LMA CTrach™ - Results of our first experience with the fiberoptic intubating laryngeal mask airway in 80 patients*

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Summary
We report on our initial clinical experience with the new LMA CTrach™. The intention was to evaluate its suitability in the routine anaesthetic working environment. **Method:** After inducing general anesthesia and muscle relaxation, the CTrach™ was used in elective patients, and its functionality was tested. We attempted to visualize the level of the vocal cords via the fiberoptic, and to subsequently carry out optically controlled endotracheal intubation. **Results:** The CTrach™ was used in 80 ASA I-III patients, 10 patients of which had been identified with difficult-to-manage airways. Ventilation via the laryngeal mask and thus securing the airway was possible in all patients. Larynx visualization was achieved in 85% of all cases. Intubation suc-ceeded in 95% at an average of 1.34 intubation attempts per patient. Tracheal intubation failed in 4 patients. **Conclusion:** LMA CTrach™ allows optically controlled intubation in a large number of patients.

Keywords: LMA CTrach; Intubation; Fiber optic; Difficult airway; Airway management

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Introduction

Unexpected difficulties or impossible intubation of the hard-to-manage airway are considerably challenging to the anesthesiologist. To keep risks such as mild to moderate hypoxia, or even death in patients as low as possible, a number of airway devices for intubation and artificial ventilation have been developed over the past few years. The LMA Fastrach™ is one of the devices available, which offers ventilation of the patient via a supraglottic airway as well as definitive securing of the airway in cases necessitating blind intubation. With the LMA CTrach™, we now have a device available, which will allow optically controlled intubation. It is based on the LMA Fastrach™ system, with a built-in viewing system which allows fiberoptic visualization of the larynx and optically controlled intubation.

This begs us to ask the question: "Does further development of the well-known LMA Fastrach™ with optically controlled intubation produce a clinical advantage in securing the airway?" and "What are the initial clinical results with LMA CTrach™ in the routine working environment?" Our primary goal was visualization of the vocal cords, followed by the ability to intubate, taking into account the length of time taken to achieve this.

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Materials and Methods

To evaluate its everyday suitability in a prospective survey, the LMA CTrach™ was used to secure the airway during the elective working environment. Because the LMA Fastrach™ is routinely available to manage the difficult airways at the trial clinic, and insertion of the CTrach is exactly like the Fastrach, a lengthy test period was waived prior to using the LMA CTrach™.

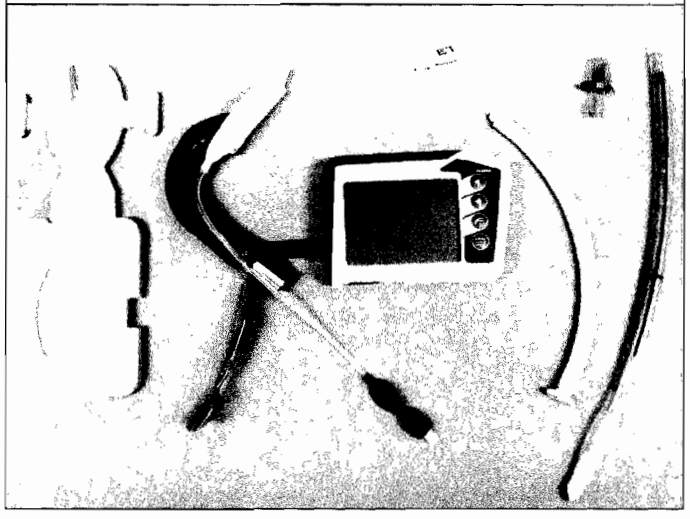
The LMA CTrach™ used in the study was the old version (2004-5) with the white epiglottic elevators.

After obtaining local Research Ethics Committee approval and informed consent, (of ASA I-III patients scheduled for intubation under general anesthesia), the ability of the LMA CTrach™ was tested to secure the airway as an alternative to conventional intubation.

Patients who were pregnant, obese, non-fasted, had gastro-oesophageal reflux or severe pulmonary disease were excluded.

