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CLINICAL RESEARCH

Comparison of channelled videolaryngoscope and intubating laryngeal mask airway for tracheal intubation in obese patients: a randomised clinical trial☆

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KEYWORDS
Obesity;
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Abstract
Background: Obesity causes various difficulties in intubation and ventilation, which are confronted due to increased fat tissue in the upper airway and diminished compliance in the chest wall. Videolaryngoscopes and Intubating Laryngeal Mask Airway (ILMA) are good options as recommended by the American Society of Anesthesologists (ASA) difficult airway guidelines. We aimed to compare ILMA and Airtraq (a channeled videolaryngoscope) in obese patients.
Methods: Eighty patients with ASA physical status 1–3, aged between 18 and 65 years and with a body mass index greater than 35 $kg.m^{-2}$, who were undergoing elective surgery requiring orotracheal intubation, were included in the study. Patients were intubated with one of the devices cited.
Results: There was no difference between the number of intubation attempts, insertion times and need for optimisation manoeuvres of Airtraq and ILMA. The intubation with Airtraq was accomplished in a shorter period of time than in that in the ILMA group (29.9 ± 22.1s vs. 50.7 ± 21.2s; $p < 0.001$). A significant difference was found when the times of total intubation were compared (29.9 ± 22.1s vs. 97.4 ± 42.7s; $p < 0.001$). The mean arterial pressure statistically increased after device insertion in the ILMA group ($p < 0.05$).
Conclusions: Airtraq appears to be superior to ILMA in obese patients, with a total of time intubation of less than 60 seconds and with low mean arterial pressure changes. However, ILMA is still a useful tool that provides both ventilation and intubation throughout the whole intubation process.

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PALAVRAS-CHAVE
Obesidade;
Intubação;
Máscaras laríngeas;
Laringoscópios;
Airtraq;
MLI

Comparação de videolaringoscópio com canal e máscara laríngea na intubação traqueal de pacientes obesos: estudo clínico randomizado

Resumo

Justificativa: A obesidade dificulta a ventilação manual e intubação tracheal, devido ao acúmulo de tecido adiposo na via aérea superior e a complacência diminuída na caixa torácica. Os videolaringoscópios e as Máscaras Laríngeas para Intubação (MLI) são alternativas boas para o manuseio da via aérea difícil, de acordo com as diretrizes da Sociedade Americana de Anestesologia (ASA). O objetivo do estudo foi comparar o uso da MLI e do Airtraq, um videolaringoscópio com canal, em pacientes obesos.
Método: Estudamos 80 pacientes com classificação ASA 1–3, com idades entre 18 e 65 anos e índice de massa corporal acima de 35 kg.m^{-2}, submetidos à cirurgia eletiva com indicação de intubação orotraqueal. Os pacientes foram intubados empregando-se um dos seguintes dispositivos: MLI ou Airtraq.
Resultados: Não houve diferença entre o número de tentativas de intubação, tempo de inserção do dispositivo e necessidade de manobras de otimização para o Airtraq e MLI. A intubação com Airtraq foi realizada mais rapidamente do que no Grupo MLI (29,9 ± 22,1s *vs.* 50,7 ± 21,2s; $p < 0{,}001$). Houve diferença significante na comparação do tempo total para intubação (29,9 ± 22,1s *vs.* 97,4 ± 42,7s; $p < 0{,}001$). Houve aumento estatisticamente significante da pressão arterial média após a inserção do dispositivo no Grupo MLI ($p < 0{,}05$).
Conclusões: Airtraq parece ser superior à MLI em pacientes obesos, apresentando tempo total de intubação abaixo de 60 segundos e com menor variação na pressão arterial média. Todavia, a MLI ainda é ferramenta útil que propicia tanto ventilação quanto intubação durante todo o processo de manejo da via aérea.

