

Clinical Comparison of Lightwand-guided versus Conventional Endotracheal Intubation

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ABSTRACT— *Background: The lightwand technique has been suggested to be as efficient as direct laryngoscopy for endotracheal intubation, but there are no recent clinical comparisons. This prospective randomised clinical study was designed to evaluate these two techniques in patients undergoing elective surgery.*

Methods: The study comprises 194 American Society of Anesthesiologists level I-II patients. Anatomical upper airway conditions were assessed with respect to mouth opening, classification according to Mallampati (I-IV) and neck mobility. Classification according to Cormack-Lehane (I-IV) was made by direct laryngoscopy after the induction of anaesthesia prior to randomisation for intubation (two attempts allowed) guided by either lightwand (Trachlight™, Laerdal, Norway) or direct laryngoscopy. The total time and number of attempts required for successful intubation by skilled anaesthesiologists with little experience from the lightwand technique were recorded together with possible associated technical or medical problems.

Results: Intubation guided by lightwand was successful within two attempts in 78 %, whereas the corresponding success rate of direct laryngoscopy was 100 % (P<0.001), also including 21 intubations made after two failed attempts with lightwand. The time for successful intubation by lightwand, 41 (25th percentile 27, 75th percentile 62; range 15–191) s, was significantly (P<0.001) longer than by direct laryngoscopy, 19 (15, 27; 7–180) s. Medical problems possibly associated with lightwand-guided intubation were found in 6 % compared to in 2 % on intubation by direct laryngoscopy (P=0.152).

Conclusions: Endotracheal intubation guided by lightwand is slower and less successful than intubation by direct laryngoscopy and does not seem suitable for routine use in clinical anaesthesiology.

Keywords— Anaesthetic techniques, laryngoscopy; Anaesthetic techniques, lightwand; Intubation, tracheal; Transillumination.

1. INTRODUCTION

Hypoxia resulting from failed intubation and ventilation is among the most important causes of serious morbidity and mortality related to anaesthesia and intensive care [1]. Difficult endotracheal intubation by direct laryngoscopy, i.e. inability of an experienced laryngoscopist to visualize the larynx despite optimal positioning, external manipulation and muscle relaxation of the patient, has been reported in 1–3 % of surgical and 3.5 % of obstetrical patients [2]. Expected difficult intubation of the trachea has been reported to be successfully managed with clinical fiberoptic-, video- or lightwand-guided techniques.

Blind endotracheal intubation based on transcutaneous illumination of the front of the neck by a lightwand positioned in the laryngeal opening, originally introduced for difficult endotracheal intubation in the late 1950's, is not widely used in daily clinical practice.

This prospective randomised clinical study was designed to evaluate and compare the lightwand technique with direct laryngoscopy for endotracheal intubation in adult patients undergoing elective surgery.

2. PATIENTS AND METHODS

After approval of the study design by the Human Research Ethics Committee at Lund University, Lund, Sweden, 194 adult ASA I-II patients scheduled for elective ear-nose-throat or plastic surgery were recruited at Skåne University Hospital, Malmö, Sweden. Before the study a total number of 144 patients had been calculated to be required to confirm statistically, with 95 % probability and 80 % power, a difference in orotracheal intubation success rate between the two techniques of intubation amounting to two thirds of that reported for novice medical officers, previously not exposed to any of these techniques [3].

2.1 Pre-operative Evaluation

The patients were included consecutively, and informed consent was obtained from each patient. Patients with a previously verified difficult airway were excluded, as were patients with severe oropharyngeal or dental pathology, coagulopathy or intolerance to drugs intended to be used in the study.

The airway was assessed with regard to mouth opening, neck mobility, and optical throat visibility according to the Mallampati classification.

2.2 Anaesthetic Management

Pure oxygen was supplied by facemask for at least three minutes before endotracheal intubation. Fentanyl (Fentanyl 50 µg/ml, Braun, Germany) 2.0 µg/kg was administered intravenously (iv), followed by 4-6 mg/kg of thiopental (Pentothal® 25 mg/ml, Hospira, Holland) or 1.5-2.5 mg/kg of propofol (Propofol-Lipuro® 10 mg/ml, Braun, Germany) iv. Muscle relaxation was established by iv administration of 0.6 mg/kg of rocuronium (Esmeron® 10 mg/ml, Schering-Plough, Holland) or of 0.08-1.0 mg/kg of pancuronium (Pavulon® 2.0 mg/ml, Schering-Plough, Holland) and 1.0 mg/kg of suxamethonium (Celocurin® 50 mg/ml, IpeX, Sweden).

