

# Reevaluation of the Airways of Obese Patients Undergone Bariatric Surgery after Reduction in Body Mass Index

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**Summary:** Lima Filho JA, Ganem EM, Cerqueira BGP – Reevaluation of the Airways of Obese Patients Undergone Bariatric Surgery after Reduction in Body Mass Index.

**Background and objectives:** Difficulty intubating is a cause of mortality in anesthesiology and it can be related to obesity. The diagnosis of difficult intubation contributes for successful airways management. However, parameters that predict difficult airways are not well established. Mallampati classification, the interincisor gap, neck circumference, thyromental distance, and the presence of obstructive sleep apnea, are parameters that can indicate difficult intubation. Surgical treatment of obesity provides reduction in body mass index (BMI) with stabilization after about 2 years. The objective of the present study was to reevaluate the parameters described above and compare them with pre-surgical values.

**Methods:** The BMI, Mallampati classification, neck circumference, interincisor gap, thyromental distance, and the degree of obstructive sleep apnea in polysomnography were evaluated in 51 patients of both genders in the preoperative period. Two years after the surgery and reduction of the BMI to  $< 35 \text{ kg.m}^{-2}$ , predictor factors of difficult airways were reevaluated by another anesthesiologist who knew the patients' BMI before surgery. Nine patients were excluded. The new reevaluation was performed, and for those who did not have another polysomnography the somnolence scale of Epworth was applied.

**Results:** Forty-two patients were reevaluated. They showed a reduction in BMI and neck circumference, and an increase in both interincisor gap and thyromental distance. Only one patient showed a reduction in Mallampati scale, and only 4 patients performed polysomnography.

**Conclusions:** Reduction of the BMI allows for an increased interincisor gap, thyromental distance, and reduction in neck circumference. Mallampati classification remains the same.

**Keywords:** Obesity; Body Mass Index; Airway Management; Intubation.

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## INTRODUCTION

Difficulty intubating is a cause of mortality in anesthesiology, and the identification of factors that predispose it is fundamental to prevent it.

Factors for prevention of difficult intubation are not well established and at least 30% of difficult airways are undetected <sup>2,3</sup>.

Mallampati classification, interincisor gap, neck circumference, thyromental distance, among others are used to identify probable difficult intubation <sup>4,5</sup>.

Some groups of patients such as obese patients have a higher probability of difficult intubation. Due to their anatomic and physiologic characteristics they develop oxygen desaturation due to faster hemoglobin than in non-obese patients especially in the supine position <sup>6,7</sup>.

Obstructive sleep apnea syndrome (OSAS), whose incidence in obese patients varies from 39% to 71%, can be an indicator of difficult intubation being related to a reduction in pharyngeal space and narrowing of the airways due to deposit of fat tissue. Gastroesophageal reflux is more common in obese patients favoring regurgitation and bronchial aspiration <sup>8</sup>.

Since the world population of obese people has been increasing, and this could be associated with several comorbidities, one would expect an increase in the number of surgical procedures in those patients, and the anesthesiologist must be aware of the peculiarities of obese patients <sup>6</sup>.

Surgical treatment of obesity is indicated in patients with a body mass index (BMI)  $> 40 \text{ kg.m}^{-2}$  or  $> 35 \text{ kg.m}^{-2}$  associated with severe cardiopulmonary comorbidity or severe diabetes, and those who did not lose weight after non-surgical therapeutic treatment <sup>9</sup>.

Roux-en-Y Gastric Bypass (RYGB) is the gold standard for bariatric surgeries because it combines gastric restriction with a minimal degree of malabsorption. This treatment provides a maximal weight reduction around  $10 \text{ mg.m}^{-2}$  over 12 to 24 months, which stabilizes in approximately 2 years <sup>8</sup>. Reduction of comorbidities such as diabetes mellitus, hypertension, and obstructive sleep apnea syndrome (OSAS) is the greatest benefit of this treatment <sup>9</sup>.

Thus, the objective of the present study was the reevaluation of the airways of obese patients undergone bariatric surgery after they reached a reduction of their BMI using the Mallampati classification, thyromental distance, interincisor gap, neck circumference, and degree of OSAS and compare with the values observed in the preoperative period.

