Video-intuboscopy: a new aid to routine and difficult tracheal intubation

M. Weiss

Summary
Video-intuboscopy gives a video display of the view from the tip of the tracheal tube during conventional laryngoscopy, and was developed particularly to assist the immediate management of unexpected difficult intubation. A lightweight, malleable video-optical intubation stylet transmits the view from the stylet tip onto a monitor. It is inserted in the tracheal tube before starting anaesthesia, and the view from the tracheal tube tip enables the anaesthetist to verify tracheal tube position in the trachea. During difficult intubation the video view is used to guide the tracheal tube into the trachea. When used to allow confirmation of tracheal placement, the system did not interfere with conventional intubation procedures. The method showed the subglottic airway, gave immediate confirmation of tracheal tube position, and aided teaching and supervision. The method was used to guide intubation in two patients with unanticipated grade 3 laryngoscopic views. Intubation was simple, rapid and atraumatic, without the need for head, neck or laryngeal manipulation. Tracheal placement was instantly confirmed using the video view from the stylet tip. Clinical studies are required to define the value of this new intubation technique. (Br. J. Anaesth. 1998; 80: 525–527)

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Difficult tracheal intubation is an important cause of morbidity and mortality in anaesthesia. Unexpected difficult intubation is a major cause of anaesthetic misadventure. The most common factor preventing successful tracheal intubation is the inability to see the vocal cords during direct laryngoscopy. To overcome the obstructed view to the glottic opening, many devices are designed to look “around the corner”, such as mirror and prism laryngoscopes, fibrebronchoscopes, optical intubating stylets and optical intubating laryngoscopes.

I describe a new intubation technique, intended primarily as a technique to confirm tracheal intubation, which allows immediate and safe management of unexpectedly difficult direct laryngoscopy. The principle of this new approach is tracheal tube guidance by viewing the vocal cords using the video view from the tracheal tube tip. Therefore, I designed a malleable video-optical intubation guiding stylet, to transmit the video view from the stylet tip directly to a video monitor. This enables the anaesthetist to guide the tracheal tube between the vocal cords into the trachea under video visual control.

Video display of the view from the tracheal tube tip during conventional laryngoscopy is termed “video-intuboscopy”.

Materials and methods

INSTRUMENTATION

The device (fig. 1 (top)) consists of a thin, malleable, metallic-forming element and an ultra-thin fibreoptic element (Video-microbendoscope, Volpi AG, Schlieren, Switzerland), bound together by a plastic tube to form a lightweight intubation stylet. The proximal end of the stylet carries a connector that fits to the 15-mm tracheal tube adapter. The video-microbendoscope leaves the proximal stylet as a 2-m long transmitting cable, which is attached by the proximal plug to a compact video camera–light source unit (Intralux Video Compact, Volpi AG, Schlieren, Switzerland). The video-microbendoscope carries optic fibres for image transmission (10 000 pixels) from the stylet tip to the video camera unit and additional light fibres for airway illumination. It is re-usable and can be sterilized using ethylene oxide.

The video-optical stylet is inserted into a tracheal tube (fig. 1 (bottom)) and locked with the stylet connector to the tracheal tube adapter, preventing rotational and longitudinal displacement. The stylet tip slightly protrudes the tracheal tube tip. Using the internal forming element, the tracheal tube can be bent to the required shape.

TECHNIQUE

Standby mode (confirmation of tracheal intubation)

The stylet is inserted in the tracheal tube and checked for correct view and function before starting anaesthesia. After induction of anaesthesia with thiopental 5 mg kg\(^{-1}\) and neuromuscular block with pancuronium 0.1 mg kg\(^{-1}\), anaesthesia is maintained with 2% sevoflurane and 65% nitrous oxide in oxygen by mask ventilation. Conventional direct laryngoscopy is performed and the trachea is intubated under direct vision as usual. After the tracheal tube tip has passed the vocal cords, the laryngoscopist uses the
video display to confirm tracheal tube position and adjust the tracheal tube as required using the video view transmitted from the stylet tip. The video-optical stylet is then removed from the tracheal tube.

**Intubation mode (guided tracheal intubation)**

If a view of the vocal cords cannot be obtained during tracheal intubation, the best possible direct laryngoscopic view is maintained with the laryngoscope blade in one hand. The tracheal tube loaded with the video-optical intubation stylet is introduced into the oropharynx with the other hand. The anaesthetist then uses the video view from the tracheal tube tip to guide the pre-formed tracheal tube between the vocal cords and into the trachea, and confirm the correct position, before the stylet is removed.

**FIRST EXPERIENCES**

**Standby mode (confirmation of tracheal intubation)**

Six operators used the video-optical intubation stylet in 30 patients undergoing elective surgery, and reported no disadvantages. The low weight, malleable nature and thin, flexible, transmitting cable to the video camera–light source unit allowed the video-optical intubation stylet to be used in the same way as a conventional intubation stylet. Removal of the video-optical intubation stylet was uneventful and any time delay from stylet removal was no longer than that with conventional gum elastic bougies or intubation styles.

