EMS systems need to know how to handle the increase in bariatric patients

An EMS crew was asked to transport a morbidly obese patient back to his residence. When they arrived at his bedside in the hospital they found a 50-year-old male weighing 672 pounds lying in the bed—200 pounds heavier than what had been dispatched. Transport was delayed while the crew coordinated to have a bariatric cot brought to the hospital. During this time the crew discussed the patient with the discharge planner, who explained that she attempted to arrange for the patient to be taken to rehab to regain his strength and become compliant.
with his CPAP, which he needed for sleep apnea. He refused to go and was also non-compliant with his diabetes medicines. He instead wanted to go back to his residence, but she first wanted to make sure he could function safely at home. However, in order to do this he would have to ambulate first to the crew's cot and later to his wheelchair at his residence.

Eventually the stretcher arrived, and with four people the crew assisted him to his feet and he was able to pivot to the cot. The crew assisted him with four people the crew assisted him to the ambulance, he was loaded with an electronic lift that can raise the cot into the ambulance. When the crew arrived at his home he fortunately had a ramp to get up to the front door; unfortunately the cot barely fit on it. Crew members weren’t sure the wooden ramp would support the weight of the cot, but surprisingly it did. It took 25 minutes of maneuvering to get the cot positioned correctly on the porch to go into the front door. In the living room the crew assisted the patient into his wheelchair, which barely fit through any door inside the home. Despite the crew’s concerns about the man's ability to move around his house, he insisted on staying. When the crew left they shared their concerns with one another about what would happen if he went into cardiac arrest at home. There would be no way to move him out of the house safely, nor would there be any way to effectively perform chest compressions on him.

The next morning when the crew arrived at work they discovered that less than 60 minutes after they had taken the patient home, EMS was called back to the residence for severe respiratory distress. It took two hours, and two ambulance crews and an engine crew, to move the patient via Stokes basket out of the residence. By the time he arrived in the emergency department he had expired.

Epidemiology

Obesity is a growing problem, with 32.2% of men and 35.5% of women classified as obese with a body mass index of greater than 30.0. Between 1985 and 2010, the prevalence of obesity rose exponentially, changing from a time when every state had less than a 15% obesity rate to the present day when no states have a prevalence under 20% (Figure 1), and this data doesn’t even reflect the worrisome trend of obesity in children. Roughly 17% of children between ages 2 and 19 are considered obese.

Obesity is determined based on an individual’s body mass index (BMI) which is derived based on their weight and height. Table 1 highlights how a BMI is used to determine obesity; essentially, the higher a BMI the more overweight or obese an individual is. A BMI under 25 is considered normal, or healthy.

There are many explanations for why obesity is rising. Our diets are filled with fats and sugars, people are more sedentary, and extended work and school hours are limiting time for calorie burning activities. Regardless of how this epidemic has arisen, there are real consequences that directly affect EMS systems and providers through both increased call volume and serious logistical issues.

Physiological Effects

Obesity is a risk factor for many diseases and illnesses, including:

- Coronary artery disease
- Type 2 diabetes
- Cancer (endometrial, breast, colon)
- Hypertension
- Stroke
- Liver and gallbladder disease
- Sleep apnea
- Osteoarthritis
- Gynecological problems
- Kidney disease
- Psychological issues.

As an individual becomes overweight, their body stores excess fat as adipose tissue. Most commonly this adipose tissue is stored across the abdomen, around the liver and surrounding muscles. Adipose tissue has also been found to release a large number of cytokines. Cytokines are molecules that signal cells to carry out specific functions and can be comprised of proteins, peptides or glycoproteins. Some cytokines are immunomodulating agents, which affect the immune system, while others affect different organ systems. While the specific function of each cytokine is beyond the scope of this article, several of these will be mentioned throughout the article.

