Effectiveness of Lightwand (Trachlight) Intubation by 1st Year Anesthesia Residents

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Abstract

Transillumination of the soft tissue of the neck using a lighted stylet (lightwand) is an effective and safe intubating technique in experienced hands. The goal of this study was to determine the effectiveness and safety of this device in intubating the trachea of elective surgical patients by non-experienced hands. One hundred and fifty, paralysed, anesthetized, adult patients (ASA I-II, no known or potential problems with intubation) were studied. Failure to intubate was defined as lack of successful intubation after three attempts. The duration of each attempt was recorded as the time from insertion of the device into the oropharynx to the time of its removal. The total time to intubation (TTI) was defined as the sum of the durations of all (as many as three) intubation attempts. Complications, such as mucosal bleeding, lacerations, dental injury and sore throat were recorded. The mean TTI was 42.0 ± 34.3 seconds. The overall intubation success rate was 92 per cent. Of all the successful intubations, 87.68 per cent were successful after one attempt. There were significantly fewer traumatic events (5.33%). Most of the trauma consisted of minor mucosal bleeding or mucosal laceration. We conclude that lightwand intubation is an effective and safe technique in non-experienced hands.

Key word : Lightwand (Trachlight), Intubation, Anesthesia Resident

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Tracheal intubation is traditionally performed by direct vision using a laryngoscope. The success of laryngoscopic intubation depends largely on the experience of the intubator and the patient's upper airway anatomy. Occasionally, even in the hands of experienced laryngoscopists, intubation by direct vision can be difficult or impossible. This difficulty with intubation has led to the development of alternative techniques. Transillumination of the soft tissue of the neck using a lighted stylet (lightwand) is one such technique[1-4]. Several lightwands are commercially available, but these instruments have limitations, primarily related to the brightness of the light source and the lightwand flexibility. The goal of this study was to determine the effectiveness of this device in intubating the trachea in elective surgical patients.

MATERIAL AND METHOD

After ethics committee approval and obtaining informed consent from the patients, 150 ASA physical status class I or II patients requiring intubation for elective surgery were enrolled in the study. Patients who had severe cardiorespiratory disease, patients with a history of previous difficult intubation, patients with tumors, polyps, foreign bodies in the upper airway, patients with a history of gastroesophageal reflux and patients with cervical spine fracture or cervical spine instability were excluded.

Fifteen 1st year anesthesia residents who had no experience of lightwand intubation before were eligible for this study. Our study included 2 phases. 1st phase : Theoretical and technical learning from a video presentation and demonstration of preparation and insertion techniques. The anesthesia residents (candidates) had enough time to practice lightwand intubation on manikins under supervision. At the end of the training program, candidates who passed a practical test were enrolled in this study. 2nd phase : The patient's trachea was intubated orally using the lightwand. All patients received morphine 0.1 $mg.kg^{-1}$ iv for premedication and were monitored with a noninvasive blood pressure monitor, ECG, $ETCO_2$ and pulse oximetry. Anesthesia was induced with 5 $mg.kg^{-1}$ thiopental iv followed by 0.1 $mg.kg^{-1}$ pancuronium iv for intubation. The patients were ventilated with 100 per cent oxygen *via* anesthetic face mask for 3 minutes and be relaxed enough. Intubations were performed with the patients' head and neck placed in a neutral position. Failure to intubate was defined as the inability to place the endotracheal tube into the trachea after three attempts. The laryngoscope was used to intubate the trachea after a failed intubation. The duration of each attempt was recorded as the time from inserting the device into the oropharynx to the time when the device was removed from the oral cavity. The total time to intubation (TTI) was defined as the sum of the duration of all intubation attempts (as many as three). Failed intubations were not included in the determination of the mean total TTI. After tracheal intubation, the oropharynx was examined for evidence of complications such as mucosal bleeding, lacerations and dental injury. Noninvasive blood pressure, heart rate and pulse oximetry were recorded at baseline, after premedication, induction, immediately intubation and every two minutes for the first 10 min following successful intubation. At the conclusion of surgery and anesthesia, extubation was carried out using routine extubation criteria. After extubation, the nurses in the postanesthesia care unit were instructed to ask the patients for complaints of dry throat, sore throat and hoarseness before discharge from the unit. All complications were recorded.

