

Effect of Cricoid Pressure on the Success of Endotracheal Intubation with a Lightwand

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Background: The lightwand may be useful as an alternative for tracheal intubation during a rapid-sequence induction of anesthesia in the presence of a full stomach. This study was undertaken to assess the effect of application of cricoid pressure on the success of lightwand intubation.

Methods: Sixty adult female patients presenting for abdominal hysterectomy were randomly allocated to lightwand intubation with and without cricoid pressure. The time to successful intubation and number of attempts were recorded.

Results: All 30 patients allocated to intubation without cricoid pressure were intubated successfully at the first attempt within a median time of 28 s (95% confidence interval, 18-77 s). Lightwand intubation with cricoid pressure was successful in 26 of 30 patients at the first attempt, but the median time to successful intubation was significantly longer at 48.5 s (95% confidence interval, 36-78 s; $P = 0.001$). Three patients required two attempts for successful intubation, and one could not be intubated with the lightwand while cricoid pressure was being applied.

Conclusions: The lightwand cannot be recommended for the first attempt at intubation where cricoid pressure is being applied because the time to successful intubation is significantly prolonged, and the failure rate for the first attempt at lightwand intubation is 13%.

A RECENT review highlighted the role of the lightwand in airway management.¹ The lightwand has been used successfully for endotracheal intubation and may be especially useful if laryngeal visualization is difficult and there is no evidence of an obstructive lesion of the mouth, pharynx, or larynx.² Patients with full stomachs who require anesthesia may regurgitate during rapid-sequence induction. Regurgitation and aspiration are prevented by application of external pressure to the cricoid cartilage (cricoid pressure [CP] or the Sellick maneuver³) to occlude the esophagus. There has been no previous study of the effect of CP on the success of lightwand intubation. This study was undertaken in normal patients undergoing elective surgery to assess the potential usefulness of the lightwand for intubation of patients in whom CP is being applied.

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Received from the Department of Anaesthesiology, University of Natal and Addington Hospital, Congella, South Africa, and the South African Medical Research Council, Institute of Biostatistics, Durban, Kwazulu-Natal, South Africa. Submitted for publication June 5, 2000. Accepted for publication September 25, 2000. Support was provided solely from institutional and/or departmental sources.

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Material and Methods

The study was approved by the Ethics Committee of the Medical Faculty of the University of Natal. Sixty adult patients presenting to Addington hospital for total abdominal hysterectomy gave informed consent to participate in the study. Patients who had previously proved difficult to intubate or in whom a difficult intubation was suspected were excluded from the study. Patients with significant cardiorespiratory disease were also excluded. Airway evaluation included a Mallampati score⁴ and measurement of interincisor gap, thyromental, and sternomental distances.

On arrival in the operating room, patients were randomized to lightwand intubation with CP (CP group) or without CP (no CP group). The study was designed to allow a difference of 5-s intubation time between these two groups to be detected at 5% level of significance with power of 70%. Randomization was performed using sequentially numbered envelopes that contained data sheets that had been randomly allocated by an intensive care unit nurse who did not take any further part in the trial.

Intravenous access was established, and monitors, including electrocardiogram, noninvasive blood pressure and pulse oximetry, were placed. Baseline heart rate, blood pressure, and oxygen saturation were recorded. Patients then breathed 100% oxygen for 3 min from a circle system, with the absorber out of the circuit and a fresh gas flow of 6 l/min. Exhaled carbon dioxide was measured using a sidestream capnograph. Anesthesia was induced with thiopentone 5 mg/kg and, after confirmation of easy mask ventilation, muscle relaxation was provided by vecuronium 0.1 mg/kg. Isoflurane 2% was added to the inspired oxygen, and mask ventilation continued until confirmation of complete paralysis by absence of response to train-of-four stimulation of the ulnar nerve at the wrist.

