

Lightwand intubation using the Trachlight™: a brief review of current knowledge

[Intubation avec le stylet lumineux Trachlight™ : un aperçu des connaissances actuelles]

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Purpose: About 1% to 3% of laryngoscopic intubations can be difficult or impossible. Light-guided intubation has been proven to be an effective, safe, and simple technique. This article reviews current knowledge about the newer version lightwand: the Trachlight™ (TL).

Source: To determine its clinical utility and limitations, we reviewed the current literature (book and journal articles) on the TL since its introduction in 1995.

Principal findings: TL has been shown to be useful both in oral and nasal intubation for patients with difficult airways. It may also be useful in "emergency" situations or when direct laryngoscopy or fiberoptic endoscopy is not effective, such as with patients who have copious secretions or blood in the oropharynx. TL can also be used for tracheal intubation in conjunction with other devices (laryngeal mask airway -LMA-, intubating LMA, direct laryngoscopy). However, TL should be avoided in patients with tumours, infections, trauma or foreign bodies in the upper airway.

Conclusions: Based on the clinical reports available, the TL has proven to be a useful option for tracheal intubation. In addition, the device can also be used together with other intubating devices, such as the intubating LMA and the laryngoscope, to improve intubating success rates. A clear understanding of the principle of transillumination of the TL, and an appreciation of its indications, contraindications, and limitations, will improve the effectiveness of the device as well as reducing the likelihood of complications. Finally, regular practice with the TL with routine surgical patients requiring tracheal intubation will further improve intubation success rates.

Objectif : La fréquence d'intubation difficile ou impossible varie de 1% à 3%. L'intubation trachéale avec le Trachlight™ (TL) représente une technique efficace, sûre et simple.

Dans cet article nous voulons réviser les connaissances actuelles sur le stylet lumineux TL.

Méthode : Pour déterminer les applications et les limitations du TL, nous avons révisé la littérature (livres ou revues) sur le TL à partir de son introduction en 1995.

Resultats : Le TL permet une intubation oro- ou naso-trachéale dans différentes situations d'intubation difficile. Cette technique d'intubation avec le TL peut également être utile dans des situations d'urgence ou quand l'intubation trachéale avec le bronchoscope n'est pas indiquée, comme chez les patients qui présentent des sécrétions abondantes ou du sang dans l'oropharynx.

Le TL peut également être utilisé pour l'intubation trachéale en même temps que d'autres dispositifs (masque laryngé, masque laryngé pour intubation, laryngoscopie directe). Cependant l'usage du TL devrait être évité chez les patients présentant une tumeur, une infection, un traumatisme ou un corps étranger dans les voies aériennes.

Conclusion : Selon les rapports cliniques à notre disposition, nous pouvons affirmer que le TL représente une solution de remplacement utile à la laryngoscopie traditionnelle. Le TL peut également être utilisé avec d'autres dispositifs comme le masque laryngé et la laryngoscopie directe pour augmenter le taux de réussite de l'intubation trachéale.

En conclusion, la pratique régulière avec le TL et une connaissance de ses indications, contre-indications et limitations, peut améliorer l'efficacité du dispositif et réduire la probabilité de complications.

MODERN methods of tracheal intubation (TI) emerged in the 20th Century.¹ Direct laryngoscopy (DL) has become the standard method of TI. Unfortunately, intubation under direct vision may be difficult or impossible in 1% to 3% of the general surgical population^{2,3} and 0.05% to 3.5% of obstetric patients.^{1,4} This is especially true in patients requiring emergency

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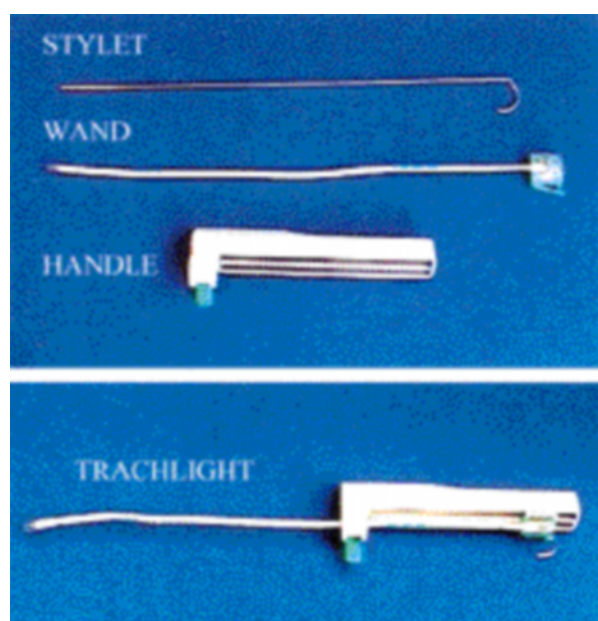


FIGURE 1 The Trachlight™ consists of three parts: a reusable handle, a flexible wand and a stiff, retractable stylet.

