Data from the U.S. National Health and Nutrition Examination Survey indicates that at least 60% of women of childbearing age are overweight or obese. In 2009, the Institute of Medicine released a new range for weight gain during pregnancy that limits the gain to 11 to 25 pounds when the BMI is greater than 30 kg/m² and 15 to 25 pounds when the BMI is between 25 and 29.9 kg/m².\(^1\)

Obesity increases the utilization of resources, especially during pregnancy. The costs associated with the care of an obese parturient have been shown to increase in direct proportion with the body mass index (BMI).\(^2\) Obese pregnant women require more prenatal tests, ultrasonographic examinations, medications, and prenatal visits compared to women of normal weight.\(^3\)

MORBID OBESITY AND PREGNANCY

Care of obese women is particularly challenging during pregnancy. Coexisting disease(s) often complicate(s) obstetric and anesthetic management of these women. Although there are no pregnancy-specific definitions of obesity,\(^4\) pregnant women are considered obese when the BMI is \(\geq\) 30 kg/m². Morbid obesity is described as a BMI \(\geq\) 40 kg/m².

**Comorbid conditions** Morbidly obese pregnant women are at increased risk for hypertensive disorders (e.g., preeclampsia, chronic hypertension),\(^5\) coronary artery disease, respiratory disorders (e.g., asthma, sleep apnea), cerebrovascular disease, diabetes mellitus,\(^6\) nonalcoholic fatty liver disease as well as thromboembolic disease. All of these conditions can complicate obstetric management and lead to greater maternal, neonatal, surgical, and anesthetic risk.

**Obstetric risk** These patients are also at increased risk for instrumented and cesarean delivery (CS).\(^5\) The risk of CS increases linearly with increasing BMI. Failure to progress, abnormal labor, nonreassuring fetal status, abnormal presentation, and shoulder dystocia are more common. Cesarean deliveries are more often complicated by longer operative times, increased operative blood loss and postpartum hemorrhage, postoperative endometritis, wound infection, as well as increased length of hospital stay. Hood and Dewan\(^6\) noted that all major postpartum complications in morbidly obese women were associated with CS.

**Neonatal outcome** Babies of obese women have increased risk of congenital anomalies, prematurity, stillbirth, neonatal intensive care unit admissions, and neonatal death in complicated cases.\(^5\) Fetal macrosomia is also common\(^6\) and increases risk of shoulder dystocia and birth trauma.

**Maternal mortality** Obesity and CS have been identified as independent risk factors for *maternal mortality*.\(^5\) More importantly, obesity is an important risk factor for anesthetic-related maternal mortality.\(^8\) Although there has been longstanding concern about risk of maternal mortality and general anesthesia for CS, there are emerging concerns about complications occurring during the administration of neuraxial anesthesia as well as during the postoperative period in the obese. A review by the Doctors Company of 22 anesthesiology claims that were filed after maternal arrests on labor and delivery wards between 1998 and 2006 again revealed *morbid obesity* as a significant risk factor for maternal arrest.\(^9\) Outcomes of the 22 patients were poor with only 1 patient leaving the hospital neurologically intact. Of the others, 10 of 22 patients died and 11 had anoxic brain damage. Thirteen of the arrests were related to respiratory arrest following spinal (5 for CS) or labor epidural (8 with unintended subarachnoid placement) placement. Of these cases, *morbid obesity* was documented in 3 out of the 8 labor epidural cases and in 1 out of 5 CS. Resuscitation of the mother was delayed in 7 of the epidural cases because of a lack of airway equipment in the labor room or a delay in transfer of the patient to the operating room (OR).

