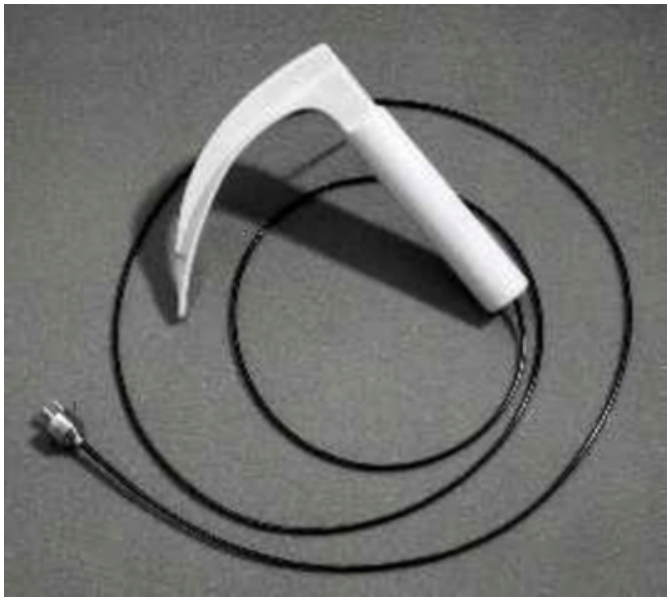


Figure 6

Fig. 6: Assembled angulated Macintosh video-intubating laryngoscope

USE OF THE VIDEO-INTUBATING LARYNGOSCOPE

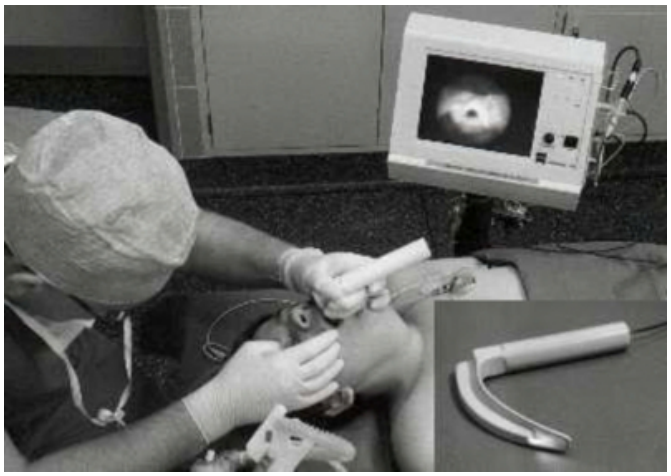
MONITORING TRACHEAL INTUBATION

Before starting anesthesia, the VIL is connected to the video

monitor system / oxygen source and is checked for proper function. Direct laryngoscopy is performed in the anesthetized patient and the trachea is intubated under direct vision as usual, the monitor view is not necessarily used. The video view transmitted from the distal blade can be used by the attending anesthetist to follow the intubation procedure and also to confirm final endotracheal tube (ETT) position between the vocal cords (Fig. 7).

Figure 7

Fig. 7: Monitoring tracheal intubation - the video-view from the distal blade tip allows to follow the conventional intubation procedure



GUIDING TRACHEAL INTUBATION

During difficult direct laryngoscopy, the video-view around the curvature of the blade is used to visualize the cords on the monitor screen (Fig. 8). Optionally the epiglottis can be picked up as with a straight intubation blade. The endotracheal tube with a protruding stylet or bougie is placed into the oropharynx as far as possible under direct vision. Then, the ETT is directed through the cords into the trachea using the video-view from the distal blade tip (Fig. 9). Finally, proper tube placement between the vocal cords is confirmed on the monitor screen (Fig. 10).

Figure 8

Fig. 8: The vocal cords are visualized using the video-view from the distal, angulated blade tip