Introduction

Obesity is a growing health concern today. Obese patients undergoing several surgeries present various challenges during intubation such as large cheeks, increased pharyngeal masses, large tongue, increased neck circumference, short neck and large breasts, all leading to difficult mask ventilation or intubation in these patients.[1,2]

The intubating laryngeal mask airway (ILMA; Fastrach; Laryngeal Mask Co., Henley on Thames, UK) was produced by Airchie Brain to overcome difficult mask ventilation and difficult intubation. It still has a valuable role in unexpected difficult airway algorithms.[3,4]

Airtraq (Prodol Meditec SA., Vizcaya, Spain) is a channeled videolaryngoscope that is superior to direct laryngoscopy in patients with a normal Body Mass Index (BMI), obese patients, and those patients with difficult airways.[5,6] Moreover, Airtraq improved the Cormack-Lehane grades and the Percentage Of Glottis Opening (POGO) scores when compared with other types of videolaryngoscopes in obese patients.[7]

This is the first trial to compare Airtraq and ILMA in class II–III obese patients (BMI > 35 kg.m^{-2}) based on the number of intubation attempts, insertion times, intubation times, need for optimisation manoeuvres, effects on haemodynamic variables and minor postoperative complications.

We hypothesised that Airtraq would provide shorter intubation times in obese patients compared with ILMA. Our primary outcome was the orotracheal intubation and the total number of orotracheal intubation times in patients.

Material and methods

This study was approved by the Local Human Research Ethics Committee and written informed patient consent was obtained from each patient. This trial was also registered at www.clinicaltrials.com NCT02969889. Eighty patients with an American Society of Anesthesiologists (ASA) physical status of 1–3, between the ages of 18 and 65 years, who had class II–III obesity with a BMI greater than 35 kg.m^{-2}, undergoing elective surgery requiring orotracheal intubation were enrolled in this prospective randomised study.

Patients with a history of difficult intubation, pregnant patients, those who had a BMI less than 35, limited mouth opening of less than 3 cm, who were un-fasted less than 8 hours or had upper respiratory tract infection were excluded from this study.

Patients were pre-medicated with Intravenous (IV) midazolam 0.03 mg.kg^{-1} in the preoperative care unit. When patients arrived in the operating room, standard anesthesia monitoring, including electrocardiogram, noninvasive blood pressure, heart rate, pulse oximetry (SpO_2) and end-tidal carbon dioxide were applied. Demographic (age, gender, weight, height, BMI, ASA physical status) and airway variables (thyromental distance, sternomental distance, interincisor distance, neck circumference, Mallampati, normal head flexion and extension were recorded in the operating room. Mandibular protrusions were classified as follows: A) Lower incisors protruded more than upper incisors, B) Lower incisors could be brought edge to edge with the upper incisors and C) Lower incisors could

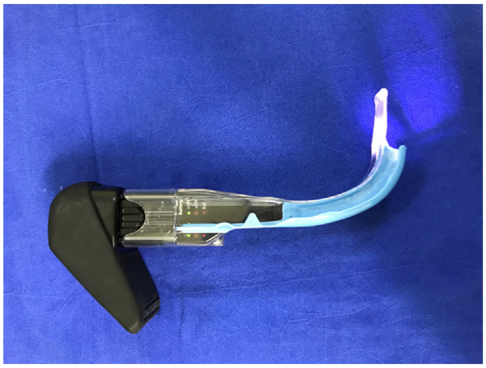

Figure 1 Airtraq videolaryngoscope.