A state review of 855 maternal deaths in Michigan between 1985 and 2003 revealed 8 of these deaths were anesthesia-related and 7 were anesthia-contributing.\(^10\) Of the anesthesia-related deaths, 6 of the patients were obese. None of the deaths occurred during induction of anesthesia, however hypoventilation and airway obstruction occurred during emergence or recovery. More than half of the deaths resulted from lapses in postoperative monitoring and inadequate supervision by an anesthesiologist.
In the most recent triennial report of maternal deaths in the United Kingdom (UK) between 2006-2008, obesity was found to be a significant contributor to maternal death. Of 261 total deaths, there were 18 Direct or Indirect maternal deaths to which perioperative anesthetic management contributed. Obesity was a contributing factor in 9 of the 18 deaths. Although there was a significant reduction in the overall number of maternal deaths compared to the previous triennium (13.95 per 100,000 maternities in 2003-05 to 11.39 per 100,000 maternities during 2006–08 [P = 0.02]), the authors caution that “many of the avoidable factors identified remain the same as in previous reports and more research is needed to identify methods, tools and training to reduce substandard care by health professionals.”

**OBESITY AND PHYSIOLOGIC CHANGES OF PREGNANCY:**

Implications for preoperative assessment and anesthetic planning

Both pregnancy and obesity lead to physiologic changes in multiple organ systems that can lead to profound functional impairment, decreased physiologic reserve, as well as obstetric and anesthetic complications. Ideally, anesthesiology consultation should be obtained early in the 3rd trimester to ensure proper evaluation and development of an anesthetic plan. In reality most will be seen for the first time on the labor and delivery ward. Although American College of Obstetricians and Gynecologists (ACOG) recommends anesthesiology consultation for obese women who are pregnant or planning a pregnancy, a recent survey of obstetric providers suggests that the anesthetic implications of obesity may not be a routine part of prenatal care for obese pregnant women.

**Airway**

The airway undergoes important changes during pregnancy and the effects of obesity are additive. Obesity and pregnancy each increase the risk of difficult intubation. The incidence of failed tracheal intubation is estimated to be 1 in 280 in the obstetric population compared to 1 in 2230 in the general surgical population. Similarly, a 6-year review of obstetric cases of failed intubation in the UK revealed 36 cases of failed intubation occurring in 8,970 obstetric general anesthetics (incidence 1:249). The average BMI of these patients was 33. A careful airway examination should be completed immediately before any anesthetic procedure since this exam is known to change during labor. In a recent evaluation of airway changes during labor, there was a significant increase in airway class from prelabor to postlabor. Thirty-eight of 61 parturients developed a class 3 or 4 airway that was independent of duration of labor or fluid administration.

The airway exam should include assessment of neck circumference, Mallampati score, mouth opening, dentition, thyromental distance, neck mobility and the ability to sublux the lower teeth beyond the upper teeth. Pregnancy increases mucosal edema of the nasopharynx, oropharynx, and larynx but preeclampsia, upper respiratory tract infections, stridor, and voice changes are all indicators of airway edema. Difficult laryngoscopy and failed intubation in obstetric patients have been associated with large breasts, increased anteroposterior diameter of the chest, airway edema and reduced chin-to-chest distance. The importance of proper airway positioning prior to CS cannot be overemphasized.

**Respiratory**

The respiratory system is challenged in pregnancy but even more so when the parturient is obese. Pulmonary mechanics, lung volumes, functional residual capacity (FRC), oxygenation, and ventilation are altered in these individuals. Chest wall compliance decreases because of increased weight of excess adipose tissue. Respiratory work and oxygen consumption are increased.

In these patients, oxygen consumption increases in direct proportion to excess adipose tissue. Although pulmonary diffusion is normal in these individuals, excess abdominal weight and decreased chest wall compliance lead to airway collapse in dependent portions of the lungs. Consequently, supine and Trendelenburg positioning can lead to deterioration of lung volumes and further reductions in FRC. Functional residual capacity may fall below closing capacity promoting small airway collapse, atelectasis, ventilation perfusion mismatch, and hypoxia, especially with supine and Trendelenburg positioning. It is often helpful to measure the oxygen saturation in the sitting and supine positions to indicate the degree of pulmonary reserve. The physiologic demands of pregnancy and obesity as well as reduced FRC reduce the period of time available for direct laryngoscopy and intubation before hypoxemia ensues.

