

Intubating Laryngeal Mask Airway in Morbidly Obese and Lean Patients

A Comparative Study

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Background: The intubating laryngeal mask airway (ILMA) was designed using the characteristics of healthy-weight subjects but was shown to be an effective airway device in morbidly obese patients. The authors compared airway management quality in morbidly obese and lean patients with use of the ILMA.

Methods: Fifty morbidly obese and 50 lean patients (mean body mass indexes, 42 and 27 kg/m², respectively) were enrolled in this prospective study. After induction of general anesthesia, characteristics of airway management were judged on safety and efficiency parameters, including success rate at ventilation and intubation and airway management quality criteria, such as the number of patients who required adjustment maneuvers, the number of failed tracheal intubation attempts, the total duration of airway management, and an overall difficulty visual analog scale score.

Results: The ILMA was successfully inserted and adequate ventilation through the ILMA was achieved in all 100 patients. The success rates of tracheal intubation through the ILMA were similar in obese and lean patients (96% and 94%, respectively). The numbers of failed blind tracheal access attempts and patients who required airway-adjustment maneuvers were significantly reduced in obese patients as compared with lean patients. Four obese patients experienced transient episodes of oxygen desaturation (oxygen saturation < 90%) before adequate bag ventilation was established with the ILMA.

Conclusion: The authors confirmed that the ILMA was an efficient airway device for airway management of both lean and obese patients. In the conditions of this study, the authors observed that airway management with the ILMA was simpler in obese patients as compared with lean patients.

THE *intubating laryngeal mask airway* (ILMA) is a pharyngeally inserted airway device proposed for airway

management. This modified form of the laryngeal mask airway has been specially designed to facilitate blind or fiberoptic-guided tracheal intubation.¹ Several clinical studies have shown that adequate ventilation and blind tracheal intubation could be achieved in most cases with the ILMA.^{2,3} The effectiveness of the ILMA was demonstrated in abnormal airways,⁴ particularly in morbidly obese patients.⁵⁻¹⁰ Because the ILMA was initially designed with the help of magnetic resonance imaging studies of healthy-weight subjects but its efficiency was demonstrated in morbidly obese patients, we hypothesized that body mass index would not influence airway management characteristics when the ILMA was used. We prospectively compared the characteristics of airway management with use of the ILMA in morbidly obese and lean patients.

Materials and Methods

After Créteil Hospital (Val-de-Marne, France) Ethics Review Board approval and patients' written informed consent were obtained, 100 adult patients (50 obese patients with body mass index > 35 kg/m² and 50 lean patients with body mass index < 30 kg/m²) scheduled to undergo abdominal, orthopedic, or cardiac surgery were included in this comparative study. Patients with a history of gastroesophageal reflux or with known pathologic airway abnormalities were not included in the study. At the preoperative visit, we recorded the following: Mallampati classification (obtained with the patient in the sitting position, tongue out, with phonation), thyromental distance (measured with the patient in the sitting position, with head in extension), and interincisor distance. Eight senior anesthesiologists with substantial expertise in laryngeal mask airway but with no experience with the ILMA participated in this study. All eight anesthesiologists received similar educational training in the use of the ILMA, using manikins.

During every procedure, a senior investigator who was experienced with the ILMA (> 60 tracheal intubations) and trained in other airway management techniques was present to assist with airway management. The difficult airway trolley present in the operating room contained a gum elastic bougie, laryngeal masks of different sizes, a fiberoptic, and a needle cricothyroidotomy kit. Patients were orally premedicated 1 h before arrival in the operating room with 50-100 mg hydroxyzine. In the oper-

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ating room, the following monitoring was used: electrocardiography, pulse oximetry, noninvasive blood pressure monitoring, and end-tidal carbon dioxide tension monitoring. Preoxygenation consisted of 4 min of spontaneous breathing (100% oxygen through a face-mask). Anesthesia was induced with 2.5 mg/kg propofol and 30 μ g/kg alfentanil given intravenously and maintained with inspired isoflurane (1–1.5%) in oxygen.

Sizes choice and insertion technique were in accord with the manufacturer's recommendations (*LMA-Fastrach*TM; SEBAC, Pantin, France; 2005). After inflation of the ILMA cuff, manual positive-pressure ventilation was attempted. If bag ventilation was adequate (visible chest expansion with oxygen saturation \geq 95% and end-tidal carbon dioxide ranging between 25 and 40 mmHg), patients received 1 mg/kg intravenous succinylcholine to facilitate blind tracheal intubation. The first blind tracheal intubation attempt was performed with a straight-cuffed silicone tube 60 s after succinylcholine administration. If any resistance or evidence of esophageal intubation occurred, the tube was removed, and tracheal intubation was reattempted after the recommended adjustment maneuvers were performed.¹ Three attempts were permitted; if all three attempts failed, intubation was performed with use of conventional laryngoscopy. Adequate ventilation and tracheal intubation were confirmed by breath auscultation and capnography.

