Chapter 10
The Obese Patient

Bradley A. Dengler

Key Points

- The ramped position should be used for intubation of obese patients.
- Obese patients will have a shorter apnea time than lean patients.
- Two people will be required for bag-mask ventilation to ensure adequate oxygen delivery and ventilation.
- The video laryngoscope provides shorter times to intubation and better views than standard direct laryngoscopy.
- Higher levels of PEEP may be needed to support oxygenation.
- Most medications should be dosed based on total body weight except for ketamine, benzodiazepine infusions, and non-depolarizing neuromuscular blockers.

B. A. Dengler (✉)
Department of Neurosurgery, Walter Reed National Military Medical Center, Bethesda, MD, USA
e-mail: Bradley.a.dengler.mil@mail.mil

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Obesity in Numbers

- Rates of obesity and especially morbid obesity continue to increase in the United States and throughout the world.
- The current prevalence of obesity has reached 35% in men and 40% in women [1, 2].
- The definition of obesity by the World Health Organization is a body mass index (BMI) over 30 kg/m^2 and morbid obesity as a BMI over 40 kg/m^2 [3].
- There is a correlation between obesity and increased mortality in the intensive care unit [3]. This is likely multifactorial but can at least, in part, be due to the difficulty and challenges obesity places on the respiratory system.
- The emergency physician and intensivist must be prepared and comfortable managing the airway in the obese patient.

Impact of Obesity

Physiology

- Obese patients have a decreased oxygen reserve as a result of collapse of the smaller distal airways and alveoli [3–6].
- This micro-atelectasis leads to a ventilation-perfusion mismatch in the well-perfused distal lung bases and therefore an increase in the alveolar-arterial oxygen gradient [7, 8].
- Placing obese patients supine during the induction phase leads to worsening of the atelectasis and the ventilation–perfusion mismatch [3, 8].
- This worsening ventilation–perfusion mismatch can lead to hypoxia.
- Obese patients also have less of an apneic reserve leading to rapid desaturations with periods of apnea. This is due to the decreasing functional residual capacity (FRC) that occurs with increasing body mass index [3, 9].
- The functional residual capacity can decrease as much as 50% in obese individuals with induction of anesthesia compared to 20% in non-obese individuals [7, 8].

- Excess body fat leads to increased metabolic rates, oxygen consumption, and increased CO_2 production [3, 9–12]. This excess CO_2 production along with decreased FRC and lung volumes lead to obese patients having increased respiratory rates in the range of 15–21 breaths per minute (in comparison to lean individuals at 10–12 breaths per minute) [13, 14].
- Additionally, the micro-atelectasis along with decreased chest wall compliance in the obese patient leads to increased airway resistance which can contribute to difficulty with bag-mask ventilation (BMV).

Pre-intubation

- Pre-intubation set up and evaluation of the patient are the most critical steps in the process of managing a difficult airway to ensure that the provider anticipates challenges and problems before they occur.
- Adequate pre-oxygenation prior to induction is imperative for successful intubation given the diminished apneic reserve in the obese patient.
- Patients should generally be positioned with their head up at least 25 degrees, as this will provide longer periods of apnea without desaturations [7, 18, 19].
- A facemask with a good seal and tidal volume breathing for 3 minutes is the best method of pre-oxygenation in this patient population [7, 20]. Oxygen can also be delivered via nasopharyngeal insufflation after pre-oxygenation, which can extend the apnea time before desaturation occurs to almost 4 minutes [21].
- The use of both continuous positive airway pressure (CPAP) delivered via facemask prior to induction and positive end expiratory pressure (PEEP) after induction can also extend the apnea period and it will help to achieve higher end tidal oxygen content more rapidly [22–24].
- Patients with BMI over 30 kg/m^2, facial hair, obstructive sleep apnea, age greater than 57, and Mallampati Score of

III or IV, are all at risk of having difficult bag-mask ventilation [15, 16].
- In the obese patient, difficulty with bag-mask ventilation is due to redundant supraglottic tissue, poor chest wall compliance, and increased upper airway resistance.
- The ability to provide adequate bag-mask ventilation is vitally important to accomplish in the obese patient given the speed at which obese patients will develop a drop in their oxygen saturation.
- Airway adjuncts such as the oropharyngeal or nasopharyngeal airway can help eliminate the obstruction caused by redundant supraglottic tissues and improve the ability to conduct bag-mask ventilation (BMV).
- A two-person technique is optimal for the BMV of the obese patient: The first provider focuses on getting an adequate seal of the mask while performing a jaw thrust maneuver while the second provider focuses on adequately squeezing the bag with two hands to help overcome the increased airway resistance and decreased chest compliance [3, 17].