Anesthesia was induced in either case with 3 mg/kg Kg thiopentone after having administered 0.03-0.05 mg/kg Kg midazolam for co-induction, followed by 2-3 µg/kg Kg fentanyl, with neu-romuscular blockade achieved by means of 0.4-0.5 mg/kg Kg rocuronium, the latter being assessed by relaxometry. Prior to inducing anesthesia, the required equipment was prepared and its functionality tested (Fig. 1). Anesthesia was maintained with isoflurane 0.5-0.6% in 35% oxygen and 65% nitrous oxide mix during the study period.

Fig. 1 Prepared equipment from left to right (cuff deflator, LMA CTrach, monitor, tube stabilizer, ETT- airway connector removed)



Prior to using the laryngeal mask it was deflated with the cuff deflator supplied, and the cuff pre-shaped as appropriate. To pre-focus the fiberoptic, the monitor was attached, the appropriate focusing card was placed 2cm in front of the optic, and the monitor adjusted correctly (Fig. 2).

Before using the LMA CTrach™, anesthesia was induced and a conventional laryngoscopy carried out to ascertain the Cormack-Lehane-Scores. CTrach was employed in compliance with the manufacturer's recommended weight classes: size 3 for children of 30-50 kg; size 4 for adults weighing 50-70 kg, and size 5 for adults >70 kg. The cuff of the CTrach was inflated with air to achieve a "just airtight seal" Following successful securing of the airway via the CTrach with problem-free ventilation (rectangular capnograph wave form with no air leak at an airway pressure of 20 cm H_2O), the color monitor was connected to the laryngeal mask (Fig. 3) in accordance with the User's Handbook[1] The view of laryngeal structures was scored according to the criteria listed in Table 1. If necessary, the fiberoptic was readjusted until the best possible view of the level of vocal cords was obtained (Fig. 4).