**Intubating mode (guided tracheal intubation)**

Intubation was guided in two patients with unexpected difficult laryngoscopy (grade 3 view). In the first patient the video-optical intubation stylet was already loaded in the tracheal tube (standby mode) so that the anaesthetist had only to change his view to the video-display and tracheal intubation was carried out under video visual control within another 15 s. In the second patient, after initial direct laryngoscopy without intubation attempts, mask ventilation was performed for a short period to prepare the tracheal tube with the video-optical stylet. The patient was then intubated within 30 s with another conventional laryngoscopy and using the video-view from the tracheal tube tip.

In both patients intubation was performed successfully at the first attempt, in a rapid and safe manner, each by a different anaesthetist with no previous experience of this method. There was no need for head, neck or laryngeal manipulation, or help from an assistant.

**Discussion**

**REVIEW**

Video-intuboscopy is a new indirect laryngoscopic intubation technique and combines the three following elements: (1) intuboscopy (transmission of the view from the tracheal tube tip to a proximal viewfinder), (2) conventional laryngoscopy and (3) video-endoscopy.

**Intuboscopy**

Intuboscopic-guided intubation was first described by Murphy in 1967. He used a fibreoptic choledoscope in a nasally passed tracheal tube. Both tracheal tube and flexible endoscope were advanced together and steered into the trachea by twisting the proximal tracheal tube while watching through the viewfinder.

**Conventional laryngoscopy**

Conventional direct laryngoscopy combined with fibrebronchoscopic intubation in anaesthetized patients, performed by two anaesthetists, has been reported as a useful intubation technique, providing enough room in the pharynx for steering the endoscopic instrument to the vocal cords, particularly if the pharynx is obscured by copious secretions, blood or soft tissue swelling.

**Video-endoscopy**

Video-endoscopy implies that the anaesthetist does not have to look into an eyepiece, and facilitates endoscopic procedures. The video display aids dexterity and enables nearly simultaneous observation of the video monitor, patient and monitors in a comfortable and efficient position for intubation.

Video-endoscopy for tracheal intubation is used mainly for demonstrating and teaching direct laryngoscopy, fibrebronchoscopy or the Bullard intubation technique.
VIDEO-INTUBOSCOPY

Standby mode

The video-optical stylet provides a useful means of monitoring tracheal tube position, and teaching and supervising tracheal intubation.

Airway monitoring. Airway imaging allows accidental oesophageal intubation to be detected and avoids endobronchial intubation during the intubation procedure. Furthermore, subglottic airway pathology such as laryngeal or tracheal tumours, stenosis, compression, webs or an aberrant tracheal bronchus could be detected during intubation, so that airway management may be modified appropriately. The costs for a compact video-intuboscopic imaging unit ($6000) are relatively low compared with median payments for claims for respiratory adverse events ($200 000) and are in the range of other anaesthetic monitoring equipment. Further development of the device to provide a disposable guide and covering element, containing the reusable fibreoptic part, would allow it to be used as a cost effective device.

Teaching direct laryngoscopy is usually limited because the instructor cannot see the view of the laryngoscopist during the procedure. Headframe-mounted video camera systems and video transmission from the laryngoscope blade have been developed for video visualization direct laryngoscopy. Video-intuboscopic in the “standby mode” is another means of allowing demonstration, teaching and supervising of intubation using the video view from the tracheal tube tip.

Intubating mode

Limited experience (in two patients with grade 3 laryngoscopy) indicated that video-intuboscopic-guided tracheal intubation can allow simple, rapid, safe and gentle intubation. Looking at a video-display in critical circumstances is much more comfortable than looking into a viewfinder of an endoscopic device, because the operator remains in the usual intubation position and can change the view from the oropharynx to monitor and vice versa. Teaching and supervising is facilitated with the video monitor.

Most anaesthetists are skilled in conventional laryngoscopy and in steering an intubation guiding stylet. Video-intuboscopic-guided tracheal intubation is almost the same procedure, except that the tracheal tube is guided by the video view from the stylet tip. This makes the video-optical intubation stylet an easy device to handle.

If the device is being used to confirm intubation, when a patient is encountered with unpredicted difficult intubation, the method can be changed promptly to aid intubation. There is no delay in preparing intubation equipment, no need to interrupt the intubation procedure and no need for additional help.

The method may be beneficial in patients with cardiovascular diseases, dental disorders and in patients with cervical spine pathology. However, these possibilities need to be confirmed by further investigations. Difficult tracheal intubation complicated by oopharyngeal secretions, swelling and bleeding, in which fibrebronchoscopic intubation may fail, could be managed by simultaneous direct laryngoscopy and video-intuboscopic-guided intubation, as has been done with fibrebronchoscopes. Lifting the tongue with the blade enables suction with large bore catheters and provides enough pharyngeal room for direction of the tracheal tube into the glottic opening.

Training in video-intuboscopic-guided intubation may be obtained by simulating difficult intubation. This would allow initial direct laryngoscopy and video-guided tracheal intubation while lowering the laryngoscope blade so that the epiglottis descends and conceals the cords. In this way, training in video-intuboscopic-guided intubation can be done without jeopardizing patient safety and without loss of experience in direct laryngoscopic intubation.

Clinical studies are required to confirm simplicity and efficacy, to define the further role and to explore other applications of this new intubation technique.