Tracheal intubation of morbidly obese patients: LMA†

CTrach™ vs direct laryngoscopy

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Background. LMA CTrach™ (CT), a modified version of the intubating LMA Fastrach™, allows continuous video-endoscopy of the tracheal intubation procedure. We tested the hypothesis that the CT is efficient for tracheal intubation of morbidly obese patients who are at risk of a difficult airway.

Methods. After Ethics’ Committee approval, 104 morbidly obese patients (BMI >35 kg m⁻²) scheduled for bariatric surgery were included in this prospective study. Patients were randomly assigned in two groups: tracheal intubation using direct laryngoscopy (DL) or the CT. Induction of anaesthesia was standardized using sufentanil, propofol and succinylcholine. Characteristics and consequences of airway management were evaluated.

Results. Preoperative characteristics of patients and consequences of anaesthesia induction on physiological variables were similar in both groups. Difficulty in facemask ventilation was similar in both groups. Tracheal intubation was successfully carried out with DL and CT. Forty-nine per cent of the patients from the CT group required laryngeal mask manipulation (ventilation and view optimization) resulting in increased duration of tracheal intubation by 57 s as compared with DL. Oxygenation was of better quality in the patients managed with CT than with DL. Blind tracheal intubation was mandatory in eight (17%) patients of the DL group, while tracheal intubation was seen in all patients of the CT group.

Conclusion. We demonstrated that the CT was an efficient airway device for ventilation and tracheal intubation in case of a difficult airway in morbidly obese patients.

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The LMA CTrach™ (CT) (SEBAC, Pantin, France) is an autoclavable-modified version of the intubating laryngeal mask airway LMA Fastrach™ (ILMA) (SEBAC, Pantin, France) with two integrated fibreoptic bundles emerging at the distal end of the airway tube. This mask is attached to a full colour viewer that provides the light source and image treatment allowing continuous video-endoscopy of illuminated anatomical structures facing the fiberoptics. This technological evolution is supposed to facilitate positioning of the mask in the pharynx, to optimize laryngeal exposition and to observe the tracheal intubation. The CT became available in our centre in May 2005. Primary clinical experience in normal airway patients demonstrated that CT systematically provided view of the advancing tracheal tube through the glottis. Conversely, our experience of tracheal intubation using direct laryngoscopy (DL) demonstrated that some morbidly obese patients required assisted tracheal intubation without systematic visualization of the glottis. We hypothesized that tracheal intubation with CT would systematically provide visual confirmation of the tube entering the glottis in all patients. We compared CT vs

†LMA® is the property of Intavent Ltd.
LMA CTrach™ in morbidly obese patients

Methods
After institutional review board approval and written informed consent was obtained, 104 elective ASA I–III adult morbidly obese (BMI >35 kg m−2) patients admitted for elective obesity surgery procedures were enrolled. Patients with limited mouth aperture <3.5 cm, symptomatic or untreated gastroesophageal reflux and allergic to succinylcholine were excluded from the study. At the anaesthesia visit, patient characteristics and morphometric upper airway characteristics were recorded. At the preoperative visit, on the evening before surgery, patients were assigned (sealed envelopes) to either DL or CT group. Six senior anaesthetists were involved in this study. Three with a substantial expertise in laryngeal mask airways including ILMA received a similar educational training in use of CT both on mannequin and on patients given by two clinical experts in CT handling, one of them being systematically present in the operating room. They performed tracheal intubation using CT. The three remaining senior physicians managed patient’s airways using DL. All participating physicians were taught to use a single difficulty VAS (VASDIF) to rate facemask ventilation difficulty (VASDIF=0 corresponded to very easy or no difficulty and VASDIF=100 corresponded to major difficulty).

Airway management procedures
In the operating theatre, the patients premedicated with oral hydroxyzine 100 mg and equipped with standard monitoring received 4 min of facemask preoxygenation. With expired oxygen concentration >90%, induction of anaesthesia was achieved using i.v. a first standardized bolus dose of propofol 2 mg kg (lean body mass)−1 and sufentanil 0.2 mg kg−1, and then 30 s later (with possible face mask ventilation), succinylcholine 1 mg kg−1. After completion of induction, manual 100% oxygen facemask ventilation was applied during 60 s before tracheal intubation techniques were attempted. In case of BIS elevation above 50 during airway management, propofol was systematically titrated with additional boluses of 50 mg.