The cuff of the ILMA was deflated, and the ILMA was removed with use of a calibrated endotracheal tube stabilizer specially designed to retain the tube in position while the ILMA was rotated out of the oral cavity. Hemodynamic and respiratory variables were recorded at 1-min intervals throughout the procedure.

An independent observer recorded the following characteristics of airway management, which were compared between lean and obese patients. Safety and efficiency were based on the success rate at ventilation and intubation through the ILMA. The quality of airway management was judged on the following parameters: the number of patients who required more than one insertion attempt of the ILMA and/or specific airway-adjustment maneuvers (Chandy maneuver, which consists of rotating and lifting the mask in the sagittal plane with use of the metal handle to facilitate bag ventilation and/or intubation), the number of failed blind endotracheal tube insertion attempts, the total duration of the airway management procedure (time from first picking up the ILMA to removal of the ILMA after tracheal intubation had been achieved), and the overall difficulty of airway management measured on a 100-mm visual analog scale as judged by the physician who managed the airway. Minimum oxygen saturation during airway management and adverse respiratory events such as oxygen desaturation (oxygen saturation \leq 90%), laryngospasm, and bronchospasm were noted.

Table 1. Characteristics of the Patients

	Obese Group (n = 50)	Lean Group (n = 50)
Age, yr	50 (15)	52 (14)
Sex, M/F	27/23	30/20
Height, cm	169 (10)	168 (7)
Weight, kg	113 (17)	68 (9)*
Body mass index, kg/m ²	42 (7)	23 (3)*
Mallampati class		
I	14	24
II	16	16
III	16	10
IV	4	0
Mouth opening, mm	42 (6)	44 (7)
Thyromental distance, mm	63 (13)	70 (9)

Values are presented as mean (SD).

* $P < 0.05$ vs. obese group.

Results are expressed as mean \pm SD or median with 95% confidence interval when distribution was not gaussian. Comparisons of means and medians were performed with the Student *t* test and the Mann-Whitney *U* test, respectively. Categorical data were analyzed with the chi-square test and the Fisher exact test as required. Based on the results of an interim statistical analysis performed with 30 patients in each group, *P* values of less than 0.025 were considered statistically significant.

Results

Demographics of patients were similar between groups, except for weight and body mass index (table 1). Characteristics of airway management are presented in table 2. A transient arterial oxygen desaturation below 90% occurred at induction in four obese patients before ILMA insertion. Mean minimum arterial oxygen saturation values (SDs) during airway management were 96% and 98% in obese⁴ and lean patients,² respectively. As confirmed by adequate ventilation obtained in all patients, the safety of the ILMA was similar in both groups. Efficiency rates of the ILMA were comparable between lean and obese patients, with 94% and 96% success rates, respectively, of tracheal intubation with the ILMA. Regarding airway management quality, obesity was significantly associated with a reduced number of patients who required Chandy adjustment maneuvers ($P < 0.02$) and fewer failed blind intubation attempts with the ILMA ($P < 0.01$). Other quality criteria were similar between lean and obese patients. No bronchospasm, laryngospasm, or accidental extubation (during ILMA removal) was observed in either group.

Discussion

In the current study, we demonstrated that primary airway management with the ILMA was as efficient and safe in morbidly obese as in lean patients. Moreover, we observed that airway management with the ILMA was

Table 2. Characteristics of Airway Management in Obese and Lean Patients

	Obese Group (n = 50)	Lean Group (n = 50)
Safety and efficiency of upper airway management		
Success rate (%) of:		
Ventilation through the ILMA	100	100
Tracheal intubation through the ILMA	96	94
Minimum oxygen saturation, %, mean (SD)	96 (3)	98 (2)
Quality of upper airway management		
Number of patients requiring:		
More than one ILMA insertion	5	7
Airway adjusting maneuvers (Chandy)	13	23*
Number of failed blind tracheal tube insertion attempts	14	27†
Total duration of airway management, s, mean (SD)	160 (51)	187 (114)
Overall difficulty scale (VAS: 0–100), median (IQR 25–75%)	29 (10–40)	38 (15–60)

Safety and efficiency of the intubating laryngeal mask airway (ILMA) were assessed using the success rate at ventilation and intubation with ILMA, and an oxygenation parameter. The quality of upper airway management was judged on the number of patients requiring ILMA manipulation, the number of failed tracheal tube insertion attempts, the total duration of airway management, and the overall difficulty of airway management measured with a 0–100 visual analog scale (VAS). Values are presented as percentage, number, mean (SD), or median (interquartile range [IQR]).

* $P < 0.025$ vs. obese group. † $P < 0.010$ vs. obese group.

simpler in morbidly obese patients as compared with lean patients.