Table 1. Demographic data.

Patient	Mean	SD
Age (yr)	39.6	16.0
Weight (kg)	56.3	10.1
Height (cm)	160.2	8.7

Table 2. Total time to intubation (sec).

Resident	Mean	SD
1	58.0	49.4
2	51.4	44.7
3	31.6	20.1
4	51.4	35.3
5	37.9	40.1
6	35.9	20.0
7	44.0	38.8
8	53.7	45.4
9	56.6	44.3
10	31.8	21.4
11	43.4	27.6
12	34.2	25.5
13	28.9	11.7
14	45.2	42.9
15	26.1	16.7
Total	42.0	34.3

Statistical analysis

Continuous data are presented as mean ± standard deviation and categorical variables are presented as counts and percentages. The changes in mean arterial blood pressure, heart rate and oxygen saturation are presented as descriptive statistics.

RESULTS

One hundred and fifty patients were studied. Demographic data are shown in Table 1. The overall intubation success rate was 92 per cent. Intubation times are presented in Table 2. The mean TTI was 42.0 ± 34.3 seconds. Of all the successful intubations, 87.68 per cent were successful after one attempt with a further 8.70 per cent after two attempts and 3.62 per cent after three attempts. The mean TTI from the eighth to tenth attempts were found to be faster than the average TTI for seven previous attempts, and tracheal intubation for the tenth patient by each candidate was 100 per cent successful.

Most intubations were carried out successfully under ambient light. However, some patients who were either obese or had thick necks, required neck shading or a reduction in the ambient lighting from dimmed lighting to dark (all lights off) to improve visualization of the transillumination during the intubation.

The changes in mean arterial blood pressure, heart rate and oxygen saturation are shown in Fig. 1-3. Blood pressure and heart rate increased significantly after tracheal intubation compared with pre-intubation values. There was a low incidence of traumatic events (5.33%). Most of the trauma consisted of minor mucosal bleeding or mucosal laceration. There was no dental injury. During postoperative assessment of throat discomfort, 4 per cent of the patients also complained of a dry throat. Two patients had a mild sore throat.

DISCUSSION

Our data have shown that lightwand (Trachlight) is an effective and safe intubating device in non-experienced hands. Interestingly, in each of these patients the trachea was readily intubated by the Trachlight with one attempt with an average TTI of 37.84 seconds. There was no correlation between the

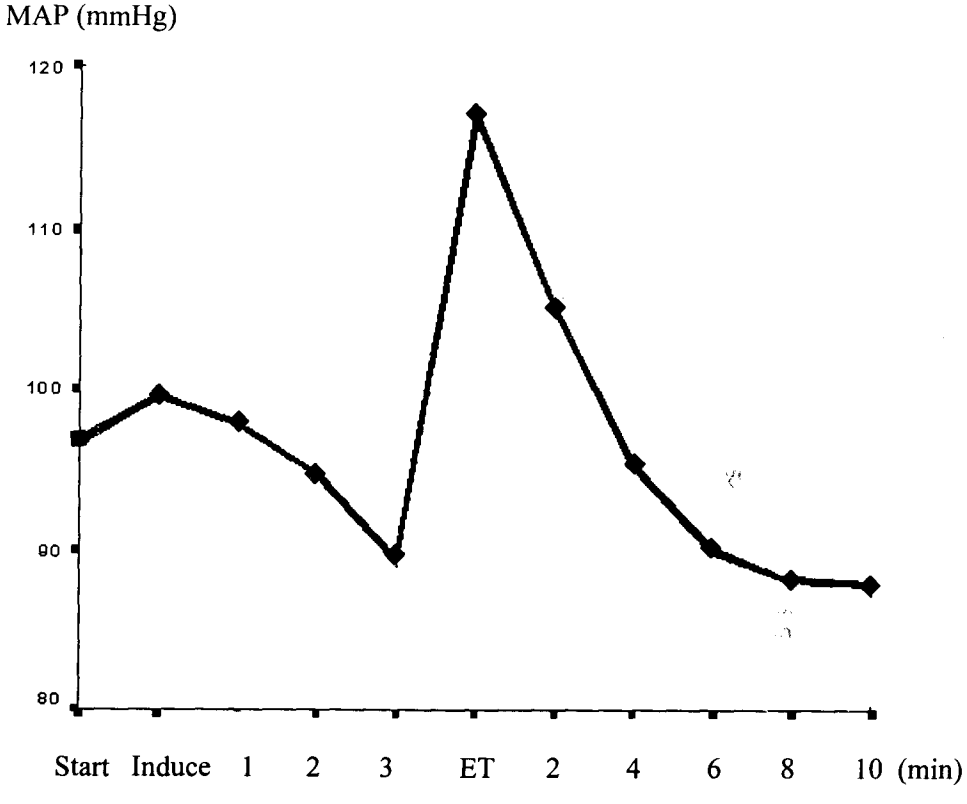

Fig. 1. Mean arterial pressure of patients before, during and after endotracheal intubation (ET) using the lightwand technique.

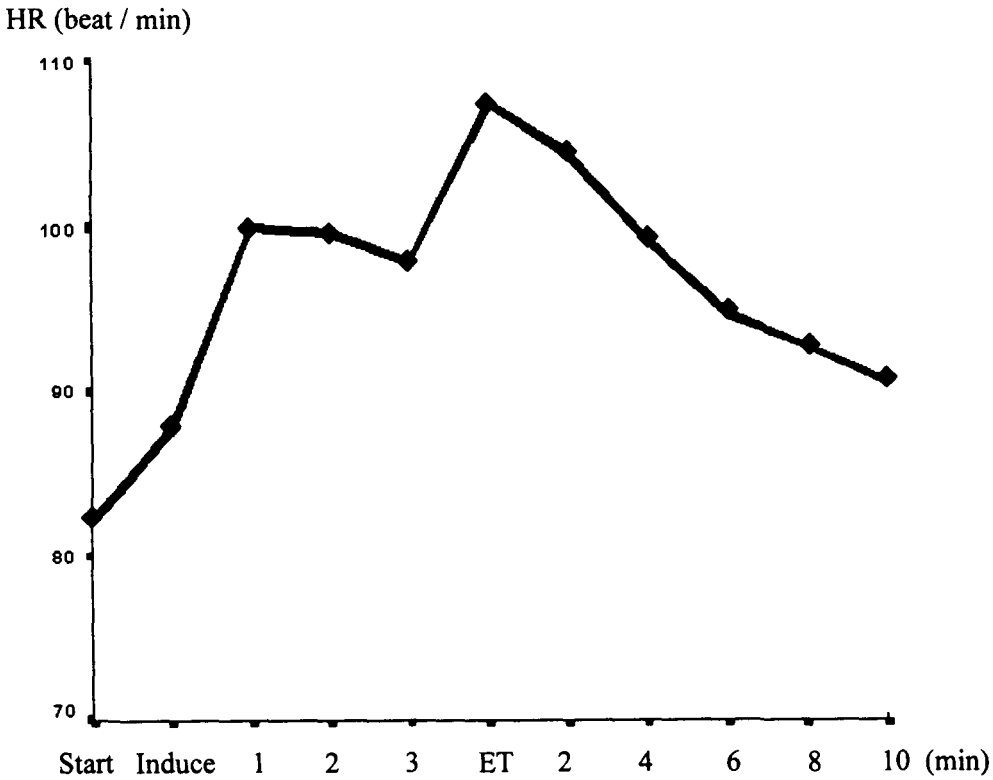

Fig. 2. Mean heart rate of patients before, during and after endotracheal intubation (ET) using the lightwand technique.

airway parameters and the time required to intubate using the Trachlight. In other words, intubation using the Trachlight was not influenced by anatomic variability in this population. This is consistent with the results of Ainsworth and Howell's study, which demonstrated no apparent correlation between a "difficult" laryngoscopic view and intubation success scores using a lighted stylet (Tubestat®)(5). Intuitively, it would be expected that it would take longer to intubate an obese patient with a thick neck because transillumination might be reduced. However, this problem may be overcome by using a brighter light source and diming the ambient light when necessary.

Successful intubation with earlier versions of the lighted stylet required a darkened environment for optimal transillumination. Ainsworth and Howells commented that "satisfactory conditions are met only when a darkened environment can be obtained and that transillumination in daylight may not be a reliable indicator of successful intubation"(5). The enhanced brightness of Trachlight has significantly improved the transillumination of the soft tissue of the neck compared with the earlier version of lightwands. In fact our data have shown that nearly 90 per cent of intubations using the Trachlight can be effectively performed under ambient light with or without shading of the neck. Hung and colleagues studied in 950 patients, comparing intubation by Trachlight and laryngoscope. There was a 1 per cent failure rate with the Trachlight and 92 per cent of intubations were successful at the first attempt, compared with a 3 per cent failure rate and 89 per cent success rate at the first attempt with the laryngoscope(2).

Intubation using the Trachlight is a light-guided technique without visualization of the laryngeal structures. There is a potential risk of trauma to the upper airway associated with its use. However, intubation using the Trachlight is a gentle technique. The tip of the tube is withdrawn and redirected when resistance is felt during the placement of the endotracheal tube. Furthermore, the atraumatic nature of the technique is demonstrated by the lower incidence of mucosal injury compared with laryngoscopy(2). Because of these potential benefits, intubation using the Trachlight may be advantageous in patients with fixed dental appliances.

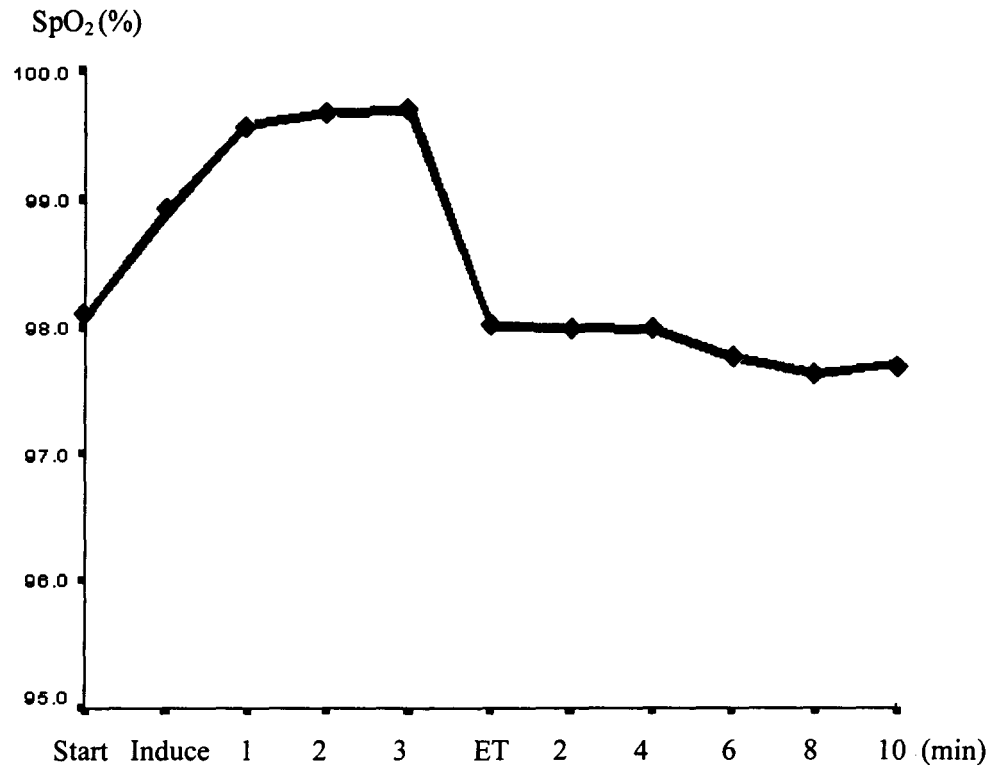

Fig. 3. Mean oxygen saturation of patients before, during and after endotracheal intubation (ET) using the lightwand technique.