Although the prevalence of obstructive sleep apnea (OSA) in pregnancy is unknown, OSA in the morbidly obese parturient is more likely. In many cases, this disorder may be undiagnosed. Diagnosis during pregnancy may be difficult because sleep disturbance and daytime fatigue are common during pregnancy, especially near term. Obstructive sleep apnea should be suspected in women with BMI ≥ 35, neck circumference ≥ 16 inches,
frequent/loud snoring, periods of apnea during sleep, frequent arousals during sleep, or profound daytime somnolence. Prompt diagnosis by polysomnography and treatment with continuous positive airway pressure may be beneficial to reduce postoperative respiratory complications. Obesity hypoventilation syndrome (Pickwickian Syndrome) can also occur in individuals with OSA. These patients are at risk for increased cardiac output, pulmonary hypertension, cardiomegaly, polycythemia, and right heart failure. Patients at risk should be referred to cardiology for further evaluation.

**Cardiac** Hypertension, ischemic heart disease, dilated cardiomyopathy, heart failure, and pulmonary hypertension can complicate the care of these patients. Obesity and pregnancy are associated with increases in circulating blood volume, pulmonary blood volume, stroke volume, and cardiac output. These cardiovascular changes contribute to worsening of the baseline comorbid condition. The excess weight of the uterus and abdominal wall can compress the vena cava, causing decreased cardiac preload, reflex tachycardia, and decreased cardiac output. Two cases of cardiac arrest have been reported after supine positioning in nonobstetric morbidly obese patients. A change to the supine position likely contributed to the circulatory changes resulting in these arrests.

A careful preoperative history, physical exam, 12-lead ECG, and chest x-ray may be helpful for screening for cardiac disease in these patients. Cardiology consultation should be obtained in women with a BMI > 35 who have a preexisting medical condition (e.g., hypertension) prior to labor and delivery.

**Gastrointestinal** Frequency of gastroesophageal reflux is strongly correlated with increasing BMI. Although hiatal hernia is more common in obese individuals compared to the non-obese, it is unknown whether the effects of obesity are additive with pregnancy in reducing lower esophageal sphincter tone. However, it is likely that pregnancy and obesity increase the risk for regurgitation and aspiration of gastric contents.

**Endocrine** Diabetes mellitus and gestational diabetes are frequent endocrine disorders in morbidly obese parturients. Diabetes and obesity increase the risk for fetal macrosomia and obstetric complications. Women with gestational diabetes will generally not require insulin during labor, whereas women with Type 1 or 2 diabetes will require careful monitoring and adjustment of insulin.

**Coagulation** Hypercoagulability results in venous thromboembolism and is a leading cause of maternal mortality.

**ANALGESIA FOR ANTICIPATED VAGINAL DELIVERY**

Neuraxial analgesia is the preferred analgesic technique in morbidly obese parturients. Parenteral opioid and inhalation techniques can be used but often at the expense of maternal drowsiness, airway obstruction, and hypoxemia. Epidural techniques provide excellent pain relief with the benefits of reducing oxygen consumption and attenuating increases in cardiac output. Because these patients are at risk for CS, a labor epidural catheter can be easily converted to a surgical catheter in the event of urgent CS in order to avoid the risks of general anesthesia. Early catheter placement is imperative since successful placement of neuraxial catheters can be time-consuming and technically more challenging. The ASA Practice Guidelines for Obstetric Anesthesia state that “Early insertion of a spinal or epidural catheter for obstetric or anesthetic indications (e.g., anticipated difficult airway or obesity should be considered to reduce the need for general anesthesia if an emergent procedure becomes necessary. In these cases, the insertion of a spinal or epidural catheter may precede the onset of labor or a patient’s request for labor analgesia.”