TI.¹ Furthermore, there is not a single method of airway assessment that can be used reliably to predict a difficult laryngoscopic intubation.^{4,5} Over the years, alternative intubation techniques have been developed.

Light-guided intubation using the principle of transillumination has proven to be an effective and simple technique. When the tip of the lightwand is placed inside the glottis, a bright light glow can be seen easily in the soft tissue of the anterior neck. In contrast, if the lightwand is placed in the esophagus, no transillumination can be observed.¹ In a study with 479 patients using a novel lightwand device (Trachlight™-TL-, Laerdal Medical Corporation, New York, USA), Hung *et al.* reported only a 1% failure rate with a 92% success rate after the first attempt.⁴

Developments leading to the TL

Several versions of the lightwand have been introduced for TI since its introduction in 1959.^{1,3-6} However, their designs had several limitations: 1) a poor light source; 2) a short lightwand which restricted its use to only short or cut endotracheal tubes (ETT); 3) the absence of a clamp or connector to secure the ETT onto the lightwand device; 4) the rigidity of the lightwand which hampered use of these devices for nasotracheal intubation (NTI); 5) most lightwands were designed for single use, increasing the cost of intubation. Due to these shortcomings, the TL was developed



FIGURE 2 Correct “hockey stick” configuration of the Trachlight™ together with the endotracheal tube prior to intubation.

and became available in 1995.

Description of the TL

The TL (Figure 1) consists of a handle, a wand and a stylet. On the handle, a locking clamp accepts and secures a standard ETT connector. The distal end of the wand has a bright lightbulb. On the proximal end of the wand is a plastic connector with a release arm which allows its connection to the grooves in the handle. To accommodate ETT of different lengths, the length of the wand can be adjusted by sliding the connector along the handle. Enclosed within the wand is a stiff, retractable stylet which allows the wand to be shaped in a “hockey stick” configuration (Figure 2). Following retraction of the stylet, the wand becomes pliable, thus allowing the ETT to advance easily into the trachea with minimal trauma.

The advantages of the TL when compared to the older lightwands are summarized in Table I.

Intubation technique with the TL

Preparation

Lubrication of the internal stylet ensures its easy retraction during intubation. With the stylet in place, the wand is attached to the handle. The length of the wand is adjusted by sliding it along the handle, placing the lightbulb close to, but not protruding beyond, the tip of the ETT. The correct position of the light-