Subsequently the optically controlled intubation via the

Fig. 2 View of the focusing card via fiberoptic

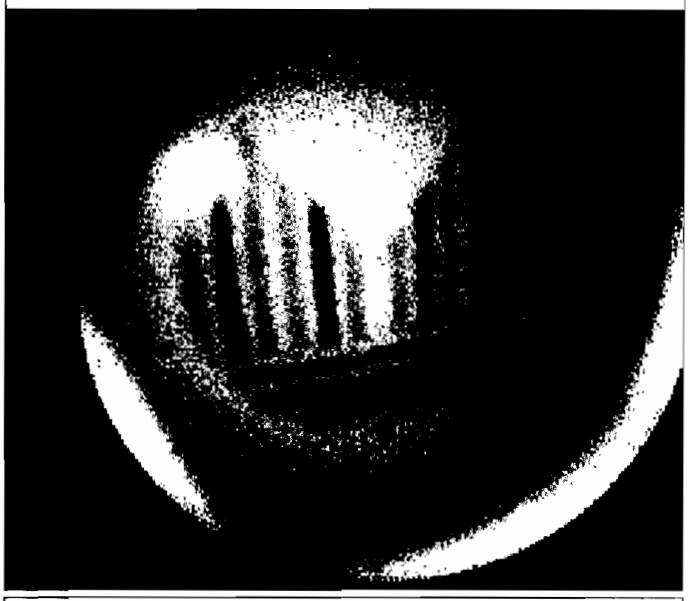


Fig. 3 LMA CTrach™ in situ with attached monitor and ventilation via the LMA

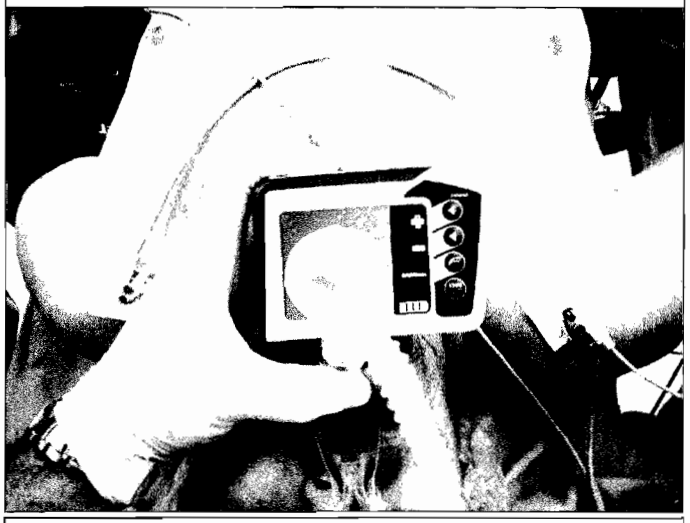
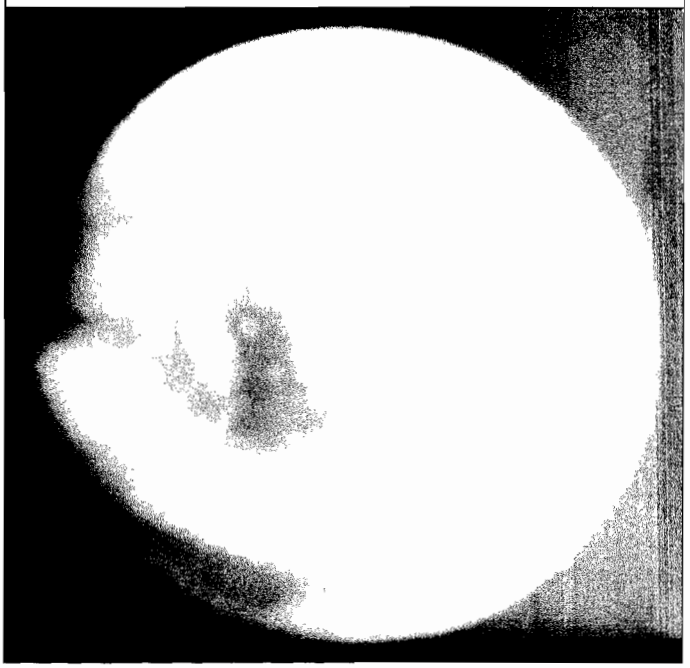


Fig. 4 View of level of the vocal cords and arytenoid via LMA-CTrach™ (Class 1 view)



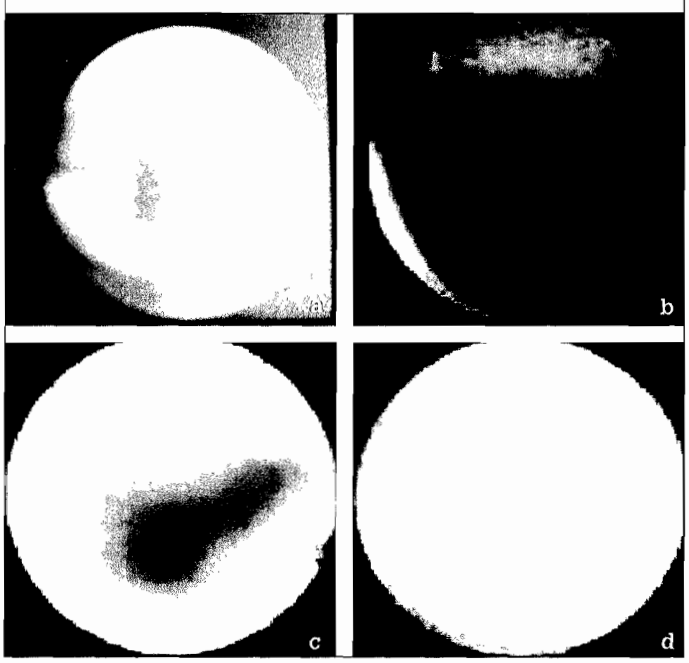
LMA CTrach™ was carried out. Where visualization of the level of the vocal cords could not be obtained, up to 3 optimizing attempts were performed (e.g. up-and-down manoeuvre, Chandy manoeuvre, or side-to-side manoeuvre). If visualization of the level of the vocal cords continued to be unsuccessful, intubation was performed blind, as with the LMA Fastrach™. Maximally 3 intubation attempts via the CTrach were carried out. If intubation continued to be unsuccessful, the patient was conventionally intubated after removal of the CTrach.

Following successful intubation with the CTrach, the LMA was removed and the deployed LMA tube remained in situ. Because the tube utilized was a tube with a low-volume high-pressure cuff, cuff pressure was controlled intermittently.

