**Chapter 58
Bariatric patient challenges**

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**Introduction**

Obesity is a major health problem in the United States. Body mass index (BMI) is used to quantify obesity and is calculated by dividing the weight in kilograms by the height in meters. More than 69% of the US population is considered overweight, and 36% are obese as determined by BMI ([Table 58.1](https://jigsaw.vitalsource.com/books/9781118990827/epub/OPS/c58.xhtml#c58-tbl-0001)) [1].

[**Table 58.1**](https://jigsaw.vitalsource.com/books/9781118990827/epub/OPS/c58.xhtml#R_c58-tbl-0001) Body mass index (BMI) classification

| **BMI (kg/m2)** | **Classification** |
| --- | --- |
| <18.5 | Underweight |
| 18.5–24.9 | Normal |
| 25.0–29.9 | Overweight |
| 30.0–39.9 | Obese |
| >40.0 | Morbidly obese |

Obesity has numerous effects on health, and is a risk factor for many diseases and health conditions such as hypertension, dyslipidemia, type 2 diabetes mellitus, coronary artery disease, stroke, gallbladder disease, osteoarthritis, obstructive sleep apnea, pulmonary hypertension, and some cancers (notably endometrial, breast, and colon) [2]. Obesity does not only contribute to medical conditions, but may also affect one’s risk for, and recovery from, trauma. Obese individuals are at increased risk for traumatic injury [3], may have increased risk of chest, pelvis and extremity fractures, and of pulmonary, renal, and thromboembolic posttraumatic complications [4]. Obstructive sleep apnea, being relatively common in the obese, increases seven-fold the risk of motor vehicle accidents [5].

The variety of anatomical and physiological changes that occur with the bariatric patient not only affects their risk for disease, but can dramatically affect their prehospital management. Mask ventilation can be difficult and poor respiratory mechanics can predispose the bariatric patient to rapid desaturation and hypercarbia. Medication administration can be complicated based upon various drug dosing calculations, and high-quality cardiopulmonary resuscitation (CPR) can be hindered by the habitus of the bariatric patient. Increasing numbers of bariatric surgery procedures present the prehospital provider with unique pathologies, while more practically speaking, the bariatric patient can pose significant challenges to patient packaging, lifting, and movement. This chapter reviews the key anatomical and physiological changes and identifies the critical management considerations that the overweight patient poses to our prehospital care systems.

**Airway**

The bariatric patient can provide significant challenges to airway management as a BMI of greater than 26 kg/m2 is an independent predictor of difficulty in maintaining oxygen saturation with mask ventilation [6]. Redundant soft tissue about the face and neck can complicate both BLS and ALS airway interventions, and positioning of the bariatric patient is critical for successful management of airway and breathing. Whenever practical, the obese patient should be allowed to sit in a Fowler’s or semi-Fowler’s position. This will displace redundant soft tissue around the neck inferiorly, allowing for easier airway management, and will improve the patient’s respiratory dynamics, which is critical as bariatric patients do not tolerate periods of apnea.

Mask ventilation of the bariatric patient requires two-person techniques to be effective, where one provider is assigned to establish and maintain a mask seal with a two-hand grip, while the other provides ventilations. Often this simple but important intervention is not performed either because of a perception of “adequacy” with one-person techniques, or because in some systems there may not be enough personnel to accomplish this. Additionally, the use of a properly sized mask with oral or nasal airway adjuncts is critical to achieving effective mask ventilation in the obese patient. Ramp positioning, where the patient’s external auditory canal is aligned with the sternal notch, has been identified as an important tool to improve laryngoscopic view and also improves mask ventilation and subsequent oxygenation [7]. This positioning can be accomplished by aggressive padding behind the shoulders, neck, and head with towels and blankets. Soft tissue displacement during laryngoscopy may be difficult, thus worsening visualization of the glottic opening, and the ramp placement assists with this.

Interestingly, although increased BMI does predict difficulty with mask ventilation, there is mixed literature to support a similar correlation with tracheal intubation [8]. Regardless, since the obese patient is clearly difficult to effectively mask ventilate, and such a technique is the basis for initial and failed airway management attempts, the bariatric patient must be approached as if any airway intervention will be difficult.

Surgical airway placement may be challenging in the bariatric patient, regardless of the open or percutaneous technique used. Due to the additional soft tissue about the neck, surgical landmarks are often obscured and conventional cuffed tracheostomy tubes may not have adequate length to assure tracheal placement. As a result, a cuffed endotracheal tube is recommended when performing a surgical airway on a bariatric patient. Supraglottic airway devices may be effective in the bariatric prehospital patient based on operating room data [5]; however, there is scant prehospital literature on the topic, and no published experience with the commonly used King airway.