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## METHODS

After approval by the Research Ethics Committee of the *Hospital Espanhol* and signing of the informed consent, 52 patients of both genders with BMI higher than 35 kg.m<sup>-2</sup> who underwent bariatric surgery under general anesthesia with tracheal intubation, from April 01, 2004 and May 16, 2007, participated in this study.

Inclusion criteria were patients with BMI > 35 kg.m<sup>-2</sup> and at least 24 months after the surgery.

Patients with BMI > 35 kg.m<sup>-2</sup> with recent anomaly or trauma in the cervical region, gravidas, and those who refused to participate in the study were excluded.

During the preanesthetic evaluation before bariatric surgery the following parameters were measured: BMI (kg.m<sup>-2</sup>), neck circumference (at the level of the cricoid cartilage), interincisor gap (with maximal mouth opening), thyromental distance (from the upper margin of the thyroid cartilage to the inferior margin of the mandible with the patient in dorsal decubitus and cervical extension), the degree of OSAS measured by polysomnography, and Mallampati classification (with the patient in the sitting position, after he exposes his/her tongue, without speaking).

All patients in this study were evaluated in the preoperative period and anesthetized by the same anesthesiologist, who did not participate in the post-surgical evaluation two years after bariatric surgery.

After reduction in BMI had been stable the patients were called for reevaluation of their airways, which was performed by another anesthesiologist who only knew the preoperative BMI of the patient.

After verifying the reduction in BMI to below 35 kg.m<sup>-2</sup>, evaluation of the airways of the patient was performed: Mallampati classification, interincisor gap, thyromental distance, and degree of OSAS.

In cases in which polysomnography was not possible, the Epworth somnolence scale which evaluates the probability of

the patient taking a nap attributing points ranging from zero to three was applied: zero, no chance of taking a nap; 1, a small chance; 2, moderate chance; and 3, increased chance of taking a nap in the following situations:

- sitting down, reading
- watching TV
- sitting in a public place, without activity
- as a passenger in a train, car, or bus
- laying down in the afternoon to rest
- sitting down, talking to someone
- sitting down quietly after lunch, without taking alcoholic beverages
- driving in heavy traffic, stopping for a few minutes

The patient does not have somnolence when the sum of the scores is equal to or lower than 10, according to the recommendations of the original publication<sup>10</sup>.

The Chi-square ( $\chi^2$ ), Fisher exact, and Wilcoxon tests were used in the statistical analysis, and a  $p < 0.05$  was considered statistically significant.

## RESULTS

Fifty-one obese patients with prior preoperative evaluation of the parameters suggestive of difficult intubation who underwent bariatric surgery under general anesthesia with tracheal intubation were selected.

Nine of those patients did not participate in the study: five for refusing to participate, one who was in the seventh month of pregnancy, and three patients who did not show a reduction in BMI at the time of evaluation. Therefore, 42 patients were evaluated.

Table I shows the pre- and postoperative parameters and after reevaluation. Separated by genders, Table II shows the values for male patients and Table III shows the values for female patients, which were statistically significant for reduction

**Table I** – Clinical Characteristics of Patients

	Before	After	p
Age (years)*	42.5 ± 11.6 (43.5)	45.7 ± 11.5 (47.0)	< 0.001**
Minimal and maximal	20 and 65	23 and 68	
Gender - n (%)			
Male	17 (40.5%)	-	
Female	25 (59.5%)	-	
BMI*	40.7 ± 3.4 (40.8)	27.2 ± 3.1 (26.8)	< 0.001**
Minimal and maximal	35.4 and 48.7	21.2 and 34.4	
Neck circumference (cm)*	42.2 ± 4.8 (43.0)	35.8 ± 3.8 (34.0)	< 0.001**
Minimal and maximal	37 and 47	30.5 and 44.5	
Weight*	113.6 ± 21.3 (112.0)	75.8 ± 15.3 (76)	< 0.001**
Minimal and maximal	78 and 168	46 and 110	
Mallampati classification*	3.2 ± 0.8 (3.0)	3.1 ± 0.8 (3.0)	0.31 #
Minimal and maximal	2 and 4	2 and 4	
Interincisor gap (cm) *	4.8 ± 0.9 (4.5)	6.4 ± 0.9 (6.5)	< 0.001#
Minimal and maximal	3.5 and 8.0	4.0 and 8.0	
Thyromental distance (cm) *	7.9 ± 1.0 (8.0)	8.8 ± 0.9 (9.0)	< 0.001#
Minimal and maximal	4.0 and 10.0	7.0 and 11.0	