Critical evaluation of neuraxial catheters is imperative to ensure that the epidural catheter can be used emergently for CS. The block should be bilateral and almost perfect. Every provider should ask the question, “Can I use this epidural for cesarean delivery?” Multiple studies have demonstrated that obese patients require more attempts, catheter replacements, have a higher risk of failures, and more inadvertent subarachnoid catheter placements compared to nonobese parturients. Any epidural catheter that is questionable should be promptly replaced. Hood and Dewan demonstrated a high rate of success when catheters were carefully evaluated and replaced early. In their series, only 1 of 55 patients required conversion to general anesthesia because of inadequate epidural anesthesia.

**Preparation** Preparation should include placement of adequate intravenous access early in labor. Central venous access may be necessary if peripheral access is unobtainable or inadequate. Blood pressure (BP) monitoring may be particularly problematic in these patients. Use of an appropriately sized cuff is imperative to ensure accurate BP measurements. If the BP cuff is too small, the BP reading will be overestimated. The forearm can be used if the
upper arm is too large or cylindrical in shape. In some cases, an arterial line will be necessary to accurately determine the BP as well as obtain arterial blood gases in patients with respiratory compromise.

**Positioning**  An important step in successful catheter placement is positioning. The sitting position is recommended to assist with identification of the midline. The patient’s back should be parallel to the edge of the bed to prevent lateral needle deviation away from the midline. Anatomic landmarks are often obscured in these patients. If spinal processes cannot be appreciated with deep palpation, a line can be drawn from the cervical vertebral spinal process to the uppermost portion of the gluteal cleft. This line marks the midline of the patient over the vertebral column. Ultrasound imaging can also be helpful to identify spinal processes. The iliac crests may also be difficult to appreciate. However, one can use the skin indentation from the fetal heart rate monitor belt as a guide. This belt usually rests on the iliac crests over the Tuffier line. By drawing a perpendicular line from the cervical spinal processes down to this line, the intersection point is a reasonable spinal or epidural needle insertion guide.

**Identification of the epidural space**  Identification of the epidural space is often problematic, especially when bony landmarks are nonpalpable, there is limited back flexion, and there are false loses of resistance due to fat deposition. It is also difficult to predict the depth to the epidural space but, the depth often positively correlates with BMI. A recent study suggests that prepuncture ultrasonography may be useful to facilitate epidural placement in obese parturients. A long 25-gauge needle can be used for infiltration of local anesthetic as well as to identify spinal processes. To determine whether needle placement is midline or lateral, the patient is often helpful in directing the needle to the midline. Failure of midline placement increases the depth to the epidural space and chance of catheter malposition. In most cases, standard neuraxial needles (9-10 cm) are usually of sufficient length. However, longer needles (16 cm) are sometimes needed in extremely obese parturients. These needles can cause serious injury so they should only be used when a standard needle is inadequate.

**Combined spinal-epidural (CSE)**  Combined spinal-epidural labor analgesia is one alternative to conventional epidural analgesia, however there is concern that the technique is more complicated than either spinal or epidural alone and the epidural catheter is “unproven” during the duration of spinal analgesia. Although CSE catheters fail at similar rates compared with conventional epidural catheters, delayed recognition of a non-functional epidural catheter is a disadvantage of this technique. However, even if the patient does not receive a “spinal dose” during CSE placement, the return of CSF in the spinal needle is confirmation of midline needle placement. This increases the likelihood of a bilateral block.

**Dosing and infusions**  Epidural analgesia for labor should ideally provide pain relief with minimal motor blockade. This is most often accomplished with dilute local anesthetic and opioid solutions. However, these opioid-laden solutions can mask a malpositioned epidural catheter because opioid administration by any route produces pain relief. Therefore, practitioners will often initiate the block with only local anesthetic to document a bilateral block before adding opioid to the epidural solution.