Patients who required CP had this applied by the anesthetic nurse allocated to the operating room before the start of the intubation attempt. All nurses were experienced at providing CP, and the application of CP was confirmed by the anesthesiologist performing the intubation (E. H.). Different nurses were used as it was impossible to allocate a single nurse to this task because of staffing limitations. The use of different nurses is consistent with clinical conditions where the nature of CP may vary depending on the person applying it.⁵

Intubation was performed using a well-lubricated size-7 endotracheal tube placed over a lightwand (Surch-

Lite; Aaron Medical, St Petersburg, FL). For the intubation, the distal end of the wand and covering tube were bent at a 90° angle ("hockey stick"), and patients were placed in the optimum "sniff" position (neck flexed and head extended). The jaw was then lifted forward with the left hand of the intubating anesthesiologist (E. H.), and the lightwand and tube were passed down the midline of the tongue using the right hand. The ambient lights were dimmed to assist visualization of the transillumination pattern. If the transillumination pattern could not be visualized, the wand and tube were removed, the "hockey stick" configuration restored, the "sniff" position reassessed and optimized, and the attempt was repeated with the wand directed more posteriorly to enter the proximal esophagus. The wand was then slowly withdrawn until the transillumination pattern appeared.

Each intubation attempt was timed from removal of the face mask until detection of carbon dioxide by the capnograph or until replacement of the face mask. The need to replace the face mask, which was performed after 3 min or if desaturation to 95% occurred, was considered to be a failed intubation attempt. A total of three attempts was allowed with face mask ventilation with 100% oxygen and 2% isoflurane to a saturation of greater than 98% between attempts.

All intubations were performed by a single investigator (E. H.) with 6 months of experience in the use of the lightwand, including a number of difficult intubations. However, the investigator did not have previous experience with lightwand intubation in the presence of CP. This was also consistent with clinical conditions where practicing intubation with CP in patients in whom the maneuver is not clinically indicated would be unusual.

Three failed attempts at lightwand intubation was considered a failure of the technique and was an indication for conventional laryngoscopic intubation using an appropriate Macintosh blade and grading the view of the larynx according to the scale proposed by Cormack and Lehane.⁶ In patients who required more than one attempt for successful intubation, the times for each attempt, including laryngoscopic attempts, were added to give a total attempt duration.

After successful intubation, mechanical ventilation with 100% oxygen and 2% isoflurane was continued for 5 min with measurement of heart rate, blood pressure, and oxygen saturation every minute. Thereafter, 60–70% nitrous oxide was introduced, the absorber was turned on, gas flow was reduced to 2 l/min, and isoflurane was reduced to 1%. Analgesia was provided with fentanyl 2–4 µg/kg titrated to effect. At the end of the case, residual neuromuscular blockade was reversed, and patients were extubated. Postoperative analgesia was provided by wound infiltration with 0.5% bupivacaine, intramuscular papaveretum, and rectal indomethacin.

Table 1. Age, Weight, and Airway Characteristics

Parameter	CP (n = 30)	No CP (n = 30)
Weight (kg)	71.4 (13.6)	70.9 (14.8)
Age (yr)	43.9 (12.4)	40.2 (9.6)
Sternomental distance (cm)	12.9 (1.6)	13.1 (1.7)
Thyromental distance (cm)	6.8 (0.83)	7.3 (1.6)
Interincisor gap (cm)	2.7 (0.69)	3.0 (0.87)
Mallampati score (median ± range)	2 (1–3)	2 (1–3)

Values are mean (±SD), except the Mallampati score, which is median (range). No significant differences between the groups could be shown.

Patients were examined 24 h postoperatively and asked about the presence of sore throat, which was graded by means of a 10-cm visual analog score.

Statistical Analysis

Data was analyzed using SAS version 6.12 (SAS Institute, Cary, NC) and S-plus 4.5 (Mathsoft Inc., Cambridge, MA). The *t* test was used to compare continuous variables, and the chi-square test was used for categorical variables. The log-rank test was used for the comparison of the Kaplan-Meier curves obtained from the total time to successful intubation for each patient. All *P* values were derived from two-sided tests. A *P* value less than or equal to 0.05 was considered to indicate statistical significance.

