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ORIGINAL ARTICLE

The LMA CTrach™ in morbidly obese and lean patients undergoing gynecological procedures: a comparative study

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Abstract
Purpose The tracheas of obese patients may be more difficult to intubate than those of normal-weight patients. The aim of this study was to compare the airway management quality in morbidly obese and lean patients with use of the LMA CTrach.
Methods After Ethics Committee approval, 60 adult patients (30 morbidly obese patients with body mass index >40 kg/m^2 and 30 lean patients with body mass index <30 kg/m^2) scheduled to undergo gynecological surgery were enrolled in this prospective study. The induction of anesthesia was standardized using propofol, fentanyl, and rocuronium. Ventilation and intubation success rates, time taken to achieve successful ventilation, and intubation through the CTrach and airway complications were recorded.
Results The CTrach was successfully inserted and adequate ventilation through the CTrach was achieved in 59 patients (98%). Only 1 patient in the lean group was not able to ventilate through the CTrach. We were successful in endotracheal intubation, either under vision or blind, in 56 patients (93%). We were able to view the larynx in 51 patients (85%). Total intubation time was significantly longer in morbidly obese patients, 69 (311) s, than in lean patients, 33 (107) s [median (range)] ($P < 0.001$).
Conclusions We concluded that the time to intubate the trachea in obese patients was significantly longer than in lean patients when the LMA CTrach was used.

Keywords Airway · LMA CTrach · Obesity · Endotracheal intubation

Introduction

Airway management is a major factor underlying morbidity and mortality related to anesthesia in the morbidly obese population. It has been shown that bag mask ventilation and tracheal intubation may be more difficult in the sedated, paralyzed, obese patients [1–5], which may account for impaired arterial oxygenation and poor tolerance of apnea [6, 7]. Therefore, it is important to develop methods to facilitate mask ventilation and intubation and decrease the duration of apnea. The LMA CTrach (The Laryngeal Mask Company, Mahe, Seychelles) system may have a role in difficult airway management by facilitating ventilation and enabling viewing of endotracheal intubation through a laryngeal mask device. Ventilation and oxygenation can be maintained nearly continuously, and visualization can enable a higher first-attempt success rate of tracheal intubation with the LMA CTrach.

The LMA CTrach is a modified version of the intubating laryngeal mask airway (ILMA) (The Laryngeal Mask Company) with a fiberoptic system and a detachable LCD screen that allows real-time view of the airway during orotracheal intubation while maintaining optimal ventilation [8–10]. It has been successfully used to manage both

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potential [11–13] and unanticipated [8] difficult airways in anesthetized patients.

The aim of this study was to compare the airway management quality in morbidly obese and lean patients with use of the LMA CTrach. We evaluated the success rates of ventilation, of viewing the larynx and of endotracheal intubation with this new system in female patients.

Materials and methods

After Local Research Ethics Committee approval and written informed consent was obtained, 60 elective ASA I–III adult female patients [30 morbidly obese with body mass index (BMI) >40 kg/m^2 and 30 lean with BMI <30 kg/m^2] admitted for gynecological surgery were enrolled. Patients who were pregnant, non-fasted, had symptomatic or untreated gastroesophageal reflux, delayed gastric emptying, severe cardiac or respiratory disease, or with limited mouth aperture (<3.0 cm) were excluded from the study. At the preoperative visit, we recorded the following: age, height, weight, BMI, Mallampati classification, thyromental and sternomental distances, and interincisor distance (mouth opening).

In the operating theater, the patients premedicated with i.v. midazolam 0.03 mg/kg and equipped with standard monitoring (electrocardiography, pulse oximetry, noninvasive blood pressure monitoring). After 4 min of facemask preoxygenation, we induced general anesthesia with propofol 2–2.5 mg/kg and fentanyl 1 μg/kg, maintained with sevoflurane 2–2.5%. After effective mask ventilation was demonstrated [14], rocuronium 0.8 mg/kg was injected to obtain satisfactory intubation conditions. One investigator (T.S.Y.) carried out all the CTrach procedures. The investigator had experience of at least 50 successful intubations with the CTrach before the commencement of the study.