**Catheter dislodgement**  Catheter dislodgement is another potential problem. Before the epidural catheter is secured, the patient should assume an upright sitting position then a lateral position. Because the ligamentum flavum has a mild grip on the epidural catheter, repositioning allows the epidural catheter to be pulled into the subcutaneous fat, sometimes by several centimeters. My practice is to insert the catheter 5 cm into the epidural space while the patient is in the sitting position. Before taping, the patient moves to a lateral position. The catheter is subsequently taped in place without adjusting the catheter.

**Inadvertent dural puncture**  In cases of inadvertent dural puncture, catheters may be thread into the subarachnoid space for continuous spinal analgesia. Although there have been suggestions that obesity reduces the risk for postdural puncture headache, routine use of spinal catheters is not recommended since accidental administration of an epidural dose of local anesthetic through the spinal catheter increases the risk of a high spinal, respiratory compromise, and loss of the airway in a labor room. When inadvertent dural puncture has occurred, these catheters will provide effective analgesia during labor. In addition, more concentrated local anesthetics can be administered to extend blocks for CS. However, higher levels of spinal anesthesia may result from reduced CSF volume. Large buttocks may also increase cephalad spread.
ANESTHESIA FOR CESAREAN DELIVERY

Several studies have demonstrated a significant relationship between increasing maternal BMI and CS. A meta-analysis of these studies suggests an odds ratio of 2.05 for CS in obese women compared to those with normal BMI. Although the use of general anesthesia for CS has decreased in the last two decades and deaths attributed to anesthesia have decreased, morbidly obese women undergoing scheduled CS have greater overall anesthesia complications, more complicated placement of neuraxial anesthesia, and more frequent requirements for general anesthesia than lower-weight women. Obesity and CS remain independent risk factors for maternal morbidity and mortality. Goals of anesthetic management include:

- Aspiration prophylaxis
- Neuraxial anesthesia unless contraindicated
- Preparation (personnel, equipment, monitoring, positioning)
- Careful evaluation and management of the airway and ventilation
- Reduction of cardiovascular stress
- Management of hypotension
- Judicious use of neuraxial, oral, or intravenous opioids
- Careful postoperative monitoring

Operating room considerations

Weight limits of standard OR tables range from 130 to 160 kg. However, some newer tables will support up to 360 kg. It may also be necessary to extend the width of the table with side extensions. If extensions are unavailable, it may be possible to improvise with arm boards placed along the sides of the OR table. Adequate padding should be used to prevent pressure-related injuries. If the maternal weight exceeds the capacity of the OR table, the surgery should be performed on a hospital bed. Transport gurneys should be of similar size limits. Patients must be properly secured so that left uterine displacement can be achieved. If patient-moving assistance devices are unavailable, additional personnel are required to prevent lifting injuries.

Surgical considerations

A panniculus in a morbidly obese patient may weigh more than 70 kg. Therefore it is an important surgical consideration with respect to the surgical approach. In such cases, the panniculus must be retracted in order to permit exposure of the surgical field. The panniculus can either be retracted caudal to permit a vertical incision above, retracted cephalad to permit a transverse incision, or retracted vertically. Many techniques (retention sutures or towel clamps attached to IV poles, an assistant to retract the panniculus during the surgery, suspender-taping to the shoulders, securing the panniculus to the anesthesia screen, suspending the panniculus from hooks in the ceiling) are used to achieve exposure. However, cephalad retraction of the panniculus can cause hypotension, respiratory distress, nonreassuring fetal heart tones, and even fetal death. During retraction, the force exerted on the upper abdomen and chest can cause compression of the inferior vena cava as well as decreased respiratory compliance. The increased pressure can decrease venous return resulting in a profound decrease in cardiac output and arterial BP. Increasing pressure on the chest may exacerbate an already compromised respiratory state. Regardless of the surgical approach, the uterus must be displaced adequately, but carefully, to avoid aortocaval compression.