2.3 Monitoring

The patients were monitored peroperatively by pulse oxymetry, non-invasive blood pressure measurements, 3-lead electrocardiography and end-tidal capnography.

2.4 Study Design

Upper airway conditions were assessed by direct laryngoscopy according to Cormach-Lehane in each patient immediately before randomization to intubation by lightwand (Trachlight™, Laerdal AS, Stavanger, Norway) or direct laryngoscopy according to a predetermined schedule including patient inclusion numbers and corresponding randomization codes. All endotracheal intubations were carried out by experienced anaesthesiologists (AR, LJ, JÅ).

The lightwand device comprises a flexible plastic wand with a distal light source, a retractable metal stylet and a plastic handle. Initial blind positioning of the tip of the endotracheal tube and lightwand at the laryngeal opening is verified by a dermal spot of light over the thyroid cartilage. The stylet is then withdrawn, and the endotracheal tube is gently introduced over the plastic wand into the upper trachea.

The study methods were compared with respect to the total time and number of attempts required for successful intubation, to use of alternative techniques, and to possible medical and/or technical complications in the per- and early postoperative period, according to a defined study protocol.

Failed intubation was defined as inability to place the endotracheal tube into the trachea after two attempts. An attempt was immediately interrupted on percutaneous oxygen desaturation at or below 88 %. The time for successful intubation with a study method was defined as the time from oral introduction of the device to confirmation of intratracheal tube position by capnography plus the time between insertion and withdrawal of the intubating device on the previous attempt with the same method.

2.5 Statistics

Statistical analyses were made with the Ms Excel™ (Microsoft Inc., Redmond WA, USA) software. Results are reported as median with first and third percentiles, and range, in parenthesis. Time periods required for successful intubation with either method were compared by unpaired student's *t*-test. The study groups were also compared by χ^2 -test with respect to the number of intubation attempts and the prevalence of complications. Statistical significance was defined as $P < 0.05$.

3. RESULTS

A total number of 194 patients were included. Nine patients were excluded due to inadequately recorded study protocols. The results are based on the data from the remaining 185 patients.

3.1 Patient Demographics

There were no significant differences between the study groups in gender, age, weight, mouth opening, neck mobility or classifications according to Mallampati and Cormack-Lehane.

3.2 Success rates

In 94 patients subjected to intubation by lightwand, intubation was successful at the first attempt in 55 patients (59 %) and at the second attempt in 18 of the remaining 39 patients (Fig. 1). The total time to intubation by lightwand in these 73 patients (78 %) was 41 (1st quartile 27, 3rd quartile 62; range 15-191) s. The remaining 21 patients were successfully intubated by direct laryngoscopy at the first attempt (Fig. 1).

In 91 patients subjected to intubation by direct laryngoscopy, intubation was successful at the first attempt in 87 patients (96 %) and at the second attempt in the remaining four patients (Fig. 1). The total time to intubation in these 91 patients (100 %) was 19 (15, 27; 7-180) s.

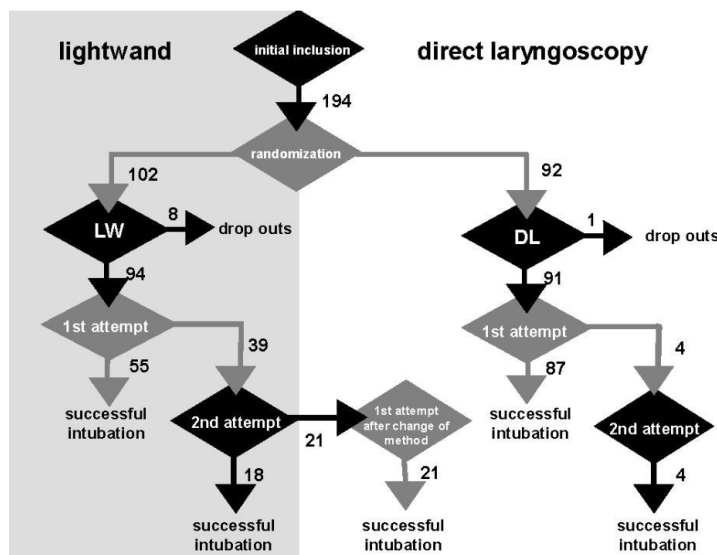


Figure 1: Schematic illustration of patient flows in the two study groups.

Approximately 40 % of patients in the lightwand group, and more than 90 % of patients in the laryngoscopy group, were successfully intubated within 40 seconds (Fig. 2).