The following data were recorded after deployment of the CTrach: patient data (ASA classification, sex, weight, Mallampati, and Cormack-Lehane classification), difficult-to-manage airway (Y/N), number of LMA insertion attempts, visualization of laryngeal structures via LMA CTrach™ (Table 1 and Fig. 5), number of intubation attempts via CTrach to secure the airway (max 4 attempts), and time taken to successful intubation (time-period from mask insertion to its removal with the endotracheal tube in place). For statistical evaluation, the collected data were saved in a Microsoft Excel table, and the mean values and standard deviation (SD) calculated.

The effect of adjusting manoeuvres to improve the laryngeal view was tested by the ranked T-test for paired samples. $P<0.05$ was considered statistically significant.

Figure 5 Grading the laryngeal view a) class 1 b) class 2 c) class 3 d) class 4. See also Table 1



Our primary endpoints were the number of CTrach insertion attempts, laryngeal view obtained immediately after insertion of the CTrach and after any measures taken, overall intubation success rate and number of intubation attempts.

Results

Up until now the LMA CTrach™ has been used in 80 ASA I-III patients, 58 males and 22 females. The mean age was 46 years (min 18 to max 81), and mean weight 78 kg (min 52 to max 102). Mean value of the Mallampati score was 1.89 (SD+/-0.6), and of the Cormack-Lehane score 1.88 (SD+/-0.79). A potentially hard-to-manage airway, defined as a Mallampati score of 3-4 or a Cormack-Lehane score of 3-4, as well as unsuccessful mask ventilation occurred in 10 patients.

An average of 1.1 (SD+/-0.3) LMA CTrach™ insertion attempts were needed to secure the airway, defined as potential ventilation via the laryngeal mask. Ventilation and therefore initial securing of the airway was achieved in all patients within seconds after insertion. Ventilation quality was classified as adequate in all patients (rectangular capnograph wave form with no air leak at airway pressure of 20 cm H_2O).

Visualization of the laryngeal structures via the fiberoptic was initially 3.23 (SD+/-1.17) after insertion of the LMA and attaching of the monitor (classification based on the score of Table 1 and Fig. 5), i.e. the level of vocal cords was visible in 24 patients only. In these 24 patients no manipulation or adjusting maneuvers were necessary. In the other 56 patients, the level of the vocal cords was not visible. After manipulation and several adjustments, visualization was improved significantly to 1.65 (SD+/-0.8) (classification based on the score of Table 1 and Fig. 5), i.e. the level of the vocal cords was visible in 68 patients ($P<0.01$, ranked T-test for paired samples).

Thus optically controlled intubation could be carried out in 85% of patients. In 12 patients in whom we could not view the larynx, we carried out blind intubation. All patients with a grade 1 view (n=40) could be intubated on the first attempt. 26 of the patients with a grade 2 view (n=28) could be intubated on the first, the other two on the second attempt. Intubation via the laryngeal mask was achieved in 95% of all patients, requiring an average of 1.38 (SD+/-0.8) intubation attempts. With the first attempt, 80% of these patients were successfully intubated, 9% in the second, 11% in the third. Four patients could not be intubated with the CTrach. However, conventional intubation in these four patients was without problems. In all patients with potentially hard-to-manage airways, intubation with the CTrach was successful. The Cormack-Lehane score (3-4 in this patients) did not seem to influence the success of ventilation, viewing the larynx and intubation via the CTrach. On average, 2.1 min (SD+/-1.05) was required from the time of the placement of the laryngeal mask to successful intubation and removal of the mask. In all patients, the endotracheal tube was

Table 1: Visibility via LMA CTrach™ fiberoptic

	Class 1	*Class 2*	*Class 3*	*Class 4*
Visibility of the laryngeal structures	Arytenoid cartilage, glottis and epiglottis are definitively visible.	Arytenoid cartilage and glottis opening are visible; level of the vocal cord is barely visible.	Arytenoid cartilage, glottis opening or epiglottis is barely visible. Visible are dark areas, making an opening downward probable.	No part of the larynx is identifiable.

used. It had been specifically developed for the intubating laryngeal mask airway.

