

Review Article

Airway management in obese patients: a literature review

Manejo de via aérea no paciente obeso: uma revisão de literatura

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ABSTRACT: *Introduction:* Airway management in obese patients is a concern for anesthesiologists. This procedure is more difficult in this population due to anatomical and physiological changes caused by excess fat. Obese patients have pulmonary alterations that may lead to faster desaturation, which makes this group more susceptible to complications during tracheal intubation. *Objective:* To understand which factors are responsible for the higher incidence of difficult airway in obese patients. *Methods:* A survey on the DeCS platform, followed by PubMed and SciELO was carried out to identify articles related to the topic, including Randomized Clinical Trials, Systematic Reviews, Meta-Analysis and Books and Documents. A total of 20 articles in Portuguese, English and Spanish were selected. *Results:* Of the analyzed studies, three identified Mallampati III/IV, reduced mobility of cervical spine and limited mouth opening as risk factors for difficult airway. One study identified neck circumference as an associated factor, while the others stated that there is no relationship between neck circumference and difficult airway. *Conclusion:* There was no consensus in the literature regarding the risk factors for difficult airway. It is necessary to develop retrospective studies that analyze patients with difficult airway and complications, determining which factors were present and affected the procedure.

Keywords: Obesity; Airway management; Intratracheal intubation.

RESUMO: *Introdução:* O manejo de vias aéreas do paciente obeso é uma preocupação dos anesthesiologistas. Tal procedimento mostra-se mais difícil se comparado aos demais pacientes devido a alterações anatômicas e fisiológicas causadas pelo excesso de gordura. O paciente obeso possui alterações na função pulmonar que favorecem uma dessaturação mais rápida do que as demais pessoas, o que torna esse grupo mais suscetível a complicações durante a intubação orotraqueal. *Objetivo:* Compreender quais fatores são responsáveis pela maior incidência de via aérea difícil nos pacientes obesos. *Métodos:* Foi realizada busca na plataforma DeCS e em seguida PubMed e SciELO para levantamento de artigos relacionados ao tema, sendo incluídos Ensaios Clínicos Randomizados, Revisões Sistemáticas, Meta-Análises e Livros e Documentos, sendo eleitos 20 artigos totais, em português, inglês e espanhol. *Resultado:* Dos estudos analisados, três encontraram fatores de risco para VA difícil como Mallampati III/IV, menor mobilidade do pescoço e menor abertura da boca. Um apontou circunferência do pescoço como fator influenciador enquanto outro afirmou que não há relação da circunferência com a dificuldade em se obter uma VA definitiva. *Conclusão:* Não houve consenso na literatura quanto aos fatores de risco para uma VA difícil. É necessário o desenvolvimento de estudos retrospectivos que analisem pacientes com ocorrência de VA difícil e complicações para que se possa levantar quais fatores estavam presentes em cada caso e como influenciaram.

Palavras-chave: Obesidade; Manuseio de vias aéreas; Intubação intratraqueal.

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INTRODUCTION

Obesity is defined by the WHO as excessive body fat accumulation that presents a risk to health. It is a chronic disease that is prevalent worldwide. A person is considered obese if their BMI, which is the most used method to estimate body adiposity, is above 30kg/m². In 2013, 16.8% of men and 24.4% of women were obese in Brazil, and the prevalence of this pathology has been increasing since 1975².

For anesthesiologists, managing obese patients is a growing concern, as they can be more difficult to manage when compared to other patients, due to the anatomical and physiological changes caused by excessive body fat. The safe apnea period (SAP) of obese patients is shorter than that of thin patients, which makes the process more laborious³. One of the difficulties is airway management, as these patients are classified as with “difficult airway” (a situation where a trained physician experiences difficulty in face mask ventilation and/or tracheal intubation)⁴. Other factors such as age, obstructive sleep apnoea syndrome, and documented snoring are also considered when determining the degree and complexity of the procedure⁵.

Face mask ventilation becomes more difficult as weight increases, and especially in morbidly obese patients (BMI greater than or equal to 40 kg/m²)³. As for orotracheal intubation (OTI), obese patients are more likely to need a second attempt of intubation by direct laryngoscopy when compared to patients with normal BMI. The risk increases progressively as BMI increases to 30 kg/m². However, once the patient reaches the obesity BMI, the risk remains fixed, with no significant differences between the number of attempts in obese grade I and obese grade III found in the literature⁶. Another common predictor is larger neck circumference, which is associated with greater difficulty in airway management⁷.