Intubation

- Studies are conflicting as to whether there is increased difficulty in accomplishing an endotracheal intubation in the obese patient, but the most recent meta-analysis did not show a significant difference in difficulty between intubations of the obese and lean patient [16].
- Although obesity itself might not be a risk factor for difficult intubation, there is evidence that patients' with increasing BMI or a BMI greater than 30 kg/m^2 will be a difficult intubation [15, 25].
- Other predictors of difficulty with tracheal intubation include neck circumference greater than 43 cm, Mallampati score greater than 3, and poor dentition [26, 27].
- The standard sniffing position for orotracheal intubation has been shown to be less ideal for the obese patient and

lead to increased intubation attempts and time to intubation.

- Instead, the patient should be placed into a ramped position where their external auditory canal is at the same level as their sternal notch (see Chap. 4: Preparing the Patient). This position is easily accomplished by placing multiple folded blankets underneath the head and shoulders [7, 19, 28].
- With the patient positioned appropriately, the next step is to choose the correct intubation devices. There is a slight trend toward better visualization, decreased attempts, and decreased time to intubation with the video laryngoscope versus direct laryngoscopy with a Macintosh Laryngoscope [3, 13, 29–34].
- The bougie is an useful adjunct in obese patients with redundant tissue causing only the epiglottis or epiglottis and partial arytenoids to be visualized during direct laryngoscopy.
- The laryngeal mask airway (LMA) and intubating laryngeal mask airway (ILMA) are also very useful rescue devices for the difficult-to-intubate obese patient. These devices have been successful in both lean and obese patients in oxygenating and ventilating a patient after failed attempts of direct laryngoscopy. These devices are also able to oxygenate and ventilate even when there is a poor grade view on direct laryngoscopy [3, 35, 36].
- An ILMA can allow an endotracheal tube to be passed through the laryngeal device at a later time to obtain a definitive airway. This procedure has been shown to be up to 96% effective in obese patients with only a slightly longer time to intubation [35].
- The fall back of using a fiberoptic scope might be more challenging in the obese patient because the redundant oropharyngeal tissue collapses around the fiberoptic scope, making it difficult to see the appropriate anatomy.
- A novel technique is to place an LMA or ILMA to maintain ventilation and oxygenation and then pass a bronchoscope along with an intubating catheter through

the supraglottic airway device. The intubating catheter can remain in place while the supraglottic device and the bronchoscope are withdrawn. This will then allow an endotracheal tube to be passed over the intubating catheter and securing the airway [7, 37–39].

Post-intubation

- Confirmation that the endotracheal tube is in the trachea and has not been misplaced into the esophagus is essential.
- The usual methods of confirming tube position such as auscultation and watching for chest rise and fall might be difficult due to the patient's body habitus.
- The chest X-ray may be more difficult to interpret due to the excessive subcutaneous fat.
- Pulse oximetry readings might be low or abnormal due to excess soft tissue on the fingers or earlobes.
- Capnography and disposable carbon dioxide detectors are likely the best options for confirming correct placement of the endotracheal tube in this patient population [3, 40, 41].

Mechanical Ventilation

- Once the patient is intubated, placing the obese ventilated patient in the reverse Trendelenberg position, or with their head of bed elevated will help to improve pulmonary mechanics and oxygenation [3, 42].
- The tidal volumes on the ventilator should be set to 6–8 cc/kg of *ideal body weight*. The patient's total body weight should not be used as this will substantially overestimate the tidal volume [3, 13].
- As discussed above, the use of PEEP is beneficial in obese patients, as it will help to recruit and stent open atelectatic airways, and a PEEP of 10 cm H_2O in these patients has been shown to provide improved oxygenation [3, 43].

- Obese patients produce more CO_2 than lean patients due to their increased mass, resulting in a more rapid shallow breathing pattern, thus a higher initial respiratory rate should be set on the ventilator [13, 14, 44].
- There have been no definitive studies completed to determine the best ventilation mode in these patients but there are some data to support that obese patients may do better with pressure support ventilation and have less post-extubation pulmonary complications with this mode compared to others [14, 45].

Medications

- The dosing of medications for intubation in the obese patient can be challenging as the lipophilicity and hydrophilicity of medications can change their effect on the patient given the large amount of fat.
- There is a substantial literature to support that when using succinylcholine it should be dosed at 1 mg/kg of total body weight, as this will allow for the best laryngoscopic view [3, 12, 46, 47].
- Non-depolarizing neuromuscular blockers in contrast should be dosed by ideal body weight [12, 47, 48].
- Induction agents become slightly more challenging because medications such as propofol and etomidate are lipophilic, thus their volume of distribution will be elevated in obese individuals. This elevated volume of distribution requires dosing based on total body weight.
- Depending on the clinical circumstance, a dose of propofol less than what the total body weight calls for might be ideal given its propensity for cardiovascular depression at higher doses [48–50].
- Benzodiazepines are also in the lipophilic category and should therefore be dosed based on total body weight.
- During continuous infusions, the benzodiazepines should be titrated down closer to ideal body weight dosages to prevent excess build up in the adipose tissue [12, 49, 51, 52].

- Ketamine has been shown to be most effectively dosed according to lean body mass. Lean body mass is estimated by adding 20% to the ideal body weight [3, 53].

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