Results

The groups were similar in terms of age, weight, Mallampati score, interincisor gap, and sternomental and thyromental distances (table 1). All patients could be intubated at the first attempt without desaturation in the no CP group (table 2).

In the CP group, three patients required two attempts for successful intubation, and intubation could not be performed with the lightwand in one patient (table 2). The patient who could not be intubated was found to have a large, floppy epiglottis on laryngoscopy that necessitated a second laryngoscopy with a Macintosh blade to improve the Cormack and Lehane grade from 3 to 2 and allow successful intubation. These four patients

Table 2. Duration of Intubation Attempts and Numbers of Patients in Whom Intubation Was Successful with (CP Group) and without (No CP Group) Application of Cricoid Pressure

Group	Attempt 1		Attempt 2		Attempt 3	
	n	Duration (s)	n	Duration (s)	n	Duration (s)
No CP	30	33.9 (19.4)				
CP	30	78.8 (41.2)	4	70.7 (48.0)	1	92
Successful	56		3		0	

Times are in seconds and given as mean (±SD). The mean and SD values were determined for patients intubated successfully at each attempt, except for attempt 3, in which one patient could not be intubated.

were all among the first fifteen patients to be enrolled in the CP group.

The mean time to successful intubation was significantly longer in the CP group (78.8 s [SD, 41.2]) compared with the no CP group (33.9 s [SD, 19.4]; table 2). If the patients requiring multiple attempts are treated as censored observations, the modified Kaplan-Meier estimator (fig. 1) shows that the duration of lightwand intubation with CP consistently exceeds that without CP ($P = 0.0001$, log-rank test). The median time to successful intubation with CP at first attempt was 48.5 s (95% confidence interval, 36-78) in 26 patients compared with 28 s (95% confidence interval, 18-77) in patients in the no CP group. Lightwand intubation was hemodynamically benign, with no significant postintubation hypertension or tachycardia. Less than half of the patients in each group experienced any postoperative sore throat, and only 5 of the 60 patients from both groups had visual analog scores greater than 5 cm. There were no significant differences between the groups.

Discussion

Patients with full stomachs who present for surgery require endotracheal intubation with a cuffed tube to minimize regurgitation of gastric contents and subsequent aspiration pneumonia. During rapid-sequence induction of anesthesia and endotracheal intubation in patients with full stomachs, CP is applied to minimize the risk of regurgitation and aspiration.³ The incidence of failed intubation using conventional laryngoscopy is increased in the presence of CP,⁷ especially in the pregnant patient.⁸ Alternatives to direct laryngoscopy may not be effective when required, *e.g.*, a fiberoptic bronchoscope may not be immediately available or may be

ineffective in the presence of airway bleeding or secretions.⁹

The lightwand is an alternative to direct laryngoscopy for endotracheal intubation.^{1,10} The time to successful intubation has been shown to be similar to that for direct laryngoscopy¹¹ without the application of CP. The effect of CP on intubation time and likelihood of successful intubation with a lightwand has not been investigated previously.

This study was undertaken to assess the effect of CP on the success of lightwand intubation in normal patients before attempting a study in patients with full stomachs requiring rapid-sequence induction with CP. The results demonstrate a significant increase in the mean time to successful intubation from 33.9 ± 19.4 s (mean \pm SD) without CP to 78.8 ± 41.2 s with CP (table 1). The time to intubation without CP is similar to previous studies of lightwand intubation without CP (37 s),¹¹ which would indicate that the anesthesiologist performing the intubations (E. H.) was adequately experienced.