For a suitable CTrach conduit in patients with different oral–pharyngeal–laryngeal distances, we chose the LMA CTrach size according to the patient's body weight, following the manufacturer's recommendations [15]. We used a size 3 CTrach and 7-mm-inner-diameter tracheal tube (TT) for patients with body weight <50 kg, a size 4 CTrach and 7.5-mm TT for patients 50–70 kg, and a size 5 CTrach and 8-mm TT for patients >70 kg. We used a flexible, cuffed, wire-reinforced silicone Fastrach tracheal tube (The Laryngeal Mask Company, Singapore) for all patients. Before the insertion, the viewer was attached to the CTrach and focused by obtaining a sharp image of a sheet of text held 1 cm in front of the fiberoptic channel port. The viewer was then detached. Only the posterior surface of the CTrach was lubricated, to prevent obscuring of the fiberoptic channel port.

The patient's head and neck were placed in neutral position and supported on a silicone jelly doughnut of 4 cm height. Before insertion of the CTrach, direct laryngoscopy was performed using a standard Macintosh blade by the second and third anesthesiologists. The laryngeal view was graded according to the method described by Cormack and Lehane [16] and was blinded to the first anesthesiologist inserting the LMA CTrach device. We inserted the CTrach with minimal neck movement in all patients, without the viewer attached. We inflated the CTrach cuff, and then checked the ventilation with the CTrach. If necessary, we manipulated the CTrach to obtain the least resistance to ventilation and minimal leak. Once satisfactory ventilation was achieved, we attached the viewer to the CTrach to obtain a view of the larynx. The quality of the initial glottis view was recorded using an original endoscopic view grading system (EVGS) parallel with the Cormack and Lehane grades of laryngoscopic view (grade 1, entire glottis aperture; grade 2, partial glottis aperture; grade 3, free edged or ventral face of epiglottis; grade 4, no recognizable structure or whiteout screen). Ventilation via the CTrach was maintained throughout this time. If we could not view the larynx, we manipulated the CTrach to try to obtain a view. We aimed to see the vocal cords and laryngeal inlet in the center of the viewer. In the patients who had epiglottic downfolding, we performed the "up-down maneuver" (slowly withdrawing the inflated cuff from the pharynx 5–6 cm to aid in unfurling the epiglottis, and then reinserting) to obtain a view of the vocal cords [15]. After obtaining the best possible view, we passed the TT through the CTrach into the trachea under vision and confirmed correct intubation by chest auscultation and end-tidal capnography. We then detached the viewer, removed the TT connector, deflated the CTrach cuff, and removed the CTrach over the TT with the aid of the stabilizer rod. The TT connector was then replaced and connected to the anesthesia circuit for continued ventilation. In case of impossible glottis visualization after three insertions or in case of impossible intubation with the CTrach correctly placed, direct laryngoscopy was proposed. The time to successful ventilation was measured from the time facemask ventilation was discontinued to the time satisfactory ventilation was achieved through the CTrach. The duration of tracheal intubation was defined as the time elapsing between picking up the CTrach and measures of expired CO_2 confirming of tracheal intubation. This timing included the time required to obtain an optimized laryngeal view and removal of the laryngeal mask conduit after tracheal intubation.

The following performance parameters of CTrach were also recorded: success rates (%) of ventilation and tracheal intubation through the CTrach, the quality of initial glottis view, and the number of successful tracheal intubation

attempts. Postoperative complications such as sore throat, dysphagia, and mucosal injury (blood on the CTrach) were also documented.