For the DL group, a standard tracheal intubation was performed using disposable Macintosh blades. With Cormack and Lehane laryngoscopy grading view >3 in optimal conditions, a gum elastic bougie (VIGON, Écouen, France) was used to facilitate tracheal tube insertion through the glottis. In case of impossible tracheal intubation (two failed attempts) or ventilation, ILMA insertion was proposed.

For the CT group, sizing and insertion technique of laryngeal masks followed manufacturer’s recommendations. Three manoeuvres applied with the metal handle and performed with the cuff remaining inflated, derived from those described by the inventor of ILMA1 were used to resolve ventilation problems and unsatisfactory visualization: Chandi, down–up–down (DUD: the laryngeal mask is blocked distal in the pharynx, then it is removed by approximately 3–6 cm and replaced more distal) and medial–lateral–medial (MLM: smooth lateralization of the laryngeal mask in the pharynx in which depth of insertion does not vary). With glottis view optimized, a reinforced flexible tracheal tube was inserted through the airway tube and railroaded in the trachea. In case of impossible glottis visualization after two insertions or in case of impossible intubation with the CT correctly placed, DL was proposed.

Airway management data
Duration of tracheal intubation was defined as the time elapsing between picking up the CT or the laryngoscope and measures of expired CO2 confirming tracheal intubation.

For the DL group, the Cormack and Lehane laryngoscopic view was graded, and for the CT group, the following performance parameters of CT were recorded: the number of mask insertion, the quality of initial glottis view using an original endoscopic grading system (EVGS) parallel with 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; and grade 4: no recognizable structure or whiteout screen), final (postmanipulations) EVGS grade and the number of tracheal intubation attempts.

Safety parameters were also recorded including oxygenation quality evaluated by the lowest oxygen saturation related to airway management, the number of patients with oxygen desaturation episode (oxygen saturation ≤92%), the sum of SO2 <92% episodes duration and the occurrence of respiratory events such as laryngospasm, bronchospasm and aspiration.

Statistics
We retrospectively reviewed Cormack and Lehane grades of laryngoscopic view of morbidly obese patients anaesthetized with propofol–remifentanil and succinylcholine in our centre over more than a 1 yr period. We measured an incidence of 17% morbidly obese patients requiring either blind (ILMA and gum elastic bougie) or partially blind (gum elastic bougie) assisted tracheal intubation. This incidence was chosen to determine sample size. We hypothesized that CT would provide tracheal intubation with systematic view of the advancing tracheal tube through the glottis. A total of 104 patients in two randomized groups was required to declare a significant difference with a β=0.9 and α=0.05 in a two-sided test. Results are expressed as mean (SD) unless specified. Chi-square Yates’ corrected, Fisher’s exact and non-parametric Mann–Whitney U-tests were applied as requested for percentages, categorical data and airway management continuous variables. P-values <0.05 were considered statistically significant.
Results
No complications related to anaesthesia and airway management occurred. Both groups were comparable for patient details and preoperative airway assessment characteristics (Table 1). Comparative airway management and safety data are presented in Table 2. In both groups, we found similar facemask ventilation difficulty and oxygenation quality before tracheal intubation was attempted. The tracheal was successfully intubated in all patients with the first line strategy technique. As compared with CT group with DL group with Cormack and Lehane grade >3 required a gum elastic bougie to assist tracheal intubation resulting in totally or partially blind tracheal intubation (P=0.04). Forty-nine per cent of the patients from the CT group required laryngeal mask manipulation (ventilation and view optimization) resulting in increased duration of tracheal intubation by 57 s as compared with DL. Data of airway management with the CT are presented in Table 3. All patients were adequately oxygenated after CT insertion. Five patients required a second CT insertion for optics cleaning before the procedure was finalized and a second attempt of tracheal intubation was requested in four patients.

Discussion
We demonstrated in morbidly obese patients that tracheal intubation performance of the CT was superior to that of DL because it allowed systematic visualization of the tracheal intubation. This promoted better oxygenation during the procedure.