The bariatric patient with respiratory distress or airway compromise can create significant clinical management challenges for higher-risk procedures such as rapid sequence intubation. A patient who is inherently unable to tolerate hypoxia, coupled with predictable difficulty in effective mask ventilation, requires a thoughtful and methodological approach to airway management. Preparation is critical, including adequate preoxygenation with continuous positive airway pressure, two-person mask ventilation techniques, and ramp positioning. Having immediate access to surgical airway equipment and supraglottic airways is also required. Most importantly, developing the critical clinical decision-making skills amongst providers who may perform rapid sequence intubation is imperative to balance the risks and benefits of the procedure in the bariatric patient.

**Breathing**

The effects of obesity can dramatically affect the acutely ill patient’s respiratory system. The overweight and obese have poor pulmonary reserves as a result of multiple factors. The obese patient demonstrates a restrictive pulmonary physiology as a result of the additional chest wall mass, as well as an increase in resting intraabdominal pressure [9]. Intraabdominal compartment pressure of greater than 12 cmH2O is often considered a compartment syndrome, and the morbidly obese often have intraabdominal pressures at or exceeding this level [10]. This decreases the effectiveness of the diaphragm for inspiratory effort and decreases venous return. Further, the bariatric patient will have decreased lung volumes, a decrease in functional reserve capacity and expiratory reserve volume, and reduced lung and chest wall compliance. These features impart poor respiratory mechanics and are coupled with an increased ventilation/perfusion mismatch compared to a non-obese patient [5,6]. Thus the bariatric patient has a smaller oxygen reserve, but because of increased metabolic activity has increased oxygen demand and CO2 production [5]. This constellation of physiological insults results in a rapid onset of hypoxemia in even the “healthy” morbidly obese patient.

To combat this inherently poor baseline physiology, a few important interventions can enhance the oxygenation of the obese patient. Whenever possible, the obese patient should be positioned in either a semi-Fowler’s or ramped position, even during preoxygenation for advanced airway procedures. For the immobilized patient, even slight reverse Trendelenburg positioning can displace body mass to decrease pressure on the diaphragm or the upper chest muscles and therefore improve respiratory muscle mechanics. When considering continuous positive airway pressure (CPAP), bilevel positive airway pressure (BiPAP), or mechanical ventilation, obese patients generally require more positive end-expiratory pressure (PEEP) to maintain alveolar ventilation than their lean counterparts and should generally be started at 10 cmH2O [11]. Thus the advantages of PEEP to recruit atelectatic alveoli in the bariatric patient have to be balanced with its negative effects on cardiac output, particularly given the elevated intraabdominal pressures that reduce cardiac preload. Extremely important, however, is remembering that lung volumes are calculated on ideal body weight and not total body weight. This is important for both mask ventilation and when placing the bariatric patient on a ventilator. Exceeding the recommended 6–8 mL/kg tidal volume calculated based on the patient's ideal body weight can increase the risk of acute lung injury and ultimately the morbidity and mortality of the obese patient [12].

The increase in chest wall tissue found in the overweight and obese can also affect the efficacy of needle thoracostomy attempts. The mean chest wall thickness in a Netherlands study was 3.5 cm, and a catheter length of 4.5 cm was found to not penetrate the pleural space in 9.9–35.4% of patients, depending on age and sex [13]. A US study found more concerning results, as the mean chest wall thickness was 4.5 cm, and concluded that the standard 4.4 cm catheter would not be successful in 50% (95% confidence interval (CI) 40.1–59.3%), requiring emergency pleural decompression [14]. Proper equipment selection and rescuer knowledge of conventional needle catheter success are thus paramount for a successful intervention.

**Circulation**

The bariatric patient has an increased circulatory blood volume, a hyperkinetic circulatory system, and often myocardial hypertrophy and diastolic dysfunction [2]. This may limit the physiological response to an acute pathological insult, putting the patient at increased risk for rapid decompensation. Basic staples of resuscitative care such as blood pressure monitoring may be difficult to obtain accurately because of excess adipose tissue, further challenging objective measurements of perfusion in the morbidly obese. Assuring response personnel are using the appropriate sized blood pressure cuff, and understanding limitations of automatic blood pressure machines compared to manual blood pressures, remain essential, important skills when managing the bariatric patient.

Effective, high-quality CPR may be negatively affected by obesity. In addition to the challenges of airway and breathing found in the bariatric patient, obtaining proper CPR positioning, sufficient compression depth, and good chest recoil may be difficult. Further, many CPR assistive devices may not fit the bariatric patient, placing increased reliance on conventional CPR techniques. Despite these considerations, there is no clear correlation between BMI and outcome for in-hospital cardiac arrest [15], and there is scant literature on its effects in the prehospital setting and what, if any, practical implications obesity has on performing high-quality CPR.

Venous access can be particularly challenging in the bariatric patient. Excess adipose tissue may limit peripheral venous access, and redundant neck tissue may make external jugular approaches nearly impossible. Longer intravenous catheters may be required, if a suitable site can be found at all. Intramuscular approaches may not effectively administer the medication to the muscle body and instead enter the excess adipose tissue, whose absorption of drug is erratic at best. Various peripheral venous access assistive devices have emerged, including ultraviolet vessel detection, ultrasound, and intraosseous devices, all with their inherent benefits and disadvantages. Intraosseous venous access is a common option in the bariatric patient, and manufacturers have created longer needles to address the limitations of traditional shorter length needles in the overweight subject. Even with advances in intraosseous technology, the bariatric patient often remains a vascular access challenge, primarily related to greater difficulty in establishing the proper landmarks for needle insertion as a result of excess adipose tissue.

Once venous access is obtained, there remain unique challenges to drug dosing in the bariatric patient. Drugs are classically dosed based on lean or ideal body weight (IBW), total body weight (TBW), or adjusted body weight. In the bariatric patient, the pharmacokinetic parameters of volume of distribution, clearance, and protein binding can be markedly affected, particularly those medications that are lipophilic [16,17]. This becomes important when managing the bariatric patient since EMS personnel may provide significantly more medication than is required because of a general tendency to calculate the dose based on TBW. [Table 58.2](https://jigsaw.vitalsource.com/books/9781118990827/epub/OPS/c58.xhtml#c58-tbl-0002) outlines common EMS medications and their recommended initial doses based on pharmacokinetic literature or expert opinion [16–19].

[**Table 58.2**](https://jigsaw.vitalsource.com/books/9781118990827/epub/OPS/c58.xhtml#R_c58-tbl-0002) Dose considerations for common prehospital medications

| **Dosing calculation** | **Medication** |
| --- | --- |
| No weight consideration | Adenosine, amiodarone, metoprolol, ondansetron, dobutamine, epinephrine |
| Ideal body weight | Dopamine, ketamine, lidocaine, morphine, norepinephrine, procainamide, rocuronium, vecuronium |
| Total body weight | Diltiazem, etomidate, fentanyl, lorazepam, midazolam, propofol, succinylcholine |

To generalize, lipophilic medications should be dosed according to TBW, while hydrophilic medications should be dosed according to IBW. To add to the confusion, some medications, such as lorazepam and midazolam, should have bolus doses calculated based on TBW and continuous infusions based on IBW. Notably, most vasoactive medications (epinephrine and norepinephrine) are generally titrated to achieve a target goal (mean arterial pressure) and therefore pharmacokinetic data have less effect on the dose regimen. Dopamine is the exception to this and dose is based on IBW in addition to the target goal.

Importantly, drug dosage recommendations are typically made based upon the pharmacokinetic or clinical data from individuals with normal weights, so there may be unique variations in the bariatric patient’s pharmacokinetic parameters that are simply not known or appreciated. In short, there is a significant paucity of data in dose recommendations for the obese and morbidly obese, and providers and EMS physicians must be prepared for the possibility of erratic absorption, longer onset, and prolonged duration of medications administered to the obese patient.

**Bariatric surgery**

As the incidence of morbid obesity has grown, so has the number of patients receiving bariatric surgery. Bariatric surgery is generally reserved for those with a BMI ≥40 kg/m2 (or ≥35 kg/m2 with comorbid conditions) and may be accomplished through a number of surgical techniques [2]. Bariatric surgery has the same short-term complications as other surgical procedures including infection, sepsis, delayed wound healing, deep venous thrombosis, and pulmonary embolism. Additional short-term complications unique to bariatric surgery include anastomotic or staple leak which may occur in up to 3% of Roux-en-Y bypass procedures [20], and approximately 3% of bariatric surgeries will experience postoperative hemorrhage which usually occurs within the first 24 hours after the procedure [21]. Long-term complications found with all procedures can include small bowel obstruction, gastric or small bowel ulcers, and nausea and vomiting. Laparoscopic adjustable gastric banding can be complicated by erosion or slippage of the band, or leakage from the port or band tubing, while Roux-en-Y can be complicated by anastomotic stricture, gastrogastric fistula, and dumping syndrome [22]. Many who undergo bariatric surgery develop gallstones as a result of such rapid weight loss and some surgeons elect to perform prophylactic cholecystectomy because of this frequent postoperative complication.