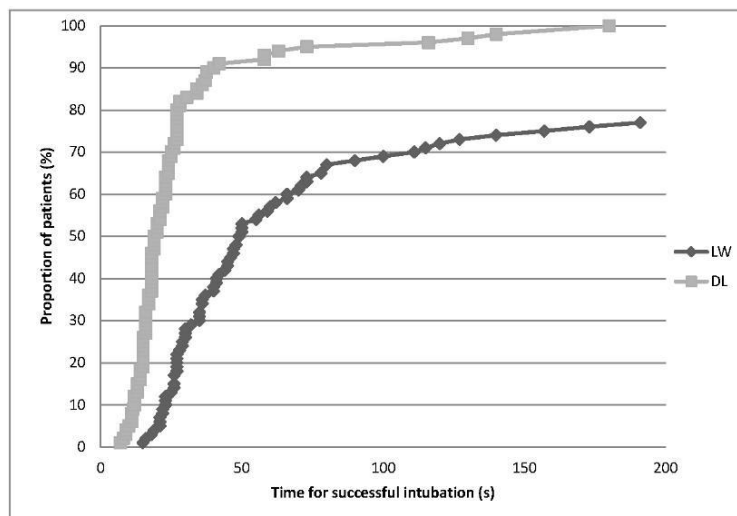


Figure 2: Proportions of patients successfully endotracheally intubated by lightwand (LW) or direct laryngoscopy (DL).

3.3 Complications

Possible medical complications were reported in six patients (6.4 %), among which hoarseness, mucosal bleeding, and sore throat were the most common ones. Hoarseness was reported in two patients (2.2 %).

4. DISCUSSION

This prospective and randomized clinical study shows that endotracheal intubation by direct laryngoscopy is overall faster and more reliable than by the lightwand technique. Our two-attempt success rates of lightwand-guided or laryngoscopic intubation (78 % vs. 100 %) are consistent with findings by others [3-5]. All operators in those studies [3-5] were novice to both techniques of endotracheal intubation. Nevertheless, as also found by us, intubation with the lightwand technique was less successful than with direct laryngoscopy.

In a South Korean study [3], novice medical officers, previously not exposed to any of these techniques, made orotracheal intubations with corresponding success rates of 67 % vs. 94 %. The mean time to successful intubation was 50 % longer (66 vs. 44 s) with the lightwand technique.

In a similarly designed Norwegian study [4], novice paramedic students made lightwand-guided or laryngoscopic intubations in cadavers and in two different kinds of manikins. Intubation guided by lightwand was successful in 50 % of cadavers, in 65 % of AMBU manikins, and in all Laerdal manikins, whereas laryngoscopic intubation was successful in 94-100 % of cadavers and manikins. The mean time to successful intubation by lightwand was longer than by laryngoscopy (30-44 vs. 19-23 s).

A study from Germany [5] reported smaller differences between these two techniques of airway management. They were found to be similarly successful (90 vs. 92 %), but endotracheal intubation guided by lightwand was slower than guided by direct laryngoscopy (30 vs. 24 s).

Our results and those referred to above differ from results obtained in two other studies [6, 7]. In a study from 1995 [6] designed similarly to ours (i. e. for comparison in elective surgical patients), intubation by lightwand was faster (16 vs. 20 s), associated with fewer complications, and reported not to have been influenced by anatomical anomalies. In a more recent study [7] the lightwand was evaluated as an intubation device without being compared with the laryngoscope. The success rate of intubation was 88 % after the first attempt and 92 % after three allowed attempts.

This prospective clinical study has been designed and carried out under standardized conditions in a well defined group of adult surgical patients, all individually evaluated for upper airway anomalies according to clinically recognized classification systems and then subjected to randomized endotracheal intubation with either technique by a small number of skilled anaesthesiologists.

Although the lightwand technique is not intended as a clinical routine alternative to direct laryngoscopy for endotracheal intubation – but rather as a complement for difficult airway management where conventional methods have failed – we conclude endotracheal intubation guided by a lightwand to be both slower and less successful than intubation made by conventional laryngoscopy for clinical routine procedures.

Based on our findings – and particularly also taking into consideration recent and more clinically established alternative techniques for endotracheal airway management, based on either fiberoptical laryngoscopy, with or without laryngeal mask airway assistance, or on video-assisted laryngoscopy – we do not consider lightwand-guided endotracheal intubation to be suitable for routine use in clinical anaesthesiology and intensive care medicine.

5. REFERENCES

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