EFFECTS ON PULMONARY HEALTH

Even in the absence of pulmonary diseases, obesity causes a decrease in pulmonary residual volume and total lung capacity. Fatty deposits across the abdomen and the chest inhibit lung compliance by stiffening the chest wall and limiting diaphragm contraction. Obesity hypoventilation syndrome (OHS) can develop, which causes hypcapnia and is suspected to be caused by a combination of a reduced respiratory drive and
The above-described reduced respiratory mechanics, as hypercapnia worsens, respiratory acidosis develops. Because this happens over time there is some degree of metabolic compensation. The respiratory drive is thought to be reduced in obese patients because adipose tissues release the aforementioned cytokines that impairs the central nervous system’s control over respiration.

The symptoms of obesity hypoventilation syndrome include obstructive sleep apnea (OSA), exertional shortness of breath, daytime sleepiness, hypercapnia, polycythemia and chronic hypoxia. The polycythemia is secondary to the chronic hypoxia experienced by these patients, which in turn is from the increased oxygen demand of excessive body mass and the heart’s excessive workload. Up to 10% of all morbidly obese patients experience OHS.4

As a result of these physiological changes obese patients often present with tachypnea and become short of breath easily. All tissue, including adipose tissue, requires oxygen and as a result of obesity the body’s oxygen demand rises exponentially. This requires the heart to circulate blood faster to accommodate increased distribution and the individual to breathe more rapidly to increase the rate of gas exchange. However, when combined with decreased total lung capacity, many patients struggle to keep up with oxygen demands and as a result have very limited oxygen reserves.

This limited oxygen reserve was well illustrated in a study performed on patients undergoing rapid sequence intubation in the operating room. Obese patients receiving the same amount of preoxygenation desaturated more than twice as fast as healthy adults (Figure 2).5 This is exacerbated by an increased airway resistance found in obesity which makes proper ventilation difficult in even the best of circumstances.5

**EFFECTS ON CARDIOVASCULAR HEALTH**

For every 10 kg increase in body weight, there is a measurable 3.0 mmHg increase in systolic and 2.3 mmHg increase in diastolic blood pressure.7 Not surprisingly, nearly 75% of the incidence of hypertension is related to obesity. When certain cytokines are released by adipose tissue they act on the renal system and on the sympathetic nervous system. In the kidneys they activate the renin-angiotensin-aldosterone (RAA) axis, which increases sodium absorption. With the RAA axis activated, sodium reabsorption increases water retention. Blood pressure increases from both water retention and the stimulation of the sympathetic nervous system. This cardiovascular stress can cause long-term damage to the renal system by stretching the renal blood vessels, stressing glomerular filtration rates and compressing the renal medulla.

One study found that the cardiovascular disease mortality rose 34% in men and 29% in women for each 5-unit increase in BMI.8 As an individual becomes more obese, fatty streaks along the tunica intima and fibrous plaque lesions become more common in the coronary arteries, as well as the aorta (see Figure 3).7

Fatty deposits can actually infiltrate the heart muscle itself and adipose tissue strands can begin to separate the myocardial cells. This leads to an obesity cardiomyopathy that will impair contractile force, cause left ventricular hypertrophy and decrease cardiac output.8 Additionally, the prevalence of congestive heart failure rises as it is also exacerbated by simultaneous rises in the frequency of hypertension, diabetes and coronary artery disease.

**EFFECTS ON RENAL HEALTH**

As mentioned previously, cytokines from adipose tissue stress renal function through constant RAA axis stimulation and hypertension. In addition to this, obese patients experience excessive renal vasodilation and glomerular hyperfiltration caused by the body’s excess fluid status. This increased renal workload stresses the kidneys and increases tubular and glomerular capillary wall stress, which over time leads to the loss of nephron function and glomerulosclerosis. Presently, there is no association between obesity and the development of end-stage renal disease or the need for dialysis.9

**EFFECTS ON OTHER SYSTEMS**

Nearly all organ systems are affected by obesity, some from excessive adipose tissue directly and others from the release of cytokines. These effects include an increased insulin resistance as a result of cytokines, and decreased sperm counts and fertility rates in men and women as a result of leptin. Other changes include pedal edema as a consequence of elevated ventricular filling pressures exerting additional pressures on the capillaries;7 increased weight on load-bearing joints in the skeletal system, increasing the frequency of arthritis; increased frequency of gallstones and pancreatitis; and increased frequency of bacterial and fungal skin infections, as well as psoriasis on the skin.
Prehospital Challenges

Obesity increases the prevalence of many medical conditions that are commonly treated by EMS providers, including cardiovascular and respiratory disease, as well as diabetes. Not only does increasing disease frequency increase EMS call volume, but each call becomes more challenging as assessing and managing obese patients presents unique challenges.