## Patient packaging and movement

Facilitating the movement and maintaining the dignity of the bariatric patient has received increased attention over the last decade. Industry has responded with numerous features designed to enhance patient comfort, promote patient and provider safety, and decrease injury to prehospital personnel. These include specialized lifting devices such as bariatric transfer sheets, reinforced and wider backboards capable of carrying larger loads, lateral transfer aids to facilitate bed to EMS and EMS to hospital transitions, and various improvements to stretchers and stair chairs such as hydraulic lifts, lateral expansion “wings” to accommodate a larger girth patient on the standard stretcher, wider stretchers, and stretchers with enhanced load limits.

Despite this, the bariatric patient poses unique packaging and movement challenges to prehospital personnel. Common disposable cervical collars often do not fit correctly nor provide adequate immobilization because of the additional adipose tissue found around the neck. Personnel must be familiar with other immobilization techniques using towels, blankets, or manual stabilization when caring for an injured victim with high concern for cervical spine injury. Further, because of the excess adipose tissue often found in the upper back, additional padding behind the head may be required to maintain the neck in a neutral position.

Older backboards often have lower weight limits than more modern boards and are therefore at risk for breakage. The standard modern backboard is 16 inches wide and most can safely handle up to 450 lbs, which may not be adequate for moving the bariatric patient. Many manufacturers are now offering wider, reinforced backboards that are capable of supporting up to 1,000 lbs. Other immobilization devices such as the Kendrick Extrication Device and various traction splints may not be able to accommodate larger torsos or proximal thighs, requiring improvisation by the responding personnel to meet the immobilization needs of the bariatric patient.

The standard EMS stretcher is 23 inches wide and is able to support between 550 and 700 lbs. Often, the challenge is with the girth of the patient and not necessarily the weight; most patients in excess of 400 lbs will not fit safely or comfortably on standard stretchers. Bariatric stretchers often have a width of 29 inches, with stretcher adapters that can expand up to 40 inches, and increased load limits of 850–1600 lbs depending on height position. These increased load capacities come at a cost as these stretchers are significantly heavier than the standard stretcher. Critical to the movement of the bariatric patient is to assure that the stretcher is kept in the lowest position possible in order to minimize the risk of tipping. Equally important is to assure that no fewer than four, and ideally six, personnel are used to move the loaded bariatric stretcher.

Once safely secured on the stretcher, the loading of that stretcher into specialized ambulances has become commonplace. The so-called “bariatric” ambulance is generally a Type I or III ambulance that includes a ramp or hydraulic system to completely remove the need for personnel to lift the patient and the stretcher into the ambulance. Ramp systems use a set of ramps and a winch to pull the stretcher into the patient compartment, while hydraulic systems use an elevator lift that brings the stretcher from the ground to the level of the patient compartment, allowing the stretcher to be rolled directly in. Both systems have weight limits that are device specific but generally can accommodate up to 1,300 lbs inclusive of stretcher, patient, equipment, etc. Bariatric ambulances also often carry bariatric stair chairs, transfer devices, and other adjuncts that can facilitate the movement of the bariatric patient while maintaining some dignity and potentially reducing the risk of provider lifting injury. Having policies or procedures in place outlining the safe movement of a bariatric patient is critical, as this outlines the capabilities and resources of a community. For example, specific limitations of regional air medical services should be determined well in advance of a request for service.

The lifting and moving of bariatric patients represent a significant injury hazard to prehospital personnel, who already experience higher injury rates than workers in most other industries [23]. The majority of these injuries are related to strains and sprains of the back, and represent an important area for injury prevention. Given the increased frequency of caring for bariatric patients, EMS agencies should establish programs to assure personnel are using the proper lifting and moving techniques for all patients, along with frequent familiarization with the specialized bariatric lifting and moving equipment that is available. Training mannikins that approach 540 lbs are available and are an important tool to assist EMS personnel in learning how to safely extricate, package, and move the bariatric patient.

## Conclusion

The bariatric patient poses unique challenges to prehospital personnel. Airway management can be complicated and poor respiratory mechanics can predispose the bariatric patient to rapid desaturation and hypercarbia; however, basic airway skills, preparation, and patient positioning may reduce this risk. An increased potential for barotrauma can result from improperly calculated tidal volumes while vascular access can be challenging despite modern technologies due to difficulties in identifying anatomical landmarks. Medication administration can be complicated based upon various drug dosing calculations, and familiarity with the unique pharmacokinetics of the bariatric patient is critical. The bariatric patient can also pose significant challenges and hazards to patient packaging, lifting, and movement; however, industry responses to this demand provide EMS personnel with new tools to respond to this challenge. Proper lifting techniques and adequate numbers of personnel to safely move the bariatric patient are imperative to reduce injury regardless of the assistive devices used.

Whether it is the ABCs or extrication and movement, being familiar with the alterations in physiology along with the pitfalls of management requires familiarization and preparation to improve the care of the bariatric patient.

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