Statistics

SPSS 11.5 was used to evaluate the data. Normality distribution of continuous variables in the two groups were tested using the Shapiro–Wilk test. The parametric test was used accordingly. Comparison of continuous variables were performed using independent samples *t* test if the distribution was normal, and chi-square and Fisher's exact test was used whenever appropriate for categorical variables. The distribution of the variables such as intubation time and CTrach insertion time were skewed, so the Mann–Whitney *U* test was used for comparison, and data were presented as median, range, and 25–75 percentiles. Pearson correlation analysis was used to evaluate the relation of Cormack and Lehane grades with conventional laryngoscopy and endoscopic view grading system with CTrach within and between the groups. For all comparisons, probability <0.05 was considered to be statistically significant.

Results

Demographics of patients were similar between groups, except for height, weight, and body mass index (Table 1). Mean minimum arterial oxygen saturation (SpO_2) values during airway management were 98% and 99% in obese and lean patients, respectively. Anesthesia was uncomplicated in all patients.

Characteristics of airway management are presented in Table 2. The CTrach was successfully inserted and adequate ventilation through the CTrach was achieved in 59 patients (98%). Only in 1 patient, in the lean group, was ventilation unsuccessful through the CTrach. We were successful in endotracheal intubation, either under vision or blind, in 56 patients (93%). We were able to view the larynx in 51 patients (85%). Total intubation time was significantly longer in morbidly obese patients, 69 (311) s, than in lean patients, 33 (107) s [median (range)] ($P < 0.001$).

Table 1 Characteristics of the patients

	Obese group ($n = 30$)	Lean group ($n = 30$)	*P*
Age (years)	46 (14)	42 (13)	0.222
Height (cm)	159 (7)	165 (7)*	0.002
Weight (kg)	115 (11)	72 (13)*	0.000
Body mass index (kg/m^2)	42 (5)	25 (4)*	0.000
Mallampati class 1/2/3/4	22/3/5/0	20/7/2/1	0.216
ASA 1/2/3	10/19/1	18/12/0	0.071
Mouth opening (cm)	5 (1)	4 (1)*	0.000
Thyromental distance (cm)	8 (2)	8 (1)	0.474
Sternomental distance (cm)	13 (2)	14 (2)*	0.002

Values are presented as mean (SD)

* $P < 0.01$ versus obese group

Efficiency rates of tracheal intubation with the CTrach were comparable between lean and obese patients, with 90% ($n = 27$) and 96% ($n = 29$) success rates, respectively. A second attempt of tracheal intubation was requested in 4 patients of the obese group and 5 patients of the lean group. The glottis visualization was impossible with the CTrach and tracheal intubation was requested with direct laryngoscopy in 3 patients of the lean group and in 1 patient of the obese group.

In the postoperative period, transient pharyngeal pain was noticed in 2 patients of the obese group but in none of the patients in the lean group, and mild mucosal injury was found in 11 patients of the obese group and in 2 patients of the lean group, as is usual after the CTrach removal. No bronchospasm, laryngospasm, or accidental extubation (during CTrach removal) was observed in either group.

Discussion

In the current study, we demonstrated that primary airway management with the CTrach was as efficient in morbidly obese patients as in lean patients.

Several reviews have reported that endotracheal intubation is more difficult in obese than in lean patients [17, 18]. Some case reports [19] and a large prospective study [11] demonstrated that LMA CTrach was an efficient airway device for ventilation and tracheal intubation in the case of a difficult airway in morbidly obese patients. In addition, a latest study showed that the LMA CTrach promoted the shortest apnea time, which can be considered as the major safety criteria for airway management [20]. However, to our knowledge, no study has compared the use of the CTrach between obese and lean patients in the same gender group. To constitute a homogeneous group and to eliminate the anatomical factors that may contribute to the results, we limited our patient population to female patients undergoing gynecological procedures.