Discussion

The number of alternatives in securing the airway by endotracheal intubation shows that the problem of the hard-to-manage airway has not yet been resolved completely, and still pre-occupies anesthesiologists world-wide. In the meantime, however, established airway alternatives are available which allow endotracheal intubation as is shown with the LMA Fastrach™. Further development of the LMA Fastrach™ to the LMA CTrach™ has attempted to eliminate blind intubation with the commonly used intubating laryngeal mask, which had often been criticized. Visualization of the larynx should increase the success rate of intubation via the laryngeal mask because manipulation of the mask under optical control should optimize positioning at the larynx.

Ferson et al[2], obtained a 100% intubation success rate in their patients using fiberoptic intubation via a LMA Fastrach™. Because visualization of the laryngeal entry could not be attained in all patients examined, the advantage of optical control is only relative. Initially, poor visibility of the level of the vocal cords may be caused by the epiglottis. During insertion of the mask, it tips over and lies directly in front of the optic.

In his work, Keller[3] demonstrates that when using the LMA Fastrach™ with fiberoptic control while positioning the mask, the level of vocal cords was partially or completely obstructed by the epiglottis in 80% of the patients. This disadvantage may be changed by the so-called "up-and-down manoeuvre" where the mask, in a blocked position, is pulled back 4-6 cm and then reinserted, prompting the epiglottis to move back into its correct position. Employment of the "up-and-down manoeuvre" improved visibility of the level of vocal cords markedly in the patients tested. Additional techniques are: side-to-side, Chandy maneuver, or positioning the device deeper. The Chandy maneuver is performed in two steps as follows; after insertion of the LMA, optimal ventilation is established by slightly rotating the device in the sagittal plane, until the least resistance to the bag ventilation is achieved. Then the device is lifted away slightly from the posterior pharyngeal wall using the metal handle.[2] These manipulations were used only in patients where the up-and-down method did not improve the view of the airway. However, employment of the aforementioned techniques does not guarantee successful visibility of the level of the vocal cords in every case. The possible reasons for this may be the shifting of the fiberoptic caused by secretions, or a fogged optic. Even when eliminating these problems in a few patients, visualization of the larynx failed. We are unable to identify the factors that lead to failure to view the larynx.

We also had the subjective impression that the light intensity and the sharpness of the image declined over the course of the applications, and compared with the image of the fiberoptic endoscope the image quality of the CTrach viewer is poor. The CTrach used in the study was the old version with the white "epiglottic elevating bar" and the old viewer. The new version with the blue "epiglottic elevating bar" and some other modifications, including a new viewer may show better results. Preliminary results with the new version in our department confirm this expectation.

The LMA CTrach™ intubation rate of 95% achieved in the patients tested is within the range of data on the LMA Fastrach™ (84.8%-96.5%) reported in the literature.[2,4,5]

In four patients, intubation was unsuccessful despite several placement attempts. In three of these four patients, visualization of the laryngeal structures could not be achieved, and intubation was attempted blindly without success. After insertion of the LMA CTrach™ in the fourth patient, only the tip of the epiglottis could be seen, but the epiglottis could not be lifted with the "epiglottic elevating bar" to allow access to the trachea, despite the correct LMA size (in this patient size 5) and deep insertion of the LMA. The tube was therefore caught between the epiglottis and epiglottic vallecula.

The approach chosen to employ the LMA CTrach™ as an alternative to conventional intubation with complete muscle relaxation was to improve success in a possible unexpected complicated intubation. Alternatives may be expected to be employed as intubation becomes difficult or impossible. At that point, the patient is often relaxed for the initial intubation attempt and anesthesia is induced with a view to carry out conventional intubation. The clinical practice of laryngeal mask insertion under deep anesthesia with propofol and opioids, without muscle relaxation was therefore abandoned. However, the administration of muscle relaxants is not unusual when using the laryngeal mask.[6] A limitation of our study is that due to the use of rocuronium we are unable to assess the ease and success of visualization of the larynx in unparalyzed patients.

Results obtained from these observations show that the new LMA may be seen as a competent and useful alternative in securing the airways, offering secondary intubation. It may be assumed that the positive experiences and results which are available for the LMA Fastrach™ in the meantime[7-10] may also be attainable for the LMA CTrach™ or could even be improved.