In addition to difficulties during the procedure, obese patients also have changes in lung function. These alterations can be explained by the decrease in diaphragmatic mobility and back movement, which impairs respiratory movements⁸. Functional residual capacity (FRC) and expiratory reserve volume (ERV) significantly decrease with increasing BMI⁹. It is known that decreased FRC leads to reduction in the oxygen reserve⁸, which leads to desaturation occurring more quickly¹⁰, increasing the risk of an unfavorable outcome.

This study is justified by the relevance of the theme, as the most common cause for anesthetic complications is inadequate airway management and most reports of difficult tracheal intubation involve obese patients.¹¹ Therefore, this review aims to discuss how excessive weight gain can lead to difficulty in obtaining an airway in in-hospital procedures.

OBJECTIVES

The primary objective of the present study is to discuss how difficult airway should be managed.

Secondary objective: to understand which factors are responsible for the higher incidence of difficult airway situations among obese individuals

METHODS

For this study, a bibliographical survey of material on epidemiology published from 2010 to 2021 and articles on pathophysiology published from 2000 to 2021 was carried out. The search was carried out between June and December 2021, in PubMed, SciELO and anesthesia journals. Articles in Portuguese, English and Spanish were selected. The DeCS platform was consulted for identifying health descriptors and their variations, and the following were found and used: “*intubação intratraqueal*”, “*manuseio das vias aéreas*” e “*obesidade*” and their correspondents in English, “intratracheal intubation”, “airway management” and “obesity”.

The following filters were used: “Books and Documents”, “Meta-Analysis”, “Randomized Controlled Trial” and “Systematic Review”, excluding bibliographic reviews.

Initially, 76 studies were selected based on their titles and year of publication. After reading their abstracts and conclusions, 37 articles were excluded because they did not address the theme of this review. Among the remaining 39, 19 articles were chosen for this review based on their level of evidence and the largest population studied. In addition to the studies found, a guideline from the Brazilian Association for the Study of Obesity (ABESO), strongly related to the theme addressed, was also used.

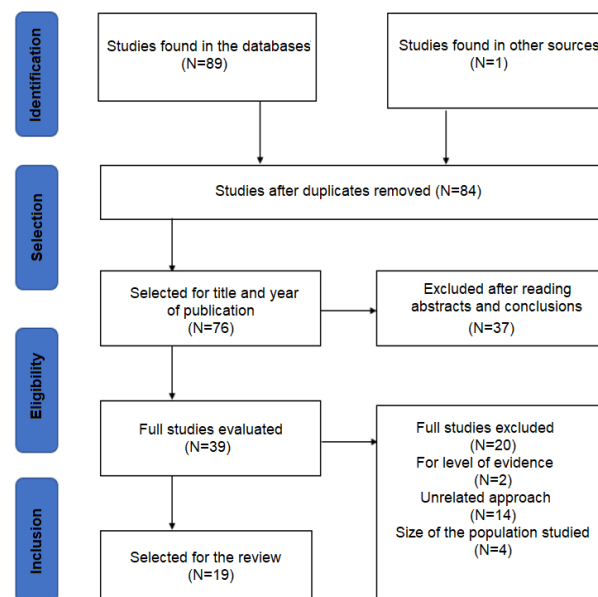


Figure 1 - Article selection flowchart adapted from PRISMA (Preferred reporting Items for Systematic Review and Meta-Analyses)¹²

RESULTS

A number of cohort and data analysis studies were evaluated seeking to find a relationship between difficult airway and high BMI, as well as other risk factors associated with obesity. Five studies were selected to collect the results.

One of the studies included did an analysis of medical records of obese patients who underwent bariatric surgery in Laparoscopic Roux-en-Y Gastric Bypass (LRYGB) between September 2001 and May 2010 to find out how many had a difficult intubation. Of the 912 patients included, 830 had an uneventful intubation. On the other hand, 57 patients (6.3%) with significant differences of age and weight had a difficult intubation. The highest rate of successful intubations was among younger women. The study identified other factors associated with difficult intubation, such as Mallampati IV, small thyromental distance, restricted jaw mobility and limited neck range of motion. The most independent predictor of poor prognostic was thyromental distance. Finally, no relationship was found between higher BMI and difficult intubation. On the contrary, the study found that mild obesity was associated to a higher rate of difficult intubation than morbid obesity¹³.