Almost equally challenging is the logistical issue of safely moving and transporting morbidly obese patients. The safety of both the patient and the crews needs to be considered carefully.

Assessment Challenges

Providing a proper and thorough assessment on an obese patient can be quite challenging. To provide a proper assessment, take the time necessary and consider the following strategies to make a physical examination easier:

• Keep the patient on his or her side or upright as much as possible.
• Listen to lung sounds on the back just medial to the scapula; this is an area of decreased adipose tissue.
• Apply pulse oximetry on the earlobe, fifth digit, nose or temporal artery. These areas where the meter’s light waveform is less likely to be dampened by adipose tissue.
• Assess for cyanosis inside the lips or eyelids.
• To listen to heart tones place the patient on his or her left side; this shifts the heart closer to the lateral aspect of the chest wall.
• Ensure a properly sized blood pressure cuff. Cuffs that are too small artificially inflate the blood pressure. Use a thigh cuff on the arm or a large cuff on the forearm as necessary.
• Avoid placing EKG electrodes on the abdomen as signals don’t transmit through adipose tissue well. Instead place leg leads on the lateral aspect of the lower abdomen.

Remember that most glucometers are calibrated to determine a capillary glucose, not venous blood such as that taken during an IV start. Studies have shown that there is a statistically significant difference in the values obtained when using a glucometer to test capillary and venous blood, which is why the glucometer is calibrated for capillary blood testing. However, there remains debate if this difference is significant enough to change clinical care in the emergency setting.

Since fingers may be quite edematous and obtaining blood may be difficult, consider testing an area of skin that is capillary rich and tends to be fatty-tissue poor, such as the earlobe. While this is painful, it avoids the need for multiple needle sticks in an effort to obtain a blood sample.

Obese patients are already prone to depression and poor self-image. Avoid making the patient feel belittled during an assessment and remind them that you are there to help them not just physically but psychologically, as well. Stress that you need their help to make an accurate assessment in order to provide optimal care.

Patient Management

AIRWAY MANAGEMENT

Careful airway management is extremely important. Obese patients are known to have a decreased gastric pH as well as increased stomach sizes. Because of this, they are considered at particularly high risk for aspiration during airway management.

The ability to BVM ventilate an obese patient is extremely important because they have decreased oxygen reserves and will not tolerate apnea for any period of time. One study demonstrated that a BMI over 26 was predictive of difficulty maintaining oxygen saturations greater than 92% with bag-mask ventilations alone.

When bag-mask ventilating, utilize a two-person technique—one holding the mask, another ventilating the patient. Remember additional force is needed to displace the diaphragm inferiorly into the abdomen and to raise the chest wall with excessive adipose tissue. Some BVMs that have a pop-off valve may need the valve disabled.

An effective strategy to make mask ventilations easier is to ramp up the patient’s torso and head by using stacks of folded blankets and towels to elevate the head % at least 25 degrees and make the auditory canals line up with the sternum (see Figure 4). This ramped position decreases the risk for aspiration, makes ventilating the lungs easier and also eases the intubation process by shifting the chest and abdominal contents inferiorly.

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The use of non-invasive positive airway pressure systems (CPAP and BiPAP) can be a very effective tool in managing obese patients with respiratory distress. However, when using them set the PEEP or ePAP to at least 10 cm H2O; the use of 7.5 cm H2O has been found to be ineffective in improving the oxygen reserve in morbidly obese patients.