not be brought to the upper incisors). Teeth morphology (full/lack/absent) was also recorded in the operating room. All patients were pre-oxygenated in a 25° ramped position using a facemask with 5 $L.min^{-1}$ 100% O_2 for a period of 3 to 5 minutes. Patients were divided into two groups using the sealed envelope technique; the standard Airtraq (with the tube guidance channel) and the ILMA Groups. In the Airtraq Group, a 7.5 mm lubricated polyvinylchloride endotracheal tube was used for women and an 8.0 mm tube was used for men. In the ILMA group, a 7.0 mm lubricated dedicated ILMA tube was used for women and an 8.0 mm was used for men. The original ILMA introducer was used for the insertion of the tube into the trachea. In the standard Airtraq Group, the endotracheal tube was lubricated and inserted in the Airtraq channel before starting the intubation process (Fig. 1). For optimal visualisation (the best Cormack-Lehane view that we gained) and insertion, the reinsertion manoeuvre and handling force manoeuvres were applied in the Airtraq Group. As soon as optimal visualisation was achieved, the endotracheal tube was advanced into the trachea. In the ILMA Group, an ILMA n° 5 was fully deflated and the posterior wall of the ILMA was lubricated with 10% lidocaine spray. The ILMA n° 5 was the largest ILMA used for patients with a body weight greater than 70 kg. The ILMA was inserted, and the cuff was inflated according to the manufacturer's recommendations.[8]

The ILMA number was chosen according to the patient's weight and height: ILMA 3 (30-50 kg, <160 cm); 4 (50-70 kg, 160-170 cm); and 5 ($\geq$70 kg, $\geq$170 cm).

Patients were intubated after optimal ventilation was achieved. To achieve optimal ventilation, the following manoeuvres were used if needed: up-down manoeuvre, Chandy manoeuvre, handling force manoeuvre or the Medial Lateral Medial (MLM) manoeuvre.

The up-down manoeuvre consists of pulling back the ILMA 6 cm towards the mouth while inflated, then inserting it again. The Chandy manoeuvre consists of pulling the handle downward and elevating the tip of the ILMA while in place. The MLM manoeuvre consists of turning the ILMA right or left in place. The Handling force maneuver consists of pulling the ILMA on the horizontal line.

General anaesthesia was induced with IV propofol 3 $mg.kg^{-1}$ according to the lean body weight and fentanyl 1 $\mu g.kg^{-1}$ according to the actual body weight. The ease of facemask ventilation was recorded as follows: easy, airway, two-handed + jaw-thrust, oxygen flush and impossible. Then 0.6 $mg.kg^{-1}$ IV rocuronium was administered for muscle relaxation and dosed on the ideal body weight of the patient.

Ideal body weight (kg) = Height (cm) − X (where X = 110 in females and 100 in males.[9]

We recorded the insertion time, orotracheal intubation time and total orotracheal intubation time for each of the patients. Cormack-Lehane grades during videolaryngoscopy were recorded only in the Airtraq group.

Insertion time

For the Airtraq group, insertion time was measured from the time the device entered the oral cavity until optimal glottis visualisation occurred. Reinsertion of the device (turning the Airtraq right or left in place), slight removal of the device (backward) and handling force manoeuvres were included in this time period. For the ILMA Group, insertion time was measured from the time that the ILMA entered the oral cavity until optimal ventilation occurred. The up-down, Chandy, MLM and handling force manoeuvres were included in this elapsed time period.

Orotracheal intubation time

For the Airtraq Group, the elapsing time was from the time the device entered the oral cavity until the visualization of the tube entering through the vocal cords. If resistance was felt during tube adjustment, then manoeuvres were applied, which included a 90° anti-clockwise rotation, cricoid pressure, head flexion and cuff inflation manoeuvres. For the ILMA Group, the elapsing time was from the time the ILMA entered the oral cavity until the endotracheal tube was inserted.

Total orotracheal intubation time

This was the total time elapsing from the time the device entered the oral cavity until the confirmation of intubation from the capnograph.

Systolic blood pressure, diastolic blood pressure, Mean Arterial Pressure (MAP), Heart Rate (HR) and SpO_2 values were recorded at baseline (preoperatively), after anaesthesia induction, after the insertion, 1 minute after intubation and at 1 minute intervals, twice, by an independent unbiased observer peroperatively in the operating room. If the patient could not be intubated after three attempts or after 120 seconds, it was recorded as failure of the device and she/he was intubated with a Macintosh laryngoscope. All intubations were performed by individuals with at least 5 years of anaesthesia experience and at least 20 successful orotracheal intubations with the standard Airtraq and the ILMA. SpO_2 less than 92 was recorded as hypoxaemia. Oesophageal intubation, teeth, tongue, lip or mucosal damage (bloodstaining on the device) were also recorded in the operating room. Minor complications such as sore throat, hoarseness, dysphagia, bronchospasm, hypoxia, nausea and vomiting were recorded by a blinded observer postoperatively in the postoperative care unit.