Positioning for airway management

Careful positioning is imperative in the care of these patients regardless of the primary anesthetic technique. A study investigating the effects of position on laryngoscopic view in 60 morbidly obese non-pregnant patients determined that the ‘ramped’ position or head elevated laryngoscopy position (HELP) clearly improved the laryngeal view when compared with the standard ‘sniff’ position. The ‘ramped’ position can be achieved by arranging blankets, or one of the commercially available pillow devices, underneath the patient’s upper body and head until horizontal alignment is achieved between the external auditory meatus and the sternal notch. This positioning allows easy access to the airway and facilitates placement of a laryngoscope (short-handled), if general anesthesia becomes necessary. Since neuraxial anesthesia has been associated with a significant decrease in spirometric parameters a 30-degree head-up position may improve respiratory mechanics and oxygenation. Uterine displacement is also necessary to avoid aortocaval compression by either the uterus or the panniculus.

Anesthetic plan

Spinal (single-injection or continuous), epidural, CSE, and general anesthesia are all acceptable techniques for CS. However, the choice of technique is dependent upon the clinical situation. For example, a woman with severe asthma may not be able to tolerate a neuraxial block and/or prolonged surgical procedure. Knowledge of the surgical team skill level and anticipated operative time are imperative for making a decision about anesthetic...
choice. Communication with the surgeon is important to explore whether there are any other factors that might make the surgery even more difficult. Finally, we must honestly evaluate our own technical skills.

**Spinal anesthesia**  Spinal anesthesia is the most common type of anesthesia utilized for CS because of its quick onset, reliability, and dense surgical anesthesia. It is one approach in obese parturients but there are concerns about technical difficulties, exaggerated spread of local anesthetic, hemodynamic compromise, and an inability to prolong the block. Spinal anesthesia is reasonable if the airway exam is normal, there is no cardiorespiratory disease, and the surgery is expected to be less than 90 minutes. It is often easier to identify the epidural space with a large gauge stiff epidural needle compared to a smaller flexible spinal needle so that the epidural needle acts as an introducer.

In a large series of obese patients undergoing non-obstetric surgery who had received spinal anesthesia, more than one-third developed hypotension. Three of the patients also experienced cardiac arrest. Although decreased cerebral spinal fluid volume has been confirmed in obese patients by magnetic resonance imaging, the median dose of bupivacaine for successful anesthesia in morbidly obese parturients undergoing CS was 9.8 mg using a randomized dose response of spinal bupivacaine with fentanyl and morphine. These study findings were similar to a previous study in nonobese parturients. However, large buttocks of obese patients may place the vertebral column in the Trendelenburg position, exaggerating the spread of spinal anesthesia. In order to avoid a high block when hyperbaric bupivacaine is used, a ramp can be placed under the patient’s chest to elevate the cervical and thoracic spines to avoid the Trendelenburg position induced by large buttocks. Regardless, spinal anesthesia should be performed with caution because of the consequences of extensive blockade, prolonged surgery and the hazards of intraoperative induction of general anesthesia. Continuous spinal anesthesia may offer the benefits of a single-injection spinal (i.e., reliability, density). However reports of routine use are lacking.

**Epidural anesthesia**  Epidural anesthesia offers several advantages over single-injection spinal anesthesia including titratable dosing of local anesthetics, ability to prolong the block, decreased risk of excessive motor block, more controllable hemodynamic changes, and utilization for postoperative analgesia. However, a multicenter prospective observational study found that epidural anesthesia failed more often than spinal or CSE techniques. Increased maternal BMI was significantly related to failure of neuraxial techniques. Hodgkinson and Hussain demonstrated that the height of an epidural block for a given volume of local anesthetic is proportional to BMI and maternal weight but not height. Incremental dosing of local anesthetics reduces risk of hypotension and high block.

**Combined spinal-epidural anesthesia**  CSE offers advantages in cases where the surgical duration is unclear by providing rapid onset and dense blockade with the flexibility of prolonging the anesthetic. However, one potential disadvantage is an untested epidural catheter.