INTRAVENOUS ACCESS

Excessive adipose tissue makes traditional landmarks difficult to visualize and palpate, making the identification of veins difficult. As a result multiple IV attempts are common, which increases infection, phlebitis and thrombosis risk. Traditional IV catheters are often not long enough to properly access a vein buried within subcutaneous adipose tissue. Consider catheters longer than the standard 1.5-inch needle and avoid the butterfly needles, as they are much shorter and even less likely to provide proper access.

Consider earlier use of IO needles during prehospital care. One IO needle attempt may have a lower infection rate than five, six or more IV attempts. There is a bariatric needle for the EZ-IO which is designed to be extra-long (44 mm compared to a standard 25 mm) to facilitate placement through adipose tissue in the leg or in the shoulder to access the humeral head.

MEDICINE ADMINISTRATION

Differences in renal blood flow and
paramedic knows, these backboards are barely wide enough for most average-size patients, much less the excessively wide patient. No bariatric spine immobilization device is available on the market. When managing a traumatically injured obese patient, it may be unrealistic to completely immobilize the spine without jeopardizing the safety of both the patient and the providers.

Rather than attempting to immobilize these patients, focus instead on minimizing excessive movement, keeping the patient as still as possible and maintaining them in a supine position. Remember that upon arrival in any trauma center, patients are almost always taken off of the long board within just a few minutes and left in a cervical collar only as long as necessary. It is reasonable to apply a cervical collar to obese trauma patients, but consider discussing with your medical director a practice that allows for transport of obese patients in a supine position on the stretcher alone without utilization of a backboard. Several studies have shown that when spinal cord injury does occur, it occurs at the time of injury, and only in rare instances does the use of a backboard actually affect the long-term outcome of patient care. While it has not been proven that obese patients have a higher incidence of decubitus ulcers from backboard use, it is reasonable to suspect that this could be true.

**Logistical Issues**

A standard EMS stretcher is 23 inches wide and can support weights between 550 and 700 pounds. Unfortunately, a patient weighing 700 pounds may be 50–55 inches wide—over twice the width of a normal stretcher. While there is no magic formula for determining patient width in comparison to their weight, it is unreasonable to assume that patients weighing in excess of 400 pounds are able to comfortably fit on a standard cot. Solutions are available. Many bariatric stretchers and stretcher adapters are available, which increase the stretcher width to 29–40 inches and a carrying capacity to up to 1,500 pounds.

Many EMS systems now utilize at least one bariatric stretcher primarily for inter-facility transport. But if bariatric stretchers are available locally, do not hesitate to request these stretchers to the scene of 9-1-1 calls, even if doing so creates a significant on-scene delay. If a patient is too wide to safely fit within the rails of a standard stretcher, it is not safe to move them on the stretcher.

When an obese patient hangs over the sides of a stretcher, they greatly increase the opportunity for the stretcher to tip over, and if it starts to tip there will be no way to stop it; any attempts to do so will likely only result in injury.

When using a bariatric stretcher always use safe lifting practices. Bariatric stretchers can weigh over 100 pounds and there is no reason to ever attempt to lift a loaded stretcher this size with only two people. At a minimum have four providers available when lifting a bariatric stretcher and, ideally, have six people available to provide support when lifting a stretcher or loading it into the ambulance. Most EMS services have standard lifting requirements of lifting as much as 75 pounds alone or 250 total pounds with a partner. Keep these requirements in mind when determining how many people to utilize when lifting an obese patient and have as many people as possible assisting with the move. Many stretchers have hydraulic lifts to raise and lower the wheels. However, these systems add additional weight to the stretcher that must be considered. Remember, during loading, the stretcher must be held by the foot end with the wheels elevated for a few moments prior to loading it into the ambulance. Additionally, while hydraulic lifts make raising and lowering a stretcher easier, they do not actually increase the stretcher’s weight limit or make patients already too wide

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**SPINE STABILIZATION**

Standard EMS backboards are 16 inches wide. As any experienced EMT or paramedic knows, these backboards are barely wide enough for most average-size patients, much less the excessively wide patient. No bariatric spine immobilization device is available on the market. When managing a traumatically injured obese patient, it may be unrealistic to completely immobilize the spine without jeopardizing the safety of both the patient and the providers.