Another article did a retrospective analysis based on records of obese patients at Memorial Hermann Hospital

Table 1 – Difficult ventilation according to neck circumference

Neck circumference	Total number of patients	Difficult ventilation	Percentage (%)
> 44cm	23	11	47.82%
41-44cm	38	10	26.31%
36-40cm	24	7	29.16%
< 36 cm	1	0	0%

Source: Adapted from Uribe et. al. (2017)¹⁵

Table 2 - Difficult tracheal intubation according to neck circumference

Neck circumference	Total number of patients	Difficult tracheal intubation	percentage (%)
> 44 cm	23	6	26.08%
41-44cm	38	4	10.52%
36-40 cm	24	5	20.83%
< 36 cm	1	1	100%

Source: Adapted from Uribe et. al. (2017)¹⁵

Among the patients, only one could not be intubated, and their neck circumference was greater than or equal to 45 cm. The study considered as difficult intubations those that required more than 3 attempts or took more than 10 minutes. The patients were placed in the ramped position with a head pillow and the BURP maneuver (Backwards, Upwards, Rightwards Pressure: rightward pressure on the thyroid cartilage in the cephalic direction, against the

in Texas, with the objective of identifying predictive factors for difficult mask ventilation. A total of 557 patients were included in this study. All patients were in ideal conditions for ventilation, as they were placed in the head elevated laryngoscopy position, with the operating table tilted in the reverse Trendelenburg position. Difficult mask ventilation was observed in 78 (14.3%) of the 557 patients. The cases were analyzed to identify common characteristics between these 78 patients that could have affected ventilation. It was found that age greater than or equal to 49 years, neck circumference greater than or equal to 43 cm and short neck were predictors for difficult ventilation. Finally, the incidence of difficult ventilation among obese patients, which, as mentioned above, was 14.3%, was compared to patients with a BMI of less than 30 kg/m², which had a frequency of 8.8%¹⁴.

Uribe et al. carried out a prospective observational study with 90 patients with a BMI greater than 30 km/m². All had to go under general anesthesia requiring orotracheal intubation by laryngoscopy, and the occurrence of difficult intubation was evaluated according to neck circumference. A curved size 3 or 4 Macintosh blade was used in all cases, and the study associated the number of attempts with the predisposing conditions. The patients were 53 women and 37 men, and the mean age group was 40-49 years. The results can be found in Tables 1 and 2.

cervical vertebrae) was performed during the attempts. The study compared patients with neck circumference of less than 40 cm and more than 40 cm and concluded that neck circumference is not associated with the success or failure of airway management, as the odds ratio found was 1.44¹⁵.

Another cohort study analyzed data from obese patients (BMI greater than or equal to 30kg/m²) admitted

to the ICU from September 2011 to April 2012 or undergoing surgery between January 2006 and December 2011 in 60 French medical centers and 4 anesthesia departments. The study compared the incidence of difficult intubation of obese patients in the ICU and in operating theatres. As in the previous study, difficult intubation was defined as 3 or more attempts or more than 10 minutes in the procedure. The objective, beyond comparison, was to find the risk factors for difficult tracheal intubation. In the ICU, 282 patients out of 1400 (20%) were obese, while among the 11035 patients undergoing surgery, 2103 (19%) were obese. Difficult intubation was more common among patients in the ICU, with 46 cases (16.2%) against 172 (8.2%) in the surgical theaters. In both groups, the risk factors for difficult intubation that were highlighted were Mallampati III/IV, Obstructive Sleep Apnoea Syndrome (OSAS) and reduced mobility of cervical spine. Among ICU patients, limited mouth opening, coma and severe hypoxemia also stood out⁵.

Finally, the fifth study analyzed was also a retrospective cohort that included patients having surgery requiring intubation at the Cleveland Clinic Foundation between January 2011 and September 2015. The

primary objective was to demonstrate whether there is a relationship between the increase in BMI and the need for more than one intubation attempt. A total of 67702 adult patients with a mean BMI of 28 kg/m² were included in the study. Among them, 40183 had a BMI of less than 30kg/m² and 27519 had a BMI greater than or equal to 30kg/m², being classified as obese. Among all patients, 61010 (90%) were intubated using direct laryngoscopy and 6692 (10%) were intubated using videolaryngoscopy. More than one intubation attempt was required, characterizing a difficult intubation, in 4420 (7.2%) patients intubated with direct laryngoscopy and 1635 (27%) patients intubated with a videolaryngoscope. The study concluded that, although a BMI greater than 30kg/m² was associated with increased odds of difficult intubation, intubation became progressively more difficult with increasing BMI until reaching this value. In patients already characterized as obese, the odds of difficult intubation remained unchanged, even with increasing BMI⁶.

Table 3 shows which risk factors were found in each study analyzed and the studies' conclusion on whether or not these factors influenced intubation success.

Table 3.1 - Conclusion of the studies analyzed

Studies	Risk factors	Conclusion of the study
Sheff SR, et al.; 2013 ⁽¹³⁾	Mallampati IV, small thyromental distance, restricted jaw mobility and reduced mobility of cervical spine.	In obese patients, an increasing BMI did not increase the incidence of difficult intubation, but rather decreased it

Table 3.2 - Conclusion of the studies analyzed

Studies	Risk factors	Conclusion of the study
Cattano D, et al., 2014 ⁽¹⁴⁾	Age > 49 years, neck circumference > 43 cm and perceived short neck	Obese patients are at increased risk of a difficult intubation
Alanis Uribe K, et al., 2017 ⁽¹⁵⁾	Did not list risk factors	Neck circumference does not influence the airway management
De Jong A, et. al.; 2015 ⁽⁵⁾	Mallampati III/IV, Obstructive Sleep Apnoea Syndrome, reduced mobility of cervical spine, limited mouth opening, coma and hypoxaemia	Patients in the ICU are at greater risk of needing more than 1 intubation attempt than surgical patients
Saasouh W, et. al.; 2018 ⁽⁶⁾	Did not list risk factors	Obese patients are at a higher risk of difficult intubation, but a higher degree of obesity does not increase the risk

Source: Own elaboration (2021)

DISCUSSION

Obesity is a chronic condition that predisposes to various metabolic, cardiovascular, renal, and pulmonary diseases and even to certain types of cancer^{1,8}. Obese patients have excess adipose tissue, which leads to a pro-inflammatory state, which, in turn, increases the incidence of atopy and is related to under development of the lungs, which can lead to asthma and other diseases associated with bronchial hyperresponsiveness⁸.

These pulmonary alterations can affect gas ex-

change, compromising this process. Studies have shown that arterial partial pressure of oxygen (PaO₂) is inversely related to BMI during the intraoperative period¹⁶. Furthermore, overweight individuals desaturate twice as fast during apnea when compared to thin individuals¹⁰. In addition, 30% of anesthesia-related deaths are due to complications in airway management¹¹. Therefore, it is important to study techniques to improve ventilation and oxygenation in this higher-risk population, aiming to increase the safety of the procedure¹⁰. These techniques include the Cormack-Lehane and Mallampati scores, used

in the preanesthetic evaluation with the objective of reducing adverse events during the procedure¹¹.

In addition to these alterations in pulmonary physiology, the literature demonstrates that obese patients are more likely to experience difficulties in face-mask ventilation and tracheal intubation when compared to other patients^{10,14}. These difficulties are due to excess weight, which causes anatomical changes such as an inverted relevance between weight and pharyngeal area, which impairs the visualization of the glottis in direct laryngoscopy¹¹. However, despite the greater incidence of difficult airway in this population, obesity alone, without the presence of other risk factors, should not be considered a predictor of difficult tracheal intubation¹⁷.

Difficult airway management, especially in tracheal intubation, can cause hypoxic brain injury, cardiac arrest, airway trauma, aspiration, among other complications, which can lead to death. Therefore, several studies try to determine correlated risk factors, but the results are still not completely understood¹⁸. Some questionnaires can be applied to screen for higher risk of failure, such as the STOP-BANG¹⁷ (acronym for Snoring, Tiredness, Observed Apnea, Pressure, Body mass index, Age, Neck circumference and Gender), which aims to identify Obstructive Sleep Apnoea, a risk factor for difficult airway^{5,17}. The STOP-BANG includes questions with direct answers (yes or no), which generate a score that classifies the individual according to their risk¹⁷. This questionnaire has already been adapted for Brazilian Portuguese¹⁹.

STOP-BANG QUESTIONNAIRE	
<p>• Snoring? Do you snore loudly (loud enough to be heard through closed doors or your bed-partner elbows you for snoring at night?) () Yes () No</p> <p>• Tired? Do you often feel tired, fatigued or sleep during the daytime (such as falling asleep during driving)? () Yes () No</p> <p>• Observed? Has anyone observed you stop breathing or choking/gasping during your sleep () Yes () No</p> <p>• Pressure? Do you have or are being treated for high blood pressure? () Yes () No</p> <p>Score criteria for general population</p> <ul style="list-style-type: none"> • Low risk for Obstructive Sleep Apnea (OSA): Yes to 0 - 2 questions • Intermediate risk for OSA: Yes to 3 - 4 question • High risk for OSA: Yes to 5 - 8 questions <p>or Yes to 2 or more of 4 STOP questions + male gender or Yes to 2 or more of 4 STOP questions + BMI > 35kg/m² or Yes to 2 or more of 4 STOP questions + neck circumference ≥ 43 cm for men or neck circumference ≥ for women</p>	<p>• Body Mass Index more than 35 kg/m²? () Yes () No</p> <p>• Age older than 50? () Yes () No</p> <p>• Neck size? (measured around Adams apple) For men: neck size equals to or greater than 43 cm. For women: neck size equals to or greater than 41 cm. () Yes () No</p> <p>• Gender = Male? () Yes () No</p>

Source: Fonseca et. al., 2016, p. 271⁽¹⁹⁾

Figure 2 - STOP-BANG questionnaire

Patients with high scores are more likely to have difficult airways, due to their association with OSAS. In addition, there are common risk factors between OSAS and difficult airway, such as reduced sternomental and thyromental distances, limited mouth opening, and large neck circumference, which explains the relationship between the two. In addition, the excess of adipose tissue in the hypopharynx may reduce the accuracy of the Mallampati score¹¹.

There are some devices that can facilitate the procedure, not only by reducing the risk of aspiration, but also by providing adequate oxygenation, which is the priority after a failed intubation attempt²⁰. The laryngeal mask airway, a supraglottic device, can be used to maintain ventilation in cases of difficult airway^{4,21}. In addition, the physician should establish a limit on the number of laryngoscopy attempts, due to the risk of airway trauma due

to excessive handling^{20,21}. In individuals with previously known difficult airways, the videolaryngoscope has been shown to be effective in increasing success rates⁴.

Cricoid pressure not only protects the airway from contamination, but can also improve the view on direct laryngoscopy, if applied correctly²¹. Mask ventilation after the application of the technique can prolong the time to desaturation²¹, which is already reduced in obese patients¹⁰. This technique should be applied when a difficult airway is found in a rapid sequence intubation²¹.

A maximum of three intubation attempts are recommended, or four if the professional is experienced. The “ramped” position should be used, which is the most appropriate for obese patients, as it ensures horizontal alignment of the suprasternal and the external auditory meatus, providing a better view during direct laryngoscopy and improving ventilation during the period of apnea²¹.

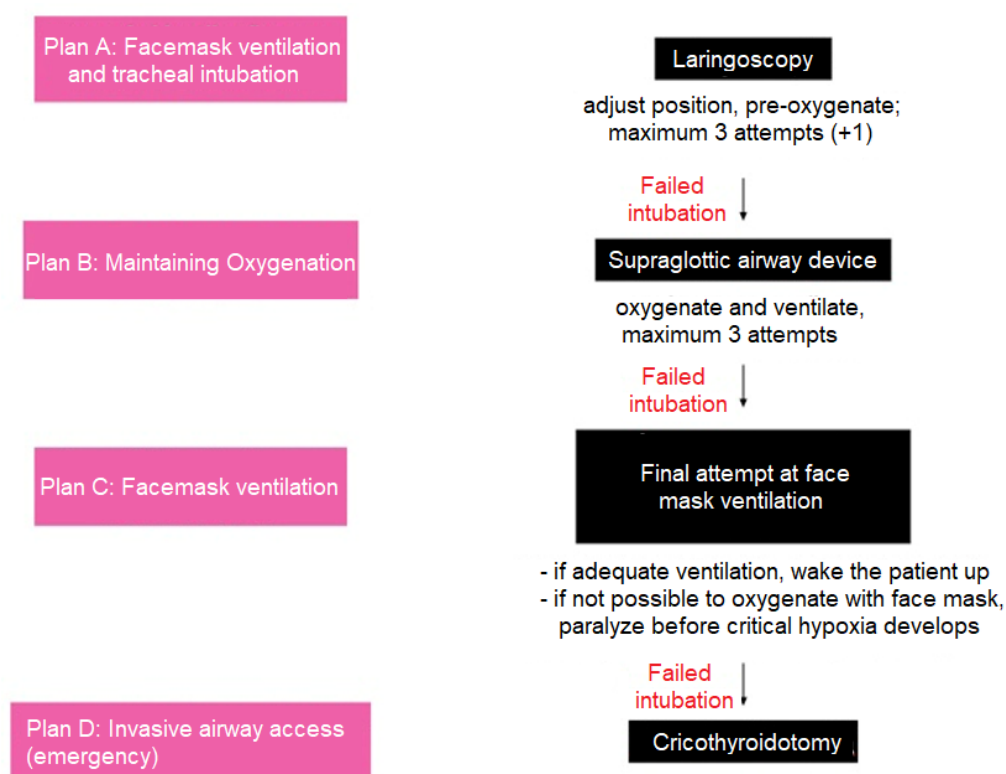


Figure 3 – Flowchart for difficult airway management, according to DAS (Difficult Airway Society). Adapted from Frerk et. al. (2015)²¹.

CONCLUSION

This literature review did not find a consensus regarding the factors that might make intubation difficult in obese patients. Despite the physiological changes in the lungs that increase the risk for complications such as desaturation and hypoxia in this population, increased BMI alone was not found to be a risk factor for a second tracheal intubation attempt.

However, after reading the articles, it was concluded that some anatomical alterations associated with obesity were risk factors for a difficult intubation, such as Mallampati III/IV score, OSAS, reduced mobility of cervical spine and limited mouth opening. Although some studies presented neck circumference as a risk factor for difficult airway, there were divergences in the literature, therefore, it was not possible to determine the

association of this item with failed intubation.

As for management, the primary objective of the work, the obese patient must be positioned correctly, in the ramped position with head pillows, and the number of intubation attempts must be limited. It is important to remember that all patients must be ventilated between attempts, but especially obese patients, who desaturate more rapidly than other individuals.

Therefore, although proper management has been determined, further studies should be conducted to identify what factors are actually associated with the tracheal intubation of obese patients. Given the importance of the subject, it is necessary to develop retrospective studies that analyze patients with difficult airway and complications, determining which factors were present and affected the procedure.

Participation of the author: *Paula de Abreu Ferreira Antunes*: elaboration of the project, introduction, objective, methods, discussion, conclusion and references; analysis of the results. *Guilherme Abreu de Britto Comte de Alencar*: orientation, elaboration of the project and objective, and critical intellectual review.

REFERENCES

1. Associação Brasileira para o Estudo da Obesidade e da Síndrome Metabólica (ABESO). Diretrizes brasileiras de obesidade. São Paulo: Abeso; 2016. Disponível em: [https://abeso.org.br/wp-content/uploads/2019/12/Diretrizes-Do-](https://abeso.org.br/wp-content/uploads/2019/12/Diretrizes-Do-wnload-Diretrizes-Brasileiras-de-Obesidade-2016.pdf)
2. Ferreira APDS, Szwarcwald CL, Damacena GN. Prevalência e fatores associados da obesidade na população brasileira: estudo com dados aferidos da Pesquisa Nacional de Saúde, 2013. *Rev Bras Epidemiol.* 2019;22. doi: <https://doi.org/10.1590/1980-549720190024>