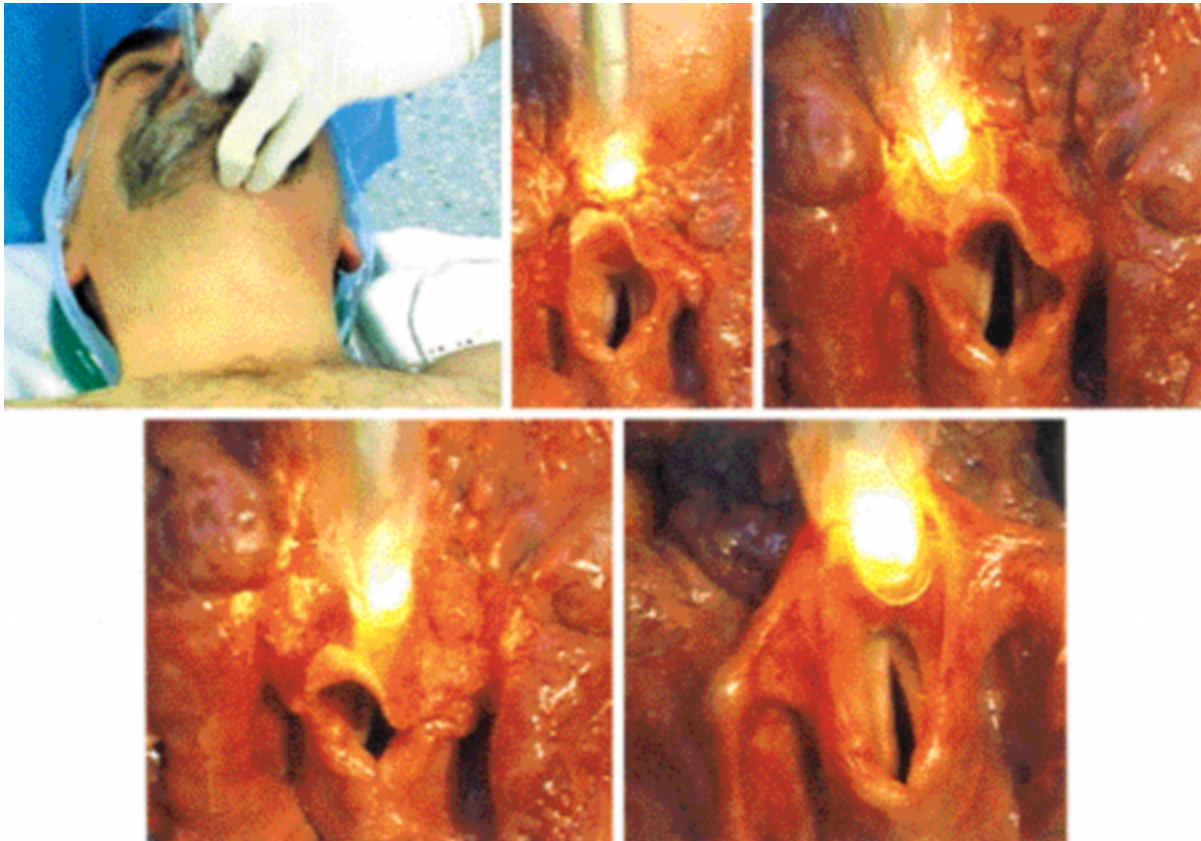


FIGURE 3 Absence of the transillumination: Trachlight™ tip is in the glosso-epiglottic or epiglottic fold.

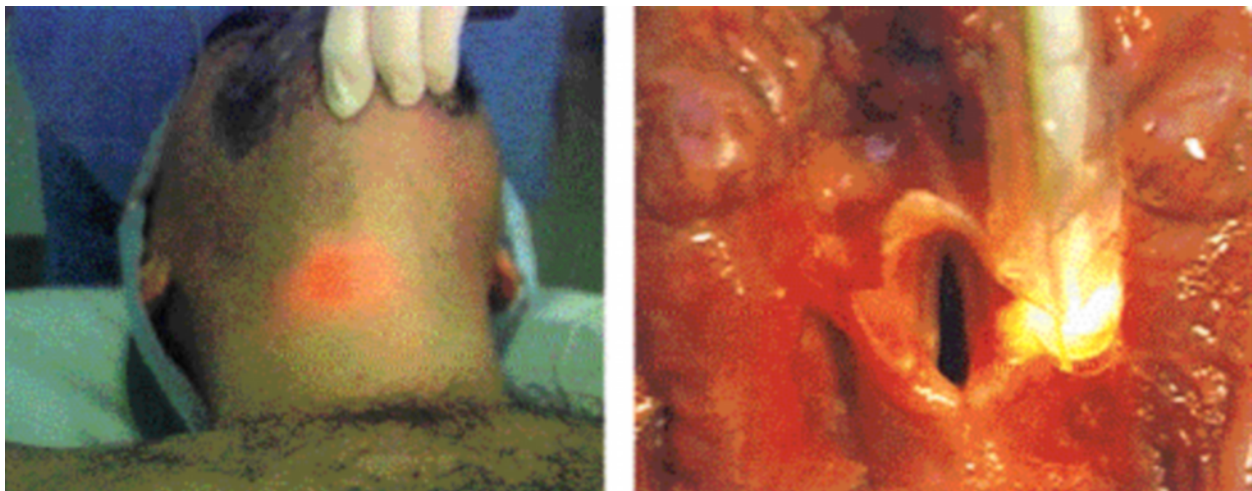


FIGURE 4 Lateral transillumination: Trachlight™ tip is in one of the two piriform recesses.



FIGURE 5 A central, clear and bright transillumination on the cricothyroid membrane suggests a correct positioning of the Trachlight™ tip into the laryngeal inlet: it is now safe to intubate the trachea.



FIGURE 6 The Trachlight™ used together with the LMA and the intubating LMA (Fastrach™).



FIGURE 7 The Trachlight™ used together with direct laryngoscopy.



FIGURE 8 The Trachlight™ used as an aid to the retrograde intubating technique.

bulb relative to the tip of the ETT is easily obtained by matching the centimetre markings of the wand with those of the ETT. The ETT-TL unit should then be bent at a 90° angle just proximal to the tube cuff in the “hockey stick” configuration. When the tip of the ETT is in the glottic opening, a right-angle bend allows the maximum light intensity to point to the surface of the skin.