Although intubation using the Trachlight has been shown to be safe, there are other risks. Stone and colleagues reported disconnection of the lightbulb from the lightwand (Flexilum®) and migration into a major bronchus(6). However, with improved technology, the light bulb of this newly designed lightwand is now firmly attached to the wand, significantly reducing the risk of disconnection. Although it is extremely rare, subluxation of the cricoarytenoid cartilage has also been reported in a study using an older version of a lighted stylet (Tubestat®)(7). However, the retractable stylet may reduce the risk of traumatizing the arytenoid cartilage during Trachlight intubation. In testing the device, we have intubated the tracheas of more than 150 patients, and we have not encountered a single patient with symptoms and signs suggestive of cricoarytenoid subluxation.

SUMMARY

We have demonstrated the lightwand (Trachlight) to be an effective and safe device when used by non-experienced personnel to intubate the tracheas of elective surgical patients. Effective use of the Trachlight to intubate the trachea requires adequate preparation of the patient (e.g., preoxygenation) and proper training as well as regular use of the Trachlight.

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ประสิทธิผลของ Lightwand (Trachlight) สำหรับการใส่ท่อหายใจโดยแพทย์ประจำบ้านวิสัญญีชั้นปีที่ 1

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การใส่ท่อหายใจด้วย lightwand อาศัยเทคนิคการดูแสงสว่างบริเวณคอเป็นวิธีที่มีประสิทธิภาพและปลอดภัยสูง การทำวิจัยนี้เป็นการศึกษาความสำเร็จของการใส่ท่อหายใจด้วย lightwand โดยแพทย์ประจำบ้านวิสัญญีชั้นปีที่ 1 จำนวน 15 คน ซึ่งไม่เคยมีประสบการณ์การใส่ท่อหายใจด้วยวิธีนี้มาก่อน ศึกษาในประชากร 150 คน อายุ 15-75 ปี, ASA class I หรือ II, งดน้ำและอาหารนานกว่า 6 ชั่วโมง ไม่มีประวัติใส่ท่อหายใจยาก, ไม่มีปัญหาของกระดูกคอและไม่ใช่ผู้ป่วยที่มีความเสี่ยงต่อการสำลักอาหาร, hyperreactive airway หรือมีการอักเสบ มีก้อนและหรือสิ่งแปลกปลอมบริเวณทางเดินหายใจส่วนบน การศึกษาแบ่งเป็น 2 ขั้นตอน : ขั้นตอนที่ 1 เรียนรู้เทคนิคจากผู้สอน และฝึกปฏิบัติกับหุ่นทดลองจนคล่องและชำนาญ ขั้นตอนที่ 2 ปฏิบัติกับ ผู้ป่วยจริง แพทย์ประจำบ้าน 1 คน ต่อผู้ป่วย 10 คน และบันทึกความดันเลือด ชีพจรและ SpO_2 ให้ morphine 0.1 มก/กก บริหารเข้าหลอดเลือดดำ นำสลบด้วย thiopental 5 มก/กก และ pancuronium 0.1 มก/กก ช่วยหายใจด้วย 100% O_2 จนครบ 3 นาที แล้วจึงใส่ท่อหายใจ บันทึกเวลา โดยถ้าไม่สามารถใส่ท่อหายใจได้ในจำนวน 3 ครั้ง หรือใช้เวลานานกว่า 3 นาทีถือว่าล้มเหลว บันทึกผลแทรกซ้อนขณะใส่และหลังใส่ท่อหายใจ ผลการศึกษาพบว่าความสำเร็จของการใส่ท่อหายใจสูงถึง 92% ใช้เวลาเฉลี่ยในการใส่ 42.0 $\pm$ 34.3 วินาที โดย 87.68% สามารถใส่ได้สำเร็จภายในครั้งเดียว พบภาวะแทรกซ้อนน้อยมาก (5.33%) ซึ่งส่วนใหญ่เป็นเพียงเยื่อบุภายในช่องปากฉีกขาดหรือเลือดออกเล็กน้อย สรุปจากการศึกษาพบว่าการใส่ท่อหายใจด้วย lightwand เป็นวิธีที่มีประสิทธิผลและความปลอดภัยสูง แม้ว่าผู้ใส่จะไม่เคยมีประสบการณ์การใส่ด้วยวิธีนี้มาก่อน

คำสำคัญ : ไลท์แวน, การใส่ท่อหายใจ, แพทย์ประจำบ้านวิสัญญีชั้นปีที่ 1

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