We based our sample size according to the Dhonneur et al.[5] study, in which they found the intubation times of the standard Airtraq to be 37 ± 6s, and the Arslan et al.[10] study, in which they found the intubation time of ILMA to be 78 ± 84s. Based on these data, $\alpha = 0.05$ and $\beta = 0.1$, we calculated our sample size as 37 patients for each group. We decided to enroll 40 patients per group, for a total of 80 patients, to account for possible exclusions.

The analysis was made using Statistical Package of Social Sciences (SPSS) for Windows 16.0 (SPSS Inc., Chicago, IL, USA). Continuous data were examined for normal distribution with the Kolmogorov-Smirnov test. For normally distributed data, we used analysis of variance (ANOVA); we used the Kruskal-Wallis test for non-normally distributed data. For continious comparisons of the groups, the paired sample *t* test was used. Normally distributed data were given as mean ± Standard Deviation (SD). Categorical data was calculated with the Monte Carlo (Chi-Square) test, and $p < 0.05$ was considered statistically significant.

Results

Eighty patients were enrolled in the study. The demographic variables and airway characteristics of patients were similar between the groups (Tables 1 and 2). The head flexions and extensions of all patients were normal. One patient in the ILMA Group could not be intubated and was intubated with a Macintosh laryngoscope. The airway management parameters of the 79 intubated patients were then analysed (Table 3). Insertion times, number of intubation attempts and the need for optimisation manoeuvres were similar between the groups (Table 3). However, the intubation and the total intubation times were longer in the ILMA Group ($p < 0.001$) (Table 3). In the Airtraq Group, 32% required the reinsertion manoeuvre and 15% required the handling force manouevre in order to obtain optimal view. In the ILMA Group, 25% required the up-down manoeuvre, 30% required the Chandy manoeuvre and 10% required MLM manoeuvres in order to achieve optimal ventilation. There was no need for head flexion, cuff inflation or cricoid pressure in any of the patients with the use of the Airtraq. The total intubation success rate in the Airtraq Group was 100% and 97% in the ILMA Group in morbidly obese patients. In the Airtraq Group one patient's SpO_2 decreased to 95%, but it did not go below 92% for any of the patients. The MAP was increased after device insertion in the ILMA Group ($p < 0.05$) (Table 4). Heart rate changes were comparable between the groups. The groups were comparable regarding minor complications (Table 5).

Discussion

The main result of this prospective randomised study is that the use of the Airtraq significantly shortened the duration of intubation when compared with ILMA in obese patients (BMI > 35).

The total intubation success rates were recorded to be between 80% and 100% in obese patients with the Airtraq.[5,11,12] According to our results, the first intubation success rate of the Airtraq in obese patients was 85% and the total intubation success rate was 100%. The increased success rate in our study was due to the skill variety of skill of the providers.

A study showed the average time for intubation with Airtraq in obese patients (BMI > 40) to be 17.3 ± 16.1 seconds in experienced hands. Intubation with Airtraq was easy in 96% of obese patients; 91.3% of patients were intubated on the first attempt; and the total intubation success rate was 100%.[13] However, the intubation time of Airtraq in our study was higher than the aforementioned study and similar to the previously published literature in obese patients (approximately 29s).[5,11,12]