Positioning

In a sniffing position, the epiglottis is almost in contact with the posterior pharyngeal wall, making it difficult for the TL to pass underneath the epiglottis. Therefore, we recommend that the patient’s head and neck be placed in a neutral or relatively extended position.⁷ Furthermore, neck extension allows maximal exposure of the anterior neck, thus enhancing visualization of the transilluminated light.¹ In our experience, in obese patients or in patients with an extremely short neck, placing a pillow under the shoulders and neck will further improve the ease of lightwand intubation. In patients with a potential cervical spine instability, the extended neck position is contraindicated. In these cases, the epiglottis can be lifted off the posterior pharyngeal wall with a simple jaw lift manoeuvre. The correct positioning of the lightwand is confirmed by the transillumination of the soft tissues of the anterior neck.⁸

Control of the ambient light

The light emitted by the TL is extremely bright, enhancing the transillumination of the neck. This is particularly true in thin patients, in which the light is so bright that it is possible to mistakenly interpret an esophageal intubation as an intratracheal placement. Therefore, all TL intubations should be performed

under ambient light. Room lights should be dimmed only when transillumination of the neck is inadequate.¹

Oral intubation

With the patient lying supine, the jaw is lifted upward to elevate the epiglottis. Inserting the TL from the midline position can be problematic in patients with a thick chest or large breasts. It is, therefore, recommended that the TL be introduced from the lateral corner of the mouth and repositioned in the midline following its entry into the oropharynx. With the light turned on, a 90° rotation toward the anesthesiologist is performed in order to direct the ETT-TL tip into the glottic opening. The midline position is maintained while the device is gently advanced in a rocking motion along an imaginary arc. The light-guided tracheal intubation is a gentle technique! The device should not be forced against any resistance.

A faint glow seen above the thyroid prominence indicates that the tip of the ETT-TL is located in the glosso-epiglottic or epiglottic fold (Figure 3). If the ETT-TL enters the esophagus, no glow can be detected. A bright glow observed in the lateral aspect of the larynx indicates that the tip of the ETT-TL is placed in the piriform fossa (Figure 4), a redirection of the ETT-TL to the midline is then required.

When the tip of the ETT-TL enters the glottic opening, a well-defined circumscribed glow can be seen in the anterior neck slightly below the thyroid prominence (Figure 5). Retracting the inner stylet approximately 10 cm makes the ETT-TL more pliable, which allows the advancement into the trachea with minimal trauma. The ETT-TL is then advanced until the glow disappears at the sternal notch. After release of the locking clamp, the TL can be removed from the ETT. The correct placement of the ETT should always

TABLE I Advantages of the Trachlight™ over the older versions of the lightwand

Ease of use (can be used with one hand only)
Brighter light source
Anterior and lateral projection of the light emitted
Intubation possible under ambient light
Less heat production (blinking of the lightbulb after 30 sec)
Ability to accommodate different lengths of endotracheal tubes
Ability to shape the device in a “hockey stick” configuration
Retraction of the stiff stylet facilitates advancement of the ETT
Allows both oral and nasal intubation

TABLE II Main clinical uses of the Trachlight™

Difficult or impossible direct laryngoscopic intubation in cases of:
Congenital abnormalities of upper airway (Treacher-Collins syndrome, Pierre-Robin syndrome, etc.)
Acquired abnormalities of upper airway (trauma, etc.)
Limited mandibular protrusion
Short mentohyoid distance
Short neck
High Mallampati grade
Secretions or blood in the oropharynx
Patients with fixed dental appliances

be confirmed with end-tidal CO₂ and auscultation.

Nasal intubation

The most difficult aspect of a blind NTI is to align the tip of the ETT with the glottis during intubation. Transillumination can assist NTI.^{2,9,10,11}

Removal of the stylet before insertion of the TL into the ETT makes the ETT-TL pliable. A water-soluble lubricant is applied to the nostril to facilitate the passage of the ETT-TL. After advancing the tip of the ETT-TL into the oropharynx, the light is switched on and NTI is performed using transillumination as described in the oral intubating technique.

A potential limitation of NTI with the TL (without the internal rigid stylet) may be related to the difficulty in controlling the ETT-TL unit. The following options have been proposed to avoid this problem:^{6,9,10} neck flexion during intubation; the use of a specialized ETT (Endotrol®, Mallinckrodt Inc, Pennsylvania, USA); inflation of the ETT cuff and the use of the rigid internal stylet. While these techniques may improve the light-guided NTI technique, its success still relies on the preparation of the patient and the skill of the operator.

Clinical applications

The TL may be a useful option in the case of a difficult or impossible laryngoscopic intubation for both

anticipated and unanticipated situations (Table II).