**General anesthesia**  should be avoided unless absolutely necessary. Hood and Dewan found that one-third of morbidly obese parturients were difficult to intubate versus none in the nonobese control group. The anatomic changes produced by both pregnancy and obesity increase risk for difficult intubation, rapid desaturation, and hypoxia during periods of apnea. The urgency of the obstetric situation must be weighed against the risks of general anesthesia. If general anesthesia is necessary, additional experienced personnel and difficult airway equipment must be available. In all cases, proper positioning of the neck, shoulders, and chest is imperative and the key to successful intubation. In some cases, an awake fiberoptic intubation may be the safest option but it poses its own problems. Nasal intubation should be avoided due to mucosal engorgement and risk of hemorrhage. Hypertension and catecholamine release can adversely affect uterine blood flow. Although fiberoptic intubation can be difficult and time-consuming, some recent reports suggest that a videolaryngoscope may be useful as the primary device or first alternative for securing the trachea.

If the patient’s airway appears normal, a rapid sequence intubation in a ramped position can be performed following denitrogenation. Denitrogenation can be accomplished with 3 minutes of tidal breathing or 4 maximal breaths with 100% oxygen.

Dosing of induction agents is based lean body weight. Lean body weight is defined as 20-30% more than ideal body weight. Succinylcholine is the muscle relaxant of choice. The dose of succinylcholine (1.0-1.5 mg/kg up to a maximum of 200 mg) is based on total body weight.

Verification of proper endotracheal intubation can only be accomplished by capnography. If intubation is unsuccessful, a failed intubation drill should be instituted immediately. The goal of failed intubation management
is to ensure maternal oxygenation despite concerns of fetal well-being or aspiration. Mask ventilation may require several people, one to continue cricoid pressure, a second to institute jaw-thrust, and the third to squeeze the bag and monitor the patient. Repeated attempts and additional succinylcholine are detrimental but a laryngeal mask airway can be lifesaving.49

In morbidly obese parturients, there are further reductions in FRC due to supine positioning, use of volatile anesthetics, muscle relaxants, and retraction of the panniculus.50 This leads to early closure of small airways and hypoxemia. Increased tidal volumes, high-inspired oxygen concentrations, reverse Trendelenburg positioning, and positive end-expiratory pressure51 have been used to maintain oxygenation and ventilation. However, use of positive end-expiratory pressure can worsen cardiac output and oxygen delivery to the fetus. Although isoflurane, sevoflurane, and desflurane can be used in standard concentrations, desflurane provides a faster recovery.52 Additional muscle relaxant may be needed besides an intubating dose of succinylcholine. Titration of nondepolarizing muscle relaxants with the help of a twitch monitor is a reasonable approach.

Although the induction of anesthesia was previously reported to be the most critical time during anesthetic administration in parturients, more recent reports suggest that emergence, extubation, and recovery are the most critical periods of anesthetic care in the obese parturient.10 The morbidly obese parturient should only be extubated when she is awake with adequate reversal of muscle relaxant. A head-up position should also be used instead of supine positioning.

POST-OPERATIVE CARE
Morbid obesity increases the risk for postoperative complications, including: hypoxemia, atelectasis, deep venous thrombosis, pulmonary embolus, pneumonia, pulmonary edema, postoperative endometritis, wound infection, and dehiscence. Goals of effective postoperative care should be aimed at enhancing pulmonary function and preventing venous thrombosis. Early ambulation, thromboprophylaxis, chest physiotherapy, and effective postoperative pain control are essential in preventing complications in these patients.

Effective postcesarean analgesia is important to hasten recovery. Opioids can be administered either neuraxially or parenterally but epidural morphine administration in the morbidly obese has been shown to result in earlier ambulation, fewer pulmonary complications, and shorter hospital stay compared to parenteral morphine administration.53 Multimodal analgesic techniques (e.g., nonsteroidal anti-inflammatory agents) should be used to decrease total opