REVIEW ARTICLE

Airway Assessment and Management of Obese Patients in Operation Room and PACU; A Narrative Review

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The most difficulties in airway management of obese individuals are due to obesity-associated anatomic and physiologic changes in airways and respiratory system. Anesthesiologists usually face some problems, such as quick oxygen desaturation, difficult mask ventilation, difficulty in laryngoscopy/intubation, and respiratory depression, following initiation of hypnotic anesthetic medications. Awareness of the physiologic and anatomic changes may help anesthesiologist in providing better preparation before tackling those difficulties. Preparative evaluation of airway in obese persons should include inspection of predictors of difficult mask ventilation and difficult intubation. Difficulties in airway management are reduced after giving ideal preoxygention and positioning using some strategies may lead to facilitate airway management of these patients and reduce some hazards in this field.

keywords: obesity; airway assessment; airway management

Obesity is a condition in which extra body fat has gathered to the extent that it may possibly have an adverse effect on health [1]. Obesity is associated with reduced posterior airway field behind the base of the tongue. Posterior dislocation of the soft palate, tongue base, and epiglottis after induction of anesthesia make the vision weak in the upper airway, and any attempts at mask ventilation may fail due to obstruction or pharyngeal collapse [2].

Individuals are generally considered obese when their body mass index (BMI) (≥35 kg/m2), a measurement found by dividing a body's weight by the square of the person's height or fat distribution by the waist–hip ratio [3-4]. Difficult airway management of the obese patient is one of the most important challenges of anesthesiologists. Obesity has also some significant changes in lung mechanics, lung volumes spirometry, respiratory muscles, breathing, ventilation/perfusion, diffusing capacity and gas exchange. All the aforementioned changes can make airway management of obese patient too much difficult. Many previous studies attempted to make the perfect evaluation and good management of obese person's airway in operation room and PACU.

Preoperative airway assessment

Management of airway, particularly in an emergency case, and the presence of high amount adipose tissue in the pharyngeal walls make it difficult and also may affect intubation and mask ventilation [5]. There are conflicting data on factors predicting tracheal intubation in obese patients. Lundstron et al. investigated 91, 332 patients and stated that the predictor for difficult tracheal intubation with an odds ratio of 1.34, is BMI ≥ 35 kg/m2 [6]. On the other hand, other investigators said that there was no related with difficult intubation in morbidly obese patients and increasing of BMI alone [7-8].

Brodsky et al. showed that Mallampati score of 3 and increasing neck circumference at the thyroid cartilage was related with difficult intubation. And with a neck circumference of 40 cm and 60 cm, the probability of a difficult intubation was about 5% and 35%, respectively [8].

In another study 180 consecutive patients were recruited, 140 women and 40 men the mean BMI was 49.4 kg/m2. which has been done in bariatric surgery patients, there was no correlation between BMI and OSAS, or neck circumference and difficult intubation, but they found a relationship between male genders (P = 0.02) with a Mallampati score of ≥3 (P = 0.02) [9].

Therefore, the best way to predict difficult intubation in obese patients is still debatable. Part of this controversy stems from a lack of standardized criteria used to define difficult tracheal intubation [10]. The American Society of Anesthesiologists (ASA) defines difficult intubation as occurring when "tracheal intubation requires multiple attempts, in the presence or absence of tracheal pathology," whereas difficult laryngoscopy is defined as being impossible "to visualize any portion of the vocal cords after multiple attempts at conventional laryngoscopy" [11].

Cormack-Lehane grade ≥3, is used to identify difficult intubation [12-13].

In the Brodsky's study, tracheal intubation was classified as problematic if the product of the Cormack-Lehane grade and the number of intubation attempts was ≥3 [8]. All the difficult intubation scores reflect all courses of intubation, whereas the Cormack-Lehane grade considers only the laryngoscopic view. It has been demonstrated that, using the

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difficult intubation scale, intubation was more difficult in obese patients than in nonobese patients, whereas the incidence of a high Cormack-Lehane grade was similar in the 2 patient populations. Thus poor laryngoscopic view does not always equate with difficult tracheal intubation [8, 14].

Obesity and BMI alone does not predict difficult intubation [8, 15], while mask ventilation is predictably problematic in patients with obesity for anatomic causes, such as enlarged upper airway resistance, higher supra-glottic tissues, lower in chest wall compliance, and reduced diaphragmatic excursion [16]. In the prospective study by Langeron et al. [17] which involved 1502 patients with and without obesity, and they recognized five preoperative predictors of difficult mask ventilation: age >55 years, BMI >26 kg/m2, deficiency of teeth, snoring history, and beard presence. If at least two of these features were found, the likelihood of difficult mask ventilation increased notably [17]. Kheterpal et al. [18] stated that age more than 57 years, BMI more than 30 kg/m2, snoring, beard presence, Mallampati class III or IV, and limited jaw protrusion are independently related with difficult mask ventilation.

The History of snoring and thyromental distance <6 cm was particularly found to be predictors of impossible mask ventilation [18].

According to these causes, some studies suggest awake intubation in morbidly obese patients [19]. This remains a matter of great controversy among specialists; the final choice depends on the experience of personnel, guidelines, and available airway devices. For this regard and according to authors, the percentage of patients with obesity requiring awake intubation is about 6%–7% and they commonly have a BMI > 40 kg/m2 [8]. And the remaining 93%–94%, difficulties are not considered after making ideal positioning and ensuring availability of different airway management options [20]. Because of poor chest wall and lung compliance in very obese individuals, it may be very difficult to use one hand to hold the ventilation mask in place and the other to manually compress the ventilation bag. Three individuals should be present at at the time of intubation, one to hold the ventilation mask in place after inserting the oral airway with two hands, and the second for squeezing the bag, and the third to give the anesthesia drugs as necessary.

Strategies for improving airway management during intra-operative period

The ideal positioning is mandatory to increase the chance of securing the airway. Elevating the upper body and head of obese patients to support their sternum and ear in a horizontal line (“ramped position”) results in a significantly better laryngoscopic view [21]. The “ramped position” is attained by placing blankets under the patient’s upper body. Furthermore, the reverse Trendelenburg position (>30º) may also improve ventilation by reducing impaired diaphragmatic excursion caused by an increased intra-abdominal pressure (IAP) [22]. This position also reduces the risk of aspiration by decreasing IAP [23]. In addition, ideal preoxygenation is necessary to prevent rapid desaturation. It has been reported that use of continuous positive airway pressure (CPAP) to maintain positive end-expiratory pressure (PEEP) of 10 cm H2O during anesthesia induction may prolong nonhypoxic apnea by 50% in morbidly obese patients [24]. Both techniques, reverse Trendelenburg position and CPAP may improve pulmonary gas exchange with a comparable efficiency, in the setting of bariatric surgery [25]. The need for rapid sequence induction (RSI) still remains unclear [10]. Obesity alone does not raise the threat of pulmonary aspiration in patients without a hiatus hernia or gastroesophageal reflux (GOR), nevertheless, obesity does help the development of GOR [26]. Freid proved that RSI is only approved in obese patients with symptomatic GOR and other risk factors for prevention of aspiration [26]. The use of RSI in obese patients results from the consideration that the higher IAP resulting from mask ventilation may lead to increase the likelihood of aspiration [26]. However, some aspect of rapid sequence induction technique may be harmful in obese patients. Rapid sequence induction can make intubation more difficult; the using of cricoid pressure (CP) can unfavorably affect direct laryngoscopy because, when applied with the suitable amount of pressure (20–30 N), the cricoid pressure produces an unavoidable deformation of the airway anatomy [27]. Although avoidance of positive pressure ventilation before intubation has been the usual recommendation in RSI, the deficiency of a test for the capability to mask ventilate may precipitate a cannot-intubate and cannot-ventilate situation [26]. The risk of RSI could outweigh the frequent event of clinically significant pneumonitis, considering that gastroesophageal reflux is a common disease while aspiration through anesthesia with resultant pneumonitis is rare [28]. A large meta-analysis noticed that there are no data to corroborate or refute the use of rapid sequence induction to decrease aspiration risk; thus the use of rapid sequence induction can be recommended only on a theoretical basis [29]. The evidence on aspiration is also changing for a number of improvements that potentially make the optimal quality of intubation condition, such as the development of new medications (rocuronium and remifentanil), airway supraglottic instruments, and video laryngoscopes. Thus the decision as to whether to use rapid sequence induction (RSI) in the obese patients must depend on the airway inspection and the patient’s co-morbidity. It preferable to be practical to attempt for reducing the risk of aspiration by decreasing the gastric volume and increasing the pH by giving antiemetics, H2 receptor antagonists, proton pump inhibitors, and antacids before induction of anesthesia, in obese patients [30]. However, none of these treatment options are recommended for routine preoperative use to decrease the risks of pulmonary aspiration in patients who have no apparent higher risk for pulmonary aspiration [31]. The supraglottic devices may be also used for positive pressure ventilation in a location of elective surgery. In 134 moderately obese patients undergoing a minor operation, use of the classic LMA (cLMA) was noted to be a choice to orotracheal intubation in terms of improving postoperative saturation and lung function [32]. It has been identified that a lower seal pressure and higher frequency of gastric insufflation are the unique disadvantages of cLMA over endotracheal tube [33] and even aspiration is rare and has an incidence comparable to that with face mask or tracheal tube [34]. The modern development of video laryngoscopic devices such as GlideScope (Verathon Inc., Bothel, WA) or Airtraq (King Systems Corporation, Noblesville, IN) has led to improving laryngoscopic grade and intubation situations