3. Brodsky JB. Recent advances in anesthesia of the obese patient. *F1000Research*. 2018;7. doi: 10.12688/f1000research.15093.1
4. Apfelbaum JL, Hagberg CA, Caplan RA, Blitt CD, Connis RT, Nickinovich DG, Hagberg CA, Caplan RA, Benumof JL, Berry FA, Blitt CD, Bode RH, Cheney FW, Connis RT, Guidry OF, Nickinovich DG, Ovassapian A; American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. *Anesthesiology*. 118(2):251-70. doi: 10.1097/ALN.0b013e31827773b2
5. De Jong A, Molinari N, Pouzeratte Y, Verzilli D, Chanques G, Jung B, Futier E, Perrigault PF, Colson P, Capdevila X, Jaber S. Difficult intubation in obese patients: incidence, risk factors, and complications in the operating theatre and in intensive care units. *Brit J Anaesth*. 2015;114(2):297-306. doi: 10.1093/bja/aeu373
6. Saasouh W, Laffey K, Turan A, Avitsian R, Zura A, You J, Zimmerman NM, Szarpak L, Sessler DI, Ruetzler K. Degree of obesity is not associated with more than one intubation attempt: a large centre experience. *Brit J Anaesth*. 2018;120(5):1110-6. doi: 10.1016/j.bja.2018.01.019
7. Brodsky JB, Lemmens HJM, Brock-Utne JG, Vierra M, Saidman LJ. Morbid obesity and tracheal intubation. *Anesth Analgesia*. 2002;94:732-6. doi: 10.1097/0000539-200203000-00047
8. Melo LC, Silva MAM, Calles ACN. Obesidade e função pulmonar: uma revisão sistemática. *Einstein (São Paulo)*. 2014;12(1):120-125. doi: 10.1590/S1679-45082014RW2691
9. Cullen A, Ferguson A. Perioperative management of the severely obese patient: a selective pathophysiological review. *Can J Anesth*. 2012;59:974-996. doi: 10.1007/s12630-012-9760-2
10. Wang HX, Wan L, Tian M, Xue FS. A safe strategy for anesthesia induction and airway management in morbidly obese patients. *Chinese Med J*. 2019;132(14):1747. doi: <https://doi.org/10.1097/CM9.0000000000000320>
11. Magalhães E, Marques FO, Govêia CS, Ladeira LC, Lagares J. Uso de preditores clínicos simples no diagnóstico pré-operatório de dificuldade de intubação endotraqueal em pacientes portadores de obesidade. *Rev Bras Anesthesiol*. 2013;63(3):262-6. <https://doi.org/10.1590/S0034-70942013000300006>
12. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Syst Rev*. 2021;10(1):89. <https://doi/10.1186/s13643-021-01626-4>
13. Sheff SR, May MC, Carlisle SE, Kallies KJ, Mathiason MA, Kothari SN. Predictors of a difficult intubation in the bariatric patient: does preoperative body mass index matter? *Surg Obes Relat Dis*. 2013;9(3):344-9. doi: 10.1016/j.soard.2012.02.004
14. Cattano D, Katsiampoura A, Corso RM, Killoran PV, Cai C, Hagberg CA. Predictive factors for difficult mask ventilation in the obese surgical population. *F1000 Res*. 2014;3:239. <https://doi.org/10.12688/f1000research.5471.1>
15. Alanís Uribe K, Guerrero Morales F, Gómez Cruz JR. Relación entre la circunferencia del cuello y vía aérea difícil en pacientes obesos. *Anest Méx*. 2017;29(2):18-27. Disponible en: http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S2448-87712017000200018&lng=es.
16. Aldenkortt M, Lysakowski C, Elia N, et al. Ventilation strategies in obese patients undergoing surgery: a quantitative systematic review and meta-analysis. *Br J Anaesth*. 2012;109(4):493-502. doi: 10.1093/bja/aes338
17. Toshniwal G, McKelvey GM, Wang H. STOP-Bang and prediction of difficult airway in obese patients. *J Clin Anesth*. 2014;26:360-367. doi: 10.1016/j.jclinane.2014.01.010
18. Uribe AA, Zvara DA, Puente EG, et al. BMI as a predictor for potential difficult tracheal intubation in males. *Front Med*. 2015;2:38. doi: 10.3389/fmed.2015.00038
19. Fonseca LBDM, Silveira EA, Lima NM, Rabahi MF. Tradução e adaptação transcultural do questionário STOP-Bang para a língua portuguesa falada no Brasil. *J Bras Pneumol*. 2016;42:266-272. <http://dx.doi.org/10.1590/S1806-37562015000000243>
20. Hagberg CA, Gabel JC, Connis RT. Difficult Airway Society 2015 guidelines for the management of unanticipated difficult intubation in adults: not just another algorithm. *Brit J Anaesth*. 2015;115(6):812-814. doi: 10.1093/bja/aev404
21. Frerk C, Mitchell VS, McNarry AF, Mendonca C, Bhargava R, Patel A, et al. Difficult Airway Society intubation guidelines working group, Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults, BJA: *Brit J Anaesth*. 2015;115(6):827-848. doi: 10.1093/bja/aev371

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