Previous studies that investigated intubation with ILMA in obese patients after optimal ventilation was achieved recorded 96% to 100% total intubation success rates.[4,10,14] Following the same procedure, we found the first intubation success rate to be 77% and the total intubation success rate to be 97% in obese patients in this study. Even as a blind intubation tool, ILMA is much more effective and provides faster intubation when compared with its video versions.[10,15] Frappier et al.[14] showed that the ILMA's total intubation success rate was 96.3%, and this rate did not differ among lower or higher Cormack-Lehane grades in obese patients. We already knew from the previous literature that the Cormack-Lehane grade 3–4 was higher in obese patients.[16,17] Ventilation was achieved in 97% of the obese patients, and 84% of the obese patients were intubated successfully with the first attempt and a total intubation success rate of 95%.[18]

Ventilation through ILMA was achieved in 18 to 29 seconds in experienced hands and with an overall success rate of 95%.[10,15,19] Dolbneva et al.[20] did a study with ILMA in 50 patients with BMI greater than 40 and recorded the insertion time to be approximately 7.2 seconds, providing intubation in 17 seconds. Ventilation through ILMA was successful in 100% of these cases. They did not try to achieve optimal ventilation and used manoeuvres as well. As such, they were able to intubate faster than that of our result rates and the previous literature.[4,10,14] Our results for previous intubation time with ILMA in obese patients was recorded to be approximately 57 seconds.[10] Total intubation time with ILMA was found to be between 78 and 160 seconds.[4,10,14] The first intubation success rate was 90% and the total intubation succes rate was 94%. We observed no complications whatsoever. In this trial we found the total intubation time to be 97 seconds. This large variation was due to varying provider experience.

ILMA remains on hand as a rescue device in many hospitals for obese patients (BMI > 30) and for expected or unexpected difficult airways.[1,21] ILMA has been successfully used in obese patients in novice hands, and has demonstrated better results than fibreoptic, Bullard or Trachlight. Novice physicians could ventilate and also intubate obese patients (BMI > 30) with ILMA in 55 ± 6.6 seconds and a 100% intubation rate in the first attempt.[22] It is a useful tool for out-of-hospital procedures as well.[23] In obese patients with lingual tonsillar hyperthropy, ILMA was used as a rescue device after failed tracheal intubation using Trachlight.[24]

Gaszynski T et al.[11] demonstrated that Airtraq required manoeuvres for glottic optimisation in 16% of obese patients. However, they did not identify these manoeuvres. We used the re-insertion manoeuvre in 32% of the patients and the handling force manoeuvre in 15% of the patients

Table 1 Demographic variables.

	Airtraq (n = 40)	ILMA (n = 40)	*p*
Age (years)	49.7 ± 12.7	51.7 ± 11.8	0.4
Height (cm)	163.1 ± 8.9	160.4 ± 6.8	0.2
Weight (kg)	115.8 ± 17.4	112.4 ± 17.1	0.4
Gender (Female/Male)	33/7	37/3	0.2
ASA (1/2/3)	9/30/1	3/37/0	0.1
BMI ($kg.m^{-2}$)	43.5 ± 5.1	43.6 ± 5.5	0.9

Values are given as mean ± SD or as numbers (n).

Table 2 Airway characteristics.

	Airtraq (n = 40)	ILMA (n = 40)	*p*
Thyromental distance (cm)	7.8 ± 1.7	8.3 ± 1.8	0.2
Sternomental distance (cm)	13.6 ± 2.2	13.9 ± 2.1	0.7
Interincisor distance (cm)	4.5 ± 0.8	4.7 ± 0.9	0.3
Neck circumference (cm)	44.4 ± 4.7	43.3 ± 3.38	0.1
Teeth morphology			
Full/Lack/Absent	33/5/2	38/1/1	0.2
Mallampati (I/II/III/IV)	9/14/14/3	7/17/14/2	0.9
Mandibula protrusion (A/B/C)	40/0/0	39/1/0	0.3
Facemask ventilation			
Easy/airway/two-handed/O_2 flush	14/15/10/1	13/20/7/0	0.5

Values are given as mean ± SD or as numbers (n).

Table 3 Airway management values of patients.