in obese patients compared with a standard laryngoscopic approach [35-36]. If the laryngeal mask ventilation consequences are unsuccessful, the essential rescue strategy in the location of failed airway is surgical cricothyroidotomy [37]. This procedure is kept for the emergency airway conditions when airway anomalies, blood, or secretions prevent placement and function of an endotracheal tube or supraglottic airway device. If awake intubation is obligatory according to non-ventilation/non-intubation criteria, flexible fiberoptic endoscope must be success of the device depends on the anesthesiologist's skill, effectiveness of topical anesthesia and sedation. In a study of twenty-seven morbidly obese patients undergoing awake tracheal intubation using a flexible fiberoptic bronchoscope, instilling 40 mL of 2% atomized lidocaine safely gave acceptable conditions for intubation [38]. The atomizer sprays lidocaine into the mouth, oropharynx, and hypopharynx, and could be particularly useful in individuals who are incapable of taking deep enough breaths to spread nebulized lidocaine during the airways or those who are too tachypneic to gargle aqueous lidocaine. As an alternative to common medications used for sedation such as Midazolam, Dexmedetomidine and remifentanil are increasingly being used to give sedation during awake fiber-optic intubation as a single agent in normal-weight patients [39]. Its use in mixture with propofol for obese patients has been suggested [40] without any evidence from randomized studies.

Obese Postoperative Respiratory System management

Obese patients are at risk for hypoventilation and hypoxemia for a variety of causes postoperatively, such as increased breathing work, reduced functional residual capacity, and decreased respiratory drive secondary to residual inhalational anesthetics, intravenous sedatives, or intravenous opioid analgesics [41-42]. In the situation of critical airway obstruction or hypoxemia occurring postoperatively in an obese patient, noninvasive positive airway pressure ventilation (NPPV), in the form of CPAP, should be done. Severe and prolonged incidents of hypoxemia are especially noticeable in those who are morbidly obese (BMI > 40 kg/m 2), and may also occur despite the appropriate use of postoperative noninvasive positive pressure ventilation (CPAP) [41].

To reduce atelectasis and avoid pneumonia, patients should be helped to cough with deep breaths, and use an incentive spirometer whenever they are conscious. Additionally, the head of the bed should be raised to 30–45°, preferably in a reverse Trendelenburg position. This position decreases the abdominal pressure on the diaphragm to improve tidal volume [43]. It is important to remember that, postoperatively, the obese patient may have difficulty maintaining an airway as a result of the incomplete reversal of neuromuscular blockade and/or OSA. Patients with OSA tend to have increased oral and pharyngeal tissue, which contributes to upper airway collapse through sleep. Almost 70% of OSA persons are obese [44]. OSA is characterized by recurrent episodes of upper airway obstruction during sleep that occur despite maintenance of neuromuscular ventilatory effort [45]. The clinical diagnosis of OSA is proved while the number of obstructive episodes is higher than fifteen times per hour of sleep, followed by episodes of choking, insomnia, or daytime sleepiness. Positive airway pressure was first described by Sullivan in 1981 [46]. It is an efficient method of treating OSA and can be done in three forms: continuous (CPAP), bilevel (BIPAP), or auto-titrating (APAP). For patients with documented OSA, the NPPV should be initiated through the postoperative period, starting in the recovery room. Gastric distension can be minimized when the peak airway pressure is set below the resting upper esophageal sphincter pressure of 33 mm Hg ± 12 mm Hg [47]. A prospective study by Huerta et al. proved that there was no correlation between CPAP usage and anastomotic disruption [48]. For obese persons without documented OSA, additional oxygen should be administered continuously until they are capable of maintaining their baseline oxygen saturation during breathing room air [49].

Conclusions

Although mask ventilation is predictably difficult in obese patients for anatomic reasons, but BMI alone does not predict difficult intubation in some studies. Thus management of the airway in the obese patients, including possibly awake intubation, must be strategic according to the presence of specific predictors of difficult mask ventilation other than those for difficult intubation. A smaller subgroup of morbidly obese patients with obstructive sleep apnea (OSA), high Mallampati class (III and IV), and large neck circumference may be difficult to intubate. Before induction of anesthesia, both reverse Trendelenburg position and CPAP should be applied to improve preoxygenation and mask ventilation.The "ramped position" may significantly reduce intubation difficulties. We suggest cautiousness for obese patient airway management especially for those who have predicted DMA and DI, so they should be prepared to face all tackling situations and to provide some facilities and strategies such as, preoxygenation, optimal position and ideal extubation with stepwise episodes.

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