Difficult mask ventilation is more common in obese patients [1]. A reduced posterior airway space behind the base of the tongue, together with an increased BMI, and upper airway obstruction after the induction of general anesthesia can cause major collapse of the pharynx and may explain difficult mask ventilation in these patients. In our group of morbidly obese patients, ventilation through the CTrach was easily achieved (ventilation success rate,

Table 2 Characteristics of airway management in obese and lean patients

	Obese group ($n = 30$)	Lean group ($n = 30$)	P
Success rate n (%)			
Ventilation through the CTrach	30 (100)	29 (97)	0.407
Tracheal intubation through the CTrach	29 (96)	27 (90)	0.224
Cormack–Lehane with Macintosh 1/2/3/4 (n)	22/5/3/0	22/4/4/0	0.880
EVGS with CTrach 1/2/3/4 (n)	26/0/0/4	27/0/1/2	0.353
Number of successful intubation attempt (n) 1/2/3	25/4/0	22/5/0	0.224
Time to successful ventilation through the CTrach (s) median, range, 25–75 percentiles	20 (146) 19–25.5	22 (80) 20–32.5	0.33
Total intubation time (s) median, range, 25–75 percentiles	69 (311) 45–126	33 (107) 20–60*	0.001
CTrach No 3/4/5 (n)	0/0/30	0/21/9*	0.000
Airway complications			
Sore throat (n)[a]	2	0	0.492
Dysphagia (n)[a]	5	0	0.052
Blood on the airway (n)	11	2*	0.005

EVGS endoscopic view grading system

[a] Fisher's exact test was used. For all other categorical comparisons, chi-square test was used

* $P < 0.01$ versus obese group

100%). In the patients with poor initial views, full views of the glottis could be obtained after applying simple measures. Although improving the view of the glottis takes time, ventilation of the lungs can be maintained. The requirement to obtain an optimized laryngeal view is likely to have contributed to the longer time to attain intubation in the obese group in our study.

The CTrach may also be useful in establishing an airway in "difficult to ventilate, difficult to intubate" scenarios, and may be left in place to maintain an airway if intubation through it fails.

In comparison with previous data obtained in morbidly obese and lean patients using ILMA [21], our results with CTrach suggest that additional visualization of laryngeal structure allowed optimization of placement of the mask in the pharynx, resulting in reduced intubation times in both groups. With the use of ILMA, in another study [5] that was instituted in morbidly obese patients (BMI > 40), the success rate of tracheal intubation was comparable with our study (96.7%), but the total intubation time was longer than ours. The overall success rates for visualized tracheal intubation were not similar with CTrach in recent studies (80, 84, 92, and 100%, respectively) [11, 22–24]. The CTrach may be an efficient device for intubation in morbidly obese patients, but glottis visualization can be difficult even in experienced hands [11], and epiglottic downfolding is the most common cause [10]. In our study, the glottis was seen fully in 26 of 30 patients (86.6%) in the obese group and in 27 of 30 patients (90%) in the lean group ($P = 0.35$).

It must be kept in mind that our patient population was restricted to female patients, so the results cannot be generalized to all patients.

In conclusion, this study demonstrated that the efficiency of the CTrach was comparable between lean and obese patients. Despite the unquestionable effectiveness of this device in achieving ventilation and tracheal intubation in morbidly obese patients, the CTrach device cannot be recommended as a routine airway for use during general anesthesia in this group of patients.

Conflict of interest We have no conflict of interest.