Successful use of the TL has been reported in patients with difficult airways.^{1,4,7,8} With DL, visualization of the glottis is generally difficult in patients who have a limited mandibular protrusion, a short mentohyoid distance, a large neck circumference, or a high Mallampati grade airway.^{1,2} All of these anatomic characteristics do not appear to influence the success of intubation with the TL.^{1,4}

The lightwand intubating technique is recommended as the first-line option in patients who can be ventilated but have had a failed laryngoscopic intubation (e.g., patients with Treacher-Collins,³ Pierre-Robin,^{3,13} or with copious secretions or blood in the oropharynx).^{3,6,14}

Intubation with the TL appears to be associated with minimal trauma. A low incidence of mucosal injury (ten out of 479 patients using the TL vs 37 out of 471 patients using laryngoscopy) has been reported.³ In addition, there was no evidence of dental trauma associated with TL intubation. Thus, intubation using the TL may be also advantageous for patients with fixed dental appliances.

Since brightness of the TL lightbulb allows intubation under ambient light, the TL is useful even in the pre-hospital environment.^{1-4,10}

Associated techniques

The TL can also be used together with other devices, such as the laryngeal mask airway (LMA),¹⁴⁻¹⁷ the intubating LMA (Fastrach™, Laryngeal Mask Company North America Inc., California, USA),^{1,8} DL,^{1,9} and a retrograde intubating technique⁵ (Figures 6, 7, 8).

Asai and Latto suggested that intubation with the TL via the LMA is simple and effective.^{1,5} Usefulness of the TL in this context is especially related to the ability to assess the position of the tip of the ETT during insertion by transillumination of the neck.

Due to the design of the intubating LMA which permits the use of a larger ETT than the “classic” LMA, the success rate of blind TI through this device is substantially improved when compared to the classic LMA. Transillumination using the TL can further improve the success rate of intubation^{1,8} with the intubating LMA.

Biehl and Bourke^{1,9} showed that the TL could improve the view in the hypopharynx, and transillumination could assist in guiding the ETT into the trachea with DL.

In 27 patients with cervical spine instability, it has been reported that the TL can facilitate retrograde intubation.⁵ TI was successful in all patients using these techniques in association.

TABLE III Limitations, difficulties and contraindications of the Trachlight™

<i>Limitations</i>	<i>Difficulties</i>	<i>Contraindications</i>	
		<i>Absolute</i>	<i>Relative</i>
No visualization of pharyngeal and laryngeal structures	Difficulties in controlling the tip of the device in case of accidental partial withdrawal of the stylet	Tumours of the upper airway	Obesity
Suboptimal transillumination in grossly obese patients or in patients with limited neck extension	Unintentional switching off of the light while withdrawing the metal stylet	Infections of the upper airway	Short neck
	Difficulties in withdrawing the metal stylet	Trauma of the upper airway	Limited neck extension
	Disturbing effects of the blinking light after 30 sec from switching on	Foreign body in the upper airway	Awake and/or uncooperative patient

Difficulties, limitations and contraindications

Lightwand intubation is not without potential hazards.^{1,2,4,18,20} The main complications, limitations and contraindications of the lightwand are summarized in Table III. Since TL intubation does not permit direct visualization of the anatomical structures, it should be avoided in patients with known abnormalities of the upper airway, such as tumours, polyps, infections (e.g., epiglottitis and retropharyngeal abscess), and trauma or presence of a foreign body in the upper airway.^{2,4} In these cases, other alternatives using direct vision should be considered. A light-guided technique should not be attempted in an uncooperative awake patient, unless a bite block is used to minimize injury to the patient, the operator, and damage to the device.¹ In addition, great caution should be used in patients when transillumination of the anterior neck may not be adequate (e.g., grossly obese patients or patients with limited neck extension).^{2,4} However, these contraindications and precautions may become irrelevant when airway compromise necessitates an emergency TL.

Possible difficulties while using the TL include: insufficient control over the tip of the ETT due to an improperly loaded internal stiff stylet (stylet partially retracts from the wand); unintentionally switching off the lightwand while withdrawing the retractable stylet; difficulties in withdrawing the stylet because no lubricant has been applied; and the distracting effect of the blinking light.¹

Conclusion

Occasional difficult laryngoscopic intubations have led to the development of many alternative intubation techniques. Neck transillumination using a lightwand has been shown to be effective for decades. A newly developed lightwand (Trachlight™) incorporates many

design modifications to facilitate both oral and nasal intubation. The device should be avoided in patients with tumours, infections, trauma or foreign bodies in the upper airways. Undoubtedly, successful TL intubation depends on the operator's experience and skill, as well the preparation of the patient and the device. As with any intubation technique, regular use of and practice with the lightwand will improve performance and may also reduce the likelihood of complications.

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