In comparison with previous data obtained in morbidly obese patients using ILMA, our results with CT suggest that additional visualization of laryngeal structure allowed optimization of placement of the mask in the pharynx. This results in reduced tracheal intubation attempts and a 100% tracheal intubation success rate. Such a high success rate for visualized tracheal intubation was not systematically obtained with CT in recent studies. The overall success rate in normal and difficult airway patients was 92, 84 and 80%, respectively. Two important reasons may explain this difference in success rate for visualized tracheal intubation. First, physicians who manipulated the CT in our comparative study were skilled. Before the beginning of the trial, they all received an intense educational programme both on manikin and in-patients supervised by two experts in CT use. Second, physicians using the CT in the present study strictly followed an efficient operating procedure to overcome most situations encountered when using the CT. Interestingly, we obtained initial total or partial glottis view in only a small majority of patients when adequate ventilation was established with the CT. A downfolded epiglottis caused most EVGS grade 4. In case of initial whiteout

Table 1 Patient details and preoperative airway assessment characteristics. DL, direct laryngoscopy; CT, LMA CTrach®. Values are mean (SD) or number. *P<0.05 vs DL group.

Table 2 Comparative airway management data. DL, direct laryngoscopy; CT, LMA CTrach®. Values are mean (SD) or number. *P<0.05 vs DL group. VAS$_{DIF}$, difficulty of facemask ventilation rated using a 100 mm difficulty visual analogue scale. VAS$_{DIF}$=0 corresponded to very easy or no difficulty and VAS$_{DIF}$=100 corresponded to impossible or major difficulty. Duration of tracheal intubation was defined by the time elapsing picking up the LMA CTrach® or the laryngoscope and the measure of expired CO$_2$ confirming tracheal intubation.

Table 3 Airway management data with LMA CTrach® (n=52). Values are % (number of patients). CT, LMA CTrach®. EVGS, endoscopic view grading system of laryngoscopic view (grade 1: entire glottis aperture, grade 2: partial glottis aperture, grade 3: free edge or lingual face of the epiglottis and grade 4: no recognizable structure or whiteout screen).
screen, slow DUD manoeuvre was the best manipulation to optimize glottis view. This particular technique allowed the physicians to almost systematically remove the epiglottis from the bowl of the mask. Our observation confirms the efficiency of other specific adjusting manoeuvres we applied. Deepening the position of the mask combined with Chandi manoeuvre solved all EVGS grade 3. Similarly, combined Chandi and MLM manoeuvres were the most efficient techniques to overpass first plane arytenoids, remove infolded edge of the cuff from the bowl and view lateralized glottis in case of EVGS grade 2. Applying these manoeuvres resulted in tracheal intubation in all patients while viewing the advancing tracheal tube penetrating the glottis. Tracheal intubation with the CT was really a simple gesture in most patients. Four patients required a second tracheal intubation attempt. Gentle manipulations of the metal handle of the CT avoided tracheal tube descent in the fossa pyriformis (n=3). In one patient, tracheal intubation required simultaneous Chandi manoeuvre and external laryngeal pressure to lead the tube in the trachea.

Tracheal intubation was almost 1 min longer with the CT than with DL. This delay is potentially linked to our method. Although controversial, because some authors still advocate rapid sequence intubation without ventilation in all morbidly obese patients, we systematically searched for adequate ventilation before different manoeuvres were undertaken to optimize glottis view. Some authors consider this procedure as a risky technique in the morbidly obese patients, increasing the lag time between loss of consciousness and time to securing the airway. We believe that this stage (36 s mean duration) was important not only because we optimized airway seal but also prevented arterial oxygen desaturation in the patients managed with a laryngeal mask. Because we included morbidly obese patients selected for their low regurgitations risk and normal gastric emptying dynamic, we did not see any aspiration in the bowl of the CT group or regurgitation during laryngoscopy in the DL group. Our results are certainly not exportable to all morbidly obese patients. We are aware that laryngeal masks even correctly placed in the pharynx do not fully protect against aspiration risk.

Although tracheal intubation duration was longer in the CT group, patients received significantly less propofol than in the DL group. Because more patients of the DL group experienced cortical arousal with BIS values above 50, our data suggest that tracheal intubation with the CT is a less intense noxious stimulus than DL. However, our method with quite low threshold for using a gum elastic bougie (Cormack ≥3) has certainly increased the number of laryngoscopy resulting in a more important amount of propofol needed to control BIS variations.

In conclusion, this study demonstrated that LMA CTrach™ was an efficient airway device for ventilation and tracheal intubation in case of a difficult airway in morbidly obese patients.

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References

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