References

1. Langeron O, Masso E, Huraux C, Guggiari M, Bianchi A, Coriat P, Riou B. Predicting of difficult mask ventilation. Anesthesiology. 2000;92:1229–36.
2. Rose DK, Cohen MM. The airway: problems and predictions in 18,500 patients. Can J Anaesth. 1994;41:372–83.
3. Voyagis GS, Kyriakis KP, Dimitriou V, Vrettou I. Value of oropharyngeal Mallampati classification in predicting difficult laryngoscopy among obese patients. Eur J Anaesthesiol. 1998; 15:330–4.
4. Pelosi P, Croci M, Ravagnan I, Cerisara M, Vicardi P, Lissoni A, Gattinoni L. Respiratory system mechanics in sedated, paralyzed, morbidly obese patients. J Appl Physiol. 1997;82:811–8.
5. Frappier J, Guenoun T, Journois D, Philippe H, Aka E, Cadi P, Silleran-Chassany J, Safran D. Airway management using the intubating laryngeal mask airway for the morbidly obese patient. Anesth Analg. 2003;96:1510–5.
6. Farmery D, Roe PG. A model to describe the rate of oxyhaemoglobin desaturation during apnea. Br J Anaesth. 1996;76:284–91.
7. Benumof JL, Dagg R, Benumof R. Critical hemoglobin desaturation will occur before return to an unparalyzed state following 1 mg/kg intravenous succinylcholine. Anesthesiology. 1997; 87:979–82.
8. Goldman AJ, Rosenblatt WH. The LMA CTrach™ in airway resuscitation: six case reports. Anaesthesia. 2006;61:975–7.

9. Goldman AJ, Wender R, Rosenblatt W, Theil D. The fiberoptic intubating LMA-CTrach™: an initial device evaluation (letter). Anesth Analg. 2006;103:508.
10. Liu EH, Goy RW, Chen FG. The LMA CTrach, a new laryngeal mask airway for endotracheal intubation under vision: evaluation in 100 patients. Br J Anaesth. 2006;96:396–400.
11. Dhonneur G, Ndoko SK, Yavchitz A, Foucrier A, Fessenmeyer C, Pollian C, Combes X, Tual L. Tracheal intubation of morbidly obese patients: LMA CTrach™ vs. direct laryngoscopy. Br J Anaesth. 2006;97:742–5.
12. Bilgin H, Yılmaz C. Awake intubation through the CTrach in the presence of an unstable cervical spine. Anaesthesia. 2006; 61:513–4.
13. Lopez AM, Valero R, Pons M, Anglada T. Awake intubation using the LMA-CTrach™ in patients with difficult airways. Anaesthesia. 2009;64:387–91.
14. Yildiz TS, Solak M, Toker K. The incidence and risk factors of difficult mask ventilation. J Anesth. 2005;19:7–11.
15. LMA NA. LMA CTrach™ instructional manual and trouble-shooting guide. San Diego: LMA N.A.; 2005.
16. Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. Anaesthesia. 1984;39:1105–11.
17. Juvin P, Lavaut E, Dupont H, Lefeure P, Demetriou M, Dumoulin JL, Desmonts JM. Difficult tracheal intubation is more common in obese than in lean patients. Anesth Analg. 2003;97:595–600.
18. Brimacombe JR. Difficult airway management with the intubating laryngeal mask. Anesth Analg. 1997;85:1173–5.
19. Goldman AJ, Rosenblatt WH. Use of the fiberoptic intubating LMA-CTrach™ in two patients with difficult airways. Anaesthesia. 2006;61:601–3.
20. Dhonneur G, Abdi W, Ndoko SK, Amathieu R, Risk N, El Housseini L, Polliand C, Champault G, Combes X, Tual L. Video-assisted versus conventional tracheal intubation in morbidly obese patients. Obes Surg. 2009;19:1096–101.
21. Combes X, Sauvat S, Leroux B, Dumerat M, Sherrer E, Motamed C, Brain A, D'Honneur G. Intubating laryngeal mask airway in morbidly obese and lean patients: a comparative study. Anesthesiology. 2005;102:1106–9.
22. Freid EB. The rapid sequence induction revisited: obesity and sleep apnea syndrome. Anesthesiol Clin N Am. 2005;23:551–64.
23. Timmermann A, Russo S, Natge U, Hever J, Graf BM. LMA CTrach™: initial experiences in patients with difficult to manage airways. Anaesthesist. 2006;55:528–34.
24. Timmermann A, Russo S, Graf BM. Evaluation of the CTrach™: an intubating LMA with integrated fibreoptic system. Br J Anaesth. 2006;96:516–21.