	Airtraq (n = 40)	ILMA (n = 39)	*p*
Number of intubation attempts (I/II/III)	34/6/0	31/7/1	0.6
Insertion time (s)	14.6 ± 11.3	15.7 ± 6.4	0.3
Intubation time (s)	29.9 ± 22.1	50.7 ± 21.2	< 0.001[a]
Total intubation time (s)	29.9 ± 22.1	97.4 ± 42.7	< 0.001[a]
Manoeuvre (Present/Absent)	22/18	16/23	0.3
SpO_2 (%)	98.9 ± 1.2	98.7 ± 2.1	0.7

Values are given as mean ± SD or as numbers (N).
[a] $p < 0.001$

Table 4 MAP values of the Airtraq and the ILMA groups; baseline, after anaesthesia induction, after device insertion, 1 minute after intubation and at 1-minute intervals twice.

MAP (mmHg)	Airtraq (n = 40)	ILMA (n = 39)	*p*
Baseline	113.4 ± 14.8	116.4 ± 16.4	0.4
After anaesthesia induction	95.9 ± 19.5	99.8 ± 21.9	0.4
After device insertion	102.7 ± 19.5	114.3 ± 29.3	0.04[a]
1 min after intubation	92.6 ± 23.6	95.2 ± 23.0	0.6
2 min after intubation	87.0 ± 20.4	86.8 ± 17.6	0.9
3 min after intubation	83.5 ± 18.5	81.7 ± 15.2	0.6

Values are given as mean ± SD.
[a] $p < 0.05$; β; $p < 0.001$.

in order to achieve view optimisation. On the other hand, another trial by Dhonneur et al.[5] required the handling force manoeuvre in 42% of obese patients during intubation with Airtraq. Putz and coleagues[25] did not need to use any manoeuvres while intubating obese patients with Airtraq.

It was previously demonstrated that the need for the Chandy manoeuvre decreased in obese patients when compared with lean patients (46% vs. 26%) to achieve optimal ventilation with the ILMA.[4,10] We demonstated comparable results in this trial as 30% of our obese patients required the

Table 5 Perioperative or postoperative minor complications.

	Airtraq (n = 40)	ILMA (n = 39)	*p*
Perioperative mouth damage			
Present/Absent	0/40	2/37	0.2
Perioperative mucosal damage			
Present/Absent	5/35	3/36	0.7
Postoperative dysphagia			
Present/Absent	4/36	4/35	1
Postoperative sore throat			
Present/Absent	5/35	9/30	0.3
Perioperative teeth damage			
Present/Absent	0/40	0/39	1
Postoperative hoarseness			
Present/Absent	0/40	0/39	1
Perioperative oesophageal intubation			
Present/Absent	1/39	2/37	0.6

Values are given as numbers (n).

Chandy manoeuvre to achieve optimal ventilation. The up-down manoeuvre was used in 25% of our patients, and MLM manoeuvre was used in 10% of our patients in this trial.

Mucosal damage occured in 19% of patients who were intubated with Airtraq in the previous study.[12] This rate was 12% in our trial.

Detected mucosal damage ranged between 9% and 17% in the previous ILMA studies.[10,14] We found it to be 7% in our trial.

There are some limitations of our study; first, the provider was not blinded to the devices being used in this trial. Second, we used only ILMA n° 5 because this is the biggest ILMA that is produced. If a larger ILMA were available, such as n° 6, the results would be different.[26] Third, our patients were mostly women. If there had been mostly men, the results would be different and the intubation difficulty would vary as well.[27] Fourth, the difference in the calibre of the tracheal tubes in women may have changed the results.

In conclusion, Airtraq was demonstrated to be superior in terms of providing a shorter intubation duration of approximately 60 seconds when compared with ILMA, and this made it a suitable airway device in obese patients who experienced decreased oxygen reserves. Both Airtraq and ILMA required manoeuvres to achieve optimal visualisation and ventilation. ILMA increased the MAP after insertion. However, the groups were comparable regarding heart rate changes and minor complications.

Conflicts of interest

The authors declare no conflicts of interest.

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