\*: Results expressed as Mean ± Standard deviation (median); \*\*: Paired t test; # Wilcoxon test.

**Table II** – Percentage Reduction in Male Patients Before and After the Surgery

Clinical Characteristics	Before	After	Percentage reduction
BMI (kg.m <sup>-2</sup> )	41.54	27.2	34.5% *
Neck circumference (cm)	47.2	39.3	16.7% *
Weight (kg)	128.4	85.8	33.2% *
Mallampati classification	3.2	3.18	0.02%
			Percentage increase
Interincisor gap (cm)	5	6.9	38.0% *
Thyromental distance (cm)	7.8	8.9	14.1% *

BMI: body mass index; \* p < 0.001.

**Table III** – Percentage Reduction in Female Patients Before and After Surgery

Clinical Characteristics	Before	After	Percentage reduction
BMI (kg.m <sup>-2</sup> )	40.2	27.2	32.3% *
Neck circumference (cm)	40.5	33.3	17.8% *
Weight (kg)	103.4	85.8	17.0% *
Mallampati classification	3.1	3.1	0.0%
			Percentage increase
Interincisor gap (cm)	4.6	6.2	34.8% *
Thyromental distance (cm)	8	8.8	10.0% *

BMI: body mass index; \* p < 0.001.

of BMI and neck circumference and increase in thyromental distance and interincisor gap. Classes of the Mallampati classification did not change.

Table IV describes the results comparing values according to gender. Figure 1 shows the degree of sleep apnea before the surgery as measured by polysomnography. Only 10% of the study population repeated this exam after reduction in BMI.

**Table IV** – Comparison of the Percentage Reduction and Increase in Clinical Characteristics of Patients in Relation to Gender

Clinical characteristics	Male (n = 17)	Female (n = 25)	p
Percentage reduction			
BMI (kg.m <sup>-2</sup> )	34.5%	32.3%	0.88
Neck circumference (cm)	16.7%	17.8%	0.92
Weight (kg)	33.2%	17.0%	0.22
Mallampati classification	0.02%	0.0%	-
Percentage increase			
Interincisor gap (cm)	38.0%	34.8%	0.83
Thyromental distance (cm)	14.1%	10.0%	0.68

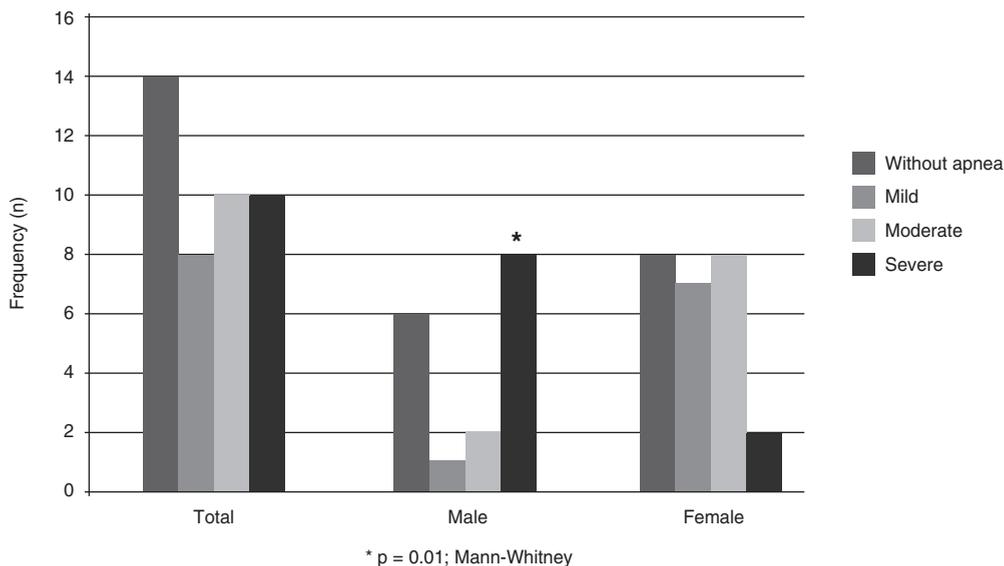
BMI: body mass index.