Intubation is learned on normal patients and then adapted in the presence of CP. Practicing anesthesiologists are unlikely to practice intubation with CP when the maneuver is not clinically indicated. However, in this study, all four patients requiring two or more attempts for successful intubation with application of CP were among the first 15 patients to be enrolled in the study. These results appear to indicate that there may be a learning curve for lightwand intubation in the presence of CP, which is separate from the learning curve for the standard technique. The reason for the difficulty in lightwand intubation compared with laryngoscopic intubation in the presence of CP may be that with laryngoscopic intubation force is applied to the upper airway structures by the laryngoscope, which tends to oppose and nullify the displacement of the larynx by CP. With lightwand intubation, because the force applied to the upper airway structures is less, the displacement of the larynx by CP may be exaggerated, thereby making intubation more difficult. Application of CP will also cause restriction of the space available in the proximal esophagus for the alternative method of lightwand intubation, which requires posterior placement of the lightwand and subsequent withdrawal.

The technique of CP may require modification to facilitate lightwand intubation. On visualization of the appropriate transillumination pattern in the neck, the CP may be released briefly to facilitate the passage of the endotracheal tube and then reapplied until the position of the endotracheal tube is confirmed and the cuff inflated. The increased risk of aspiration caused by the brief release of CP would require individualization according to the skill of a particular anesthesiologist in lightwand intubation.

Anesthesiologists who may wish to incorporate the use of the lightwand in airway management where CP is being applied should thus be encouraged to practice on

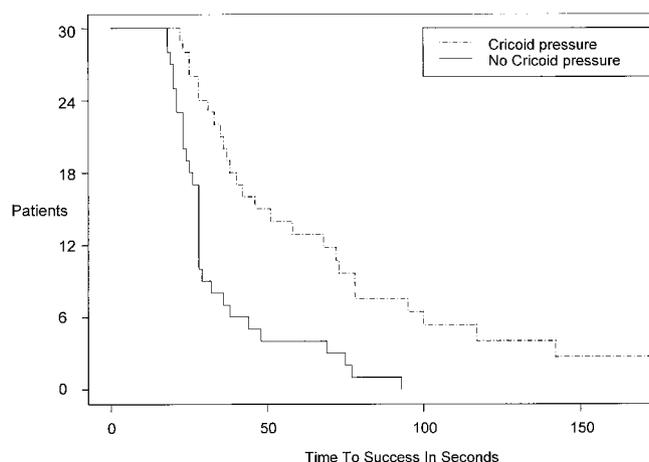


Fig. 1. Kaplan-Meier plot of time to successful intubation for the sixty patients. Thirty patients were intubated with cricoid pressure, with values for four patients requiring multiple attempts censored. Thirty patients were intubated without cricoid pressure. Time to successful intubation was significantly prolonged in the cricoid pressure group ($P = 0.0001$, log-rank test).

normal patients before attempting the technique in the presence of a full stomach.

Although this study shows that CP significantly prolongs the time required for successful intubation using a lightwand, intubation was possible in all but one patient. She had a large epiglottis, which resulted in partial upper airway obstruction. Obstructive lesions within the upper airway have been recognized as relative contraindications to lightwand intubation^{1,10} but, as in this case, may not be obvious until intubation has been attempted.

In conclusion, this study shows that lightwand intubation is possible in the presence of CP but that time to intubation is significantly prolonged. The failure rate for a first attempt at lightwand intubation with the application of CP was 13%. The overall failure rate for lightwand intubation with application of CP was 3% after three attempts, each attempt lasting up to 3 min. These results apply only to the device used, namely, the Surch-Lite (Aaron Medical), and may differ for other devices, *e.g.*, the Trachlight (Laerdal, Armonk, NY). Lightwand intubation cannot be recommended as the first-line technique for intubation in the presence of CP because the failure rate for the first attempt in this study was 13%.

However, lightwand intubation may be considered as an alternative for intubation when CP is being applied and conventional laryngoscopy has failed, as lightwand intubation with CP was successful in 97% of patients in this study.

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