As with all intubation alternatives, employment of the LMA CTrach™ can only be successful if sufficient experience is gathered prior to a "can't ventilate, can't intubate" situation. To ensure safe application (in an emergency situation), routine handling of the airway device is an absolute necessity. Only continued training and practice assures safe insertion of the device.[11]

The gathered observations show that all techniques applicable to improving the airway view, as described in the User's Handbook, require several LMA applications. We caution strongly against the use of the LMA CTrach™ as an airway alternative without prior repeated training on a problem-free patient. The Handbook passage "In emergency situations, the laryngeal mask may be easily inserted by personnel with minimal training until competent personnel arrives"[1] is therefore quite incorrect.

In summary, it may be said that attempted fiber optically-supported directly-visualized intubation via LMA CTrach™ did not succeed in every case. In 15% of patients, the airway was not visible, but tracheal intubation can be successful despite grade III or IV views in the majority of the patients. If the airway was visible, intubation was attained in 100% of patients. Our clinical experience relative to the fiberoptic intubation laryngeal mask airway may be considered positive in the patients presented in this paper and in the work of Timmermann et al[12,13], and Liu et al.[14]

References

1. *LMA CTrach™ Anleitungshandbuch. The Laryngeal Mask Company Limited. 2004*
2. *Ferson DZ, Rosenblatt WH, Johansen MJ, Osborn I, Ovassapian A. Use of the intubating LMA-Fastrach™ in 254 patients with difficult-to-manage Airways. Anesthsiology 2001; 95: 1175-81*
3. *Keller C, Brimacombe J, Pühringer F. A fibreoptic scoring system to assess the position of laryngeal mask airway devices. Inter-observer variability and a comparison between the standard, flexible and intubating laryngeal mask airways. Anästhesiologie Intensivmedizin Notfallmedizin Schmerztherapie 2000; 35:692-694*
4. *Kawamura T, Amaha K, Fukutome T, Nakazawa K, Noguchi H. A multicenter study for evaluating a new intubating laryngeal mask airway. The Japanese journal of Anesthsiology 1999; 48: 782-786*
5. *Langenstein H, Moeller F. Intubating laryngeal mask airway – Fastrach. Anaesthesist 1998; 47: 311-319*
6. *Pühringer FK, Rex C. Muskelrelaxation und Larynxmaske. Anästhesiologie Intensivmedizin Notfallmedizin Schmerztherapie 2004; 39:489-491*
7. *Joo H; Rose K. Fastrach - a new intubating laryngeal mask airway: successful use in patients with difficult airways. Canadian Journal of Anaesthesia 1998; 45:253-256*
8. *Sener E B, Sarihasan B, Ustan E, Kocamanoglu S, Kelsaka E, Tur A. Awake tracheal intubation through the laryngeal mask airway in patient with halo traction. Canadian Journal of Anaesthesia 2002; 49:610-613*
9. *Fukutome T; Amaha K; Nakazawa K; Kawamura T; Noguchi H. Tracheal intubation through the intubating laryngeal mask airway (LMA-Fastrach) in patients with difficult airways. Anesthesia and intensive care 1998; 26:387-391*
10. *Genzwürker H; Hundt A; Finteis T; Ellinger K. Comparison of different laryngeal mask airway in a resuscitation model. Anästhesiologie Intensivmedizin Notfallmedizin Schmerztherapier 2003; 38:94-101*
11. *Castner Th. Critical Airway Management: Praktische Umsetzung der Empfehlungen zum Atemwegsmanagement. Rettungsdienst 2003; 26:1158-1162*
12. *Timmermann A, Russo S, Natge U, Heuer J, Graf BM. LMA CTrach™ mark Initial experiences in patients with difficult-to-manage airways. Anaesthesist 2006 55;528-534*
13. *Timmermann A, Russo S, Graf BM. Evaluation of the CTrach - an intubating LMA with integrated fibreoptic system. British Journal of Anaesthesia 2006; 96:516-21.*
14. *Liu E H C, Goy R W L, Chen F G. The LMA CTrach™, a new laryngeal mask airway for endotracheal intubation under vision: evaluation in 100 patients. Br J Anaesth. 2006;96:396-400.*