**DISCUSSION**

Careful preoperative evaluation of patients increases the possibility of detecting parameters that could suggest the presence of difficult airways, but with inadequate sensitivity and specificity<sup>12</sup>. Studies analyzing clinical parameters associated with difficult intubation showed sensitivity and positive predictive factor ranging from 33% to 71%<sup>13</sup>.

It has been describe in the literature that an increase in BMI, small thyromental distance, short and enlarged neck, macroglossia, and small opening of the mouth are related with intubation<sup>14-19</sup>.

The relationship between the distribution of fatty tissue in the thorax and in the anterior region of the neck and difficulty intubating can compromise management of the airways. In android obesity, more common in males, a predominance of fat in the superior portion of the body is seen while in gynoid



**Figure 1.** Frequency in absolute numbers (n) of the total number of patients, regardless of their gender and separated by gender who did not have apnea and with mild, moderate, and severe degrees of OSAS before bariatric surgery.

obesity accumulation of fat is seen in inferior portions of the body. Consequently it seems that access to the airways of male patients is more difficult, since the fat tissue deposited in the cervical region limits its mobility and reduces the space of the oral cavity<sup>20-22</sup>.

Using magnetic resonance imaging to evaluate the conformity of the face and neck an excess of fat in the submandibular region was observed even in patients with normal BMI. The accumulation of fat in the neck is more pronounced in males although the percentage of body fat is higher in females<sup>23</sup>.

When the amount of fat in the anterior cervical region of obese patients was quantified by ultrasound and related with the difficulty in handling their airways, it was demonstrated that the higher the concentration of adipose tissue the higher the chances of difficulty to intubate. Neck circumference is closely related to the accumulation of fat in the cervical region<sup>24</sup>.

Increased neck circumference is a predictor of difficult intubation<sup>25</sup>. In the present study, neck circumference values were not higher than 60 cm. Mean prior levels were 42.2 cm and after stabilization of weight loss they were reduced to 15.2%. The reduction in neck circumference is related with the reduction in adipose tissue in the anterior region of the neck, which can facilitate manipulation of the area and consequently its management.

Thyromental distance is an indicator of the mandibular space where the tongue will be displaced by the laryngoscope<sup>26</sup>.

In the present study mean values of thyromental distance prior to bariatric surgery were 7.9 cm and after the surgery this parameter increased by 11.4% showing that the reduction of fat in the submandibular region favors better neck extension.

Interincisor gap evaluates mouth opening. It indicates the mobility of the temporomandibular joint and the degree of difficulty to insert the laryngoscope. A consensus between this parameter and difficulty to intubate does not exist<sup>27</sup>. Interincisor gap increased by 33.3% in the present study. Better mouth opening favors manipulation of the oral cavity and facilitates laryngoscopy.

From Mallampati classification one can estimate the relationship between the size of the tongue and oral cavity, the possibility of dislocating the tongue by the laryngoscope blade, and whether mouth opening allows tracheal intubations. Besides pharyngeal structures Mallampati classification also evaluates neck and head mobility<sup>28-31</sup>.

Decreased visibility of oropharyngeal structures is associated to greater difficulty in direct laryngoscopy. There is a correlation between Mallampati classification and Cormack and Lehane score for the diagnosis of difficult laryngoscopy<sup>28</sup>.

In obesity, when weight gain is followed by an increase in the size of the tongue so that the proportion between the tongue and pharyngeal structures are altered, the possibility of difficult laryngoscopy exists. Incapability of visualizing the posterior pharyngeal wall in this population is two times higher than in non-obese patients. There is a positive correlation between BMI and higher Mallampati classification<sup>32</sup>.