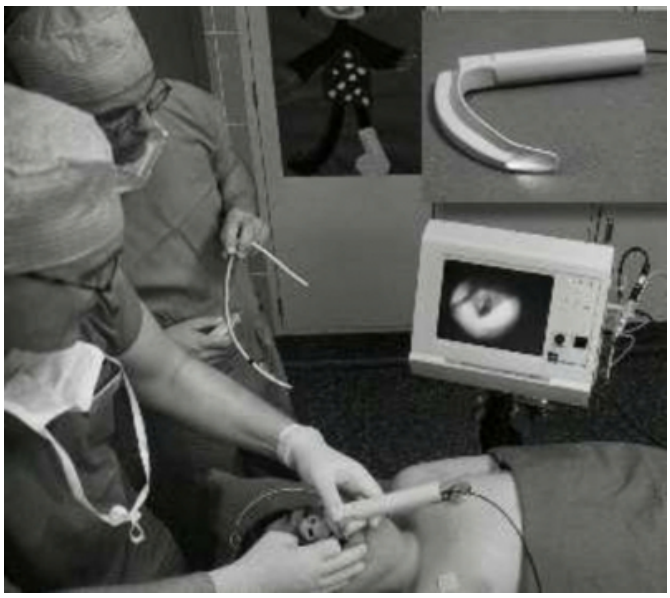
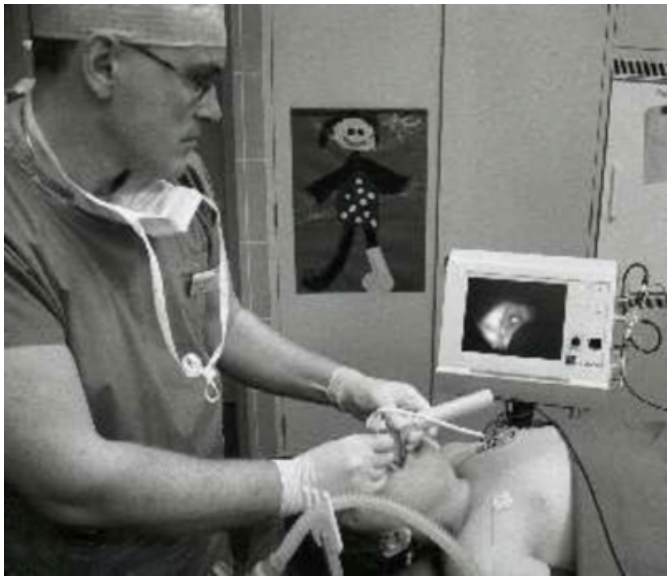


Figure 9

Fig. 9: The ETT respectively the stylet is directed through the cords using the video-view

Figure 10

Fig. 10: The ETT is confirmed and adjusted between the vocal cords (black mark) using the monitor view



DISCUSSION

Video-laryngoscopy with a flexible fiberscope passed through the nose or with a rigid telescope introduced through the mouth is a well known diagnostic technique in otolaryngology. ([7]) Aoyama reported the successful use of flexible transnasal video-laryngoscopy to guide an orally inserted curved ETT through the glottis under video-control. ([8])

The VIL combines video-laryngoscopy, an indirect laryngoscopic visualisation technique with conventional direct laryngoscopy. Therefore, the device can be used for routine tracheal intubation and may be helpful in case of difficult direct laryngoscopy with impaired view to the vocal cords.

During routine intubation, the VIL, remaining a regular laryngoscope, is handled in an identical manner as a standard laryngoscope (Fig. 7). First clinical applications showed that the light-weight fiberoptic transmitting cable does not interfere with stearing the laryngoscope. Integration of the ultrathin video-endoscope in the lateral flange allows conventional laryngoscopy without impaired direct vision to the cords. Airway illumination provided by the endoscope was jugded to be equal to that of a standard laryngoscope. The oxygen flow at the tip of the scope not only protected the lens against fogging up and secretions, but simultaneously allowed apnoic oxygenation during laryngoscopy. ([9]) Coordination of laryngeal manipulations by the second anesthetist using the video-laryngoscopic view was felt to be of special value.

As the presented video-intubating laryngoscope consists of a disposable plastic laryngoscope with a bore hole and a reusable video-endoscopic system, different sizes and types of such plastic laryngoscopes could be used with a single optic-system cost-effectively for routine tracheal intubation.

The fact that a second anesthetist could directly see all details of the intubation procedure, makes it an excellent tool for demonstration, teaching and monitoring conventional laryngoscopy. Video-recording enables documentation and review of the intubation sequence later on.

In situations where direct visualisation of the cords is impaired, the VIL allows to overcome the obstructed view to the larynx using conventional intubation technique and the video view around the curvature of the blade (Fig. 8).

Preliminary, limited experiences in patients with direct laryngoscopic view Grade II and III (classification by Cormack and Lehane) showed, that the video-display from the distal blade gives an better view of the cords and the patients were intubated under monitor control without forced laryngoscopy or head-neck manipulations (Fig 9).

CONCLUSION

The presented video-intubating laryngoscope is a useful tool for documentation, teaching and monitoring tracheal intubation. Limited experiences using the device for difficult intubation management suggest that the video-intubating laryngoscope can become a helpful aid during difficult direct laryngoscopy.

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