Some case reports have described successful tracheal intubation with the ILMA in obese patients, and a large prospective study with this device in morbidly obese patients has been conducted recently.¹⁰ However, to our knowledge, no study has compared use of the ILMA as a first-step airway management technique between obese and lean patients. Because the ILMA was built according to magnetic resonance imaging studies of healthy-weight subjects,¹ we considered a comparative study between control healthy-weight patients and morbidly obese patients to be mandatory. We hypothesized that body mass index would not influence airway management characteristics using the ILMA. We demonstrated that the safety and efficiency of the ILMA were comparable between lean and obese patients, but according to quality criteria, airway management was simpler in obese as compared with lean patients.

With 100% and 95% success rates at ventilation and intubation, respectively, in most published series, more than 1,000 patients would have been required to perform a sufficiently powered study to demonstrate a significant difference in safety and efficiency at intubation between lean and obese patients. However, after 60 patients, we observed a tendency toward better quality of upper airway management in obese as compared with

lean patients. Based on descriptive statistics of the initial part of the study, the sample size of each group required to reduce by 20% the number of airway adjustment maneuvers and failed intubating attempts with a risk of 0.025 and a power of 0.9 was calculated. One hundred patients were needed to achieve such endpoints. Because of this interim analysis, a P value of less than 0.025 was required to reject the null hypothesis. Although obesity was shown to modify pharyngeal anatomical characteristics and mechanics significantly,^{11,12} our results suggest that ILMA can be used advantageously in overweight patients.

In the scenario of unanticipated difficult airway management, several alternative or rescue techniques have been proposed, but few are able to overcome the problem of simultaneous difficult ventilation and intubation. Unfortunately, the anatomy of morbidly obese patients makes them more liable to present such a life-threatening scenario at induction of anesthesia. Because obesity is significantly related to difficult mask ventilation,¹³ poor tolerance of apnea,^{14,15} and difficult intubation,^{16–18} the ILMA, with its characteristics of permitting both ventilation and intubation, might be the rescue airway device of choice for these patients in whom difficult airway management is encountered. Moreover, we have demonstrated that the ILMA, in the hands of nonexpert anesthesiologists, allowed ventilation within 1 min in all of the obese patients in our study and intubation in less than 2 min in most of them (96%). Our results confirm previous works that showed that the ILMA allowed adequate ventilation when used by non-anesthesiologists^{19–21} and a high success rate of intubation even if placed by inexperienced anesthesiologists.¹⁰ With such effectiveness in achieving adequate ventilation and tracheal intubation in obese patients and 100% successful fiberoptic bronchoscope-assisted intubation through laryngeal airways,²² the ILMA could be proposed as the primary routine airway management technique in this population of patients.

Surprisingly, we observed with the ILMA a trend toward simpler airway management of obese as compared with lean patients. Although they did not reach statistical significance, probably because of large interindividual variability, lower overall difficulty airway management scores as measured by the visual analog scale and a shorter duration of airway management were noted in obese patients as compared with lean patients. We believe that these parameters are closely related, and increasing the sample size of both groups might confirm this strong tendency. When the anesthesiologists responsible for ILMA placement were interviewed, they believed that the ILMA was simpler to insert in the pharynx of obese patients as compared with lean patients. After the ILMA was inserted in the oral cavity, few further manipulations of the upper airway were necessary in the obese group. Fewer ILMA manipulations with use of the

metal handle may be the result of better spontaneous pharyngeal placement of the mask because of the reduced pharyngeal caliber that can be observed in obese patients. Magnetic resonance imaging has shown a decreased pharyngeal area and volume in obesity associated with the deposition of adipose tissue, predominantly in the lateral pharyngeal walls.^{23,24} These lateral fat columns might serve to guide or railroad the ILMA into place during its descent into the pharynx and stabilize its position after cuff inflation. This hypothesis may explain why a sealed airway was more frequently obtained in obese patients as compared with lean patients. However, Archie Brain, M.D. (personal verbal communication, 46^e Congrès de la Société Française d'Anesthésie et Réanimation, Club Respiratoire, Paris, France, September 2004), noted that in normal patients, with the ILMA as opposed to the standard laryngeal mask airway, the narrow convex posterior part of the ILMA, combined with the rigidity of its airway tube, seemed to cause the mask to slip more easily to one side or the other of the oppositely curved midline cervical bodies. He suggested that this tendency might be a factor causing occasional misalignment of the mask with the laryngeal aperture. We believe that these observations may account for our higher incidence of airway-adjustment maneuvers and failed blind intubation attempts in lean patients, resulting in longer and more difficult airway management in some of these patients.

In conclusion, we have shown that, although it was not specifically designed for morbidly obese patients, when used by nonexpert anesthesiologists, the ILMA can provide adequate ventilation and allows tracheal intubation in most of these patients. Although further study is required to confirm our findings, our experience has convinced us that ILMA can be used advantageously in overweight patients.

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