In the present study, only one male patient showed reduction in Mallampati classification after reduction of the BMI. This patient went from class IV to class III. The lack of reduction in Mallampati classification shows visualization of posterior laryngeal structures not related to accumulation of fat in the anterior neck region and for this reason weight loss did not reflect in changes in this parameter.

Obstructive sleep apnea syndrome occurs during sleep due to changes in the airways. Muscle tonus is decreased, leading to collapse of the pharynx and fall of the tongue. Partial or complete obstruction of the airways, similar to that observed during sedation, occurs as a consequence; this could be related with difficult intubation<sup>33,34</sup>. An association between obesity and OSAS exists<sup>35</sup>.

In the present study, all patients performed preoperative polysomnography. However, after reduction in BMI only 10% of the patients redid this test since the remaining 90% did not show symptoms of OSAS anymore.

Epiworth scale which evaluates somnolence subjectively was applied to all patients after reduction of the BMI. However, this scale does not allow correlation with polysomnography results, considered the gold standard for detection of OSAS.

In this study, only one male patient had an Epiworth score compatible with somnolence. Before bariatric surgery, this patient had OSAS and he continued with the same symptoms after reduction of the BMI.

To conclude, reduction in BMI after bariatric surgery in obese patients of both genders resulted in an increase in both thyromental distance and interincisor gap, reduction in neck circumference, and maintenance of Mallampati classification.

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**Resumen:** Lima Filho JÁ, Ganem EM, Cerqueira BGP – Nueva evaluación de la Vía Aérea del Paciente Obeso sometido a la Cirugía Bariátrica, después de la reducción del Índice de Masa Corporal.

**Justificativa y objetivos:** La dificultad en la intubación traqueal es la causa de mortalidad en anestesiología y puede estar relacionada con la obesidad. Diagnosticar la intubación difícil contribuye para el éxito del abordaje de la vía aérea, pero los parámetros de predicción de la intubación difícil todavía no están bien establecidos. La clasificación de Mallampati, la distancia interincisivos, la circunferencia del cuello, la distancia tiromentoniana y la presencia del síndrome de la apnea obstructiva del sueño son parámetros que pueden indicar la intubación difícil. El tratamiento quirúrgico de la obesidad proporciona una reducción del índice de masa corporal (IMC), con su estabilización alrede-

dor de los dos años. El objetivo de esta investigación fue evaluar nuevamente los parámetros anteriormente descritos con los valores prequirúrgicos.

**Método:** Cincuenta y un pacientes de los dos sexos, fueron evaluados en el período preoperatorio en cuanto a su IMC, la clasificación de Mallampati, la circunferencia del cuello, la distancia interincisivos, la distancia tiromentoniana y el grado del síndrome de la apnea obstructiva del sueño, por medio de la polisomnografía. Después de dos años de efectuada la cirugía y la reducción del IMC < a35 kg.m<sup>2</sup> los predictores de intubación difícil se evaluaron nuevamente por otro médico anestesiólogo que conocía el IMC con anterioridad. Fueron excluidos nueve pacientes. Se ejecutó la nueva evaluación de los parámetros anteriormente citados, y para los que no se rea-

lizó una nueva polisomnografía se aplicó la escala de somnolencia de Epiworth.

**Resultados:** De los 42 pacientes evaluados de nuevo, algunos presentaron reducción del IMC, de la circunferencia del cuello, de la distancia interincisivos y tiromentoniana. Apenas un paciente presentó reducción en la escala de Mallampati y solo 4 realizaron la polisomnografía.

**Conclusiones:** La reducción del IMC aumenta las distancias interincisivas y tiromentonianas. Se verifica la reducción de la circunferencia del cuello. El Mallampati permanece sin alteraciones.

**Descriptor:** ENFERMIDAD, Obesidad; INTUBACIÓN TRAQUEAL; SISTEMA RESPIRATORIO: Vía aérea; TÉCNICAS DE MEDICIÓN, Índice de Masa Corporal.