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for the stretcher more comfortable.

Imagine taking the time to safely lift and load an obese patient onto a proper stretcher inside of their residence to only then realize that you need to traverse narrow halls, icy sidewalks, a dirt path or broken cobblestones to get the patient safely to the ambulance. Such situations can pose a significant and serious dilemma to both your and the patient’s safety.

Think ahead when preparing to transport the patient, as there is no reason to rush and create an injury. Get the ambulance as close to the residence as possible. Create a vision with coworkers as to how each patient move needs to occur, working backward from the ambulance to wherever the patient presently is resting.

In some instances it may not be reasonable to load the patient onto the stretcher immediately. If scene logistics require the patient to walk with assistance, it is OK to request this to prevent provider injury.

Additionally, consider the use of other patient moving devices. There are several heavy-duty bariatric tarps available that are designed to be slid beneath the patient and then used to literally drag patients across floors and through doors without exposing the patient to injury. These tarps are thick enough to withstand puncturing or tearing from standard materials found around homes and residential areas and have hand holds for up to 12 individuals to move the patient. Another option when enough providers are available is to use a Stokes basket to move the patient to a location where they can be lifted onto the stretcher.

When lifting and moving an obese patient, make sure to have more than enough assistance. There is no reason to rush a move and cause a medical provider a career-ending back injury. This includes when loading patients into ambulances. While many stretchers now have automatic wheel lifts, bariatric stretchers do not. Two separate systems have been designed to help load obese patients into the ambulance. Both systems require stretchers to be in their lowest position, which means either moving the stretcher in the lowest position with the patient on it, or lowering the stretcher before loading the patient.

Ramp systems utilize a cable and winch to pull the stretcher up secured ramps and into the ambulance. Another available system is the hydraulic lift, which can lift the stretcher to the level of the ambulance floor to allow it to be slid directly in. While both of these systems can lift as much as 1,300 pounds into an ambulance, it is important to remember that this includes the weight of the stretcher, the patient and any equipment attached to the patient.

Summary

Obesity is a serious disease that poses many problems for EMS. Morbidly obese patients do not fit on standard EMS equipment and the need for the safe transport

UNDERSTANDING MECHANICAL VENTILATION

Following intubation, some EMS systems have begun using mechanical ventilators. Additionally, mechanical ventilators are a common tool during critical care interfacility transport. Proper mechanical ventilation is important because normal respiratory mechanisms, as well as normal gas exchange, are greatly impaired in sedated and paralyzed patients. When placing patients on a ventilator, the use of high tidal volumes, particularly those exceeding 13 mL/kg of ideal body weight, offers no advantage in comparison to lower volumes and can actually place the patient at risk for barotrauma by raising the plateau pressure. To prevent lung injury utilize a lower than estimated lung volume, try to estimate the patient’s ideal body weight carefully and monitor airway pressures closely. Increase the respiratory rate to increase the minute volume should additional gas exchange be needed to improve carbon dioxide elimination and acidosis. The FiO₂ may need to be maximized to optimize oxygen absorption. If you are in a system that uses a ventilator that does not have the ability to monitor airway pressures, challenge your manager for their reasons why.

During mechanical ventilation the use of PEEP recruits additional alveoli into use and improves oxygenation and respiratory mechanics. High amounts of PEEP at 10 cm H₂O may be needed. However, exceeding 10 cm H₂O is likely to impair cardiac function.

When transporting a bariatric patient, you need to develop a feasible plan as to how you will get the patient out of his residence. If possible, ensure you have enough personnel on scene to assist with any unforeseen difficulties.
of obese patients is rising. In addition to posing many logistical dilemmas, obese patients are prone to many serious medical conditions that are likely to increase their exposure to EMS systems. Prepare yourself and your program for the management and transport of obese patients by designing a safe patient transport model and policy with protocols geared toward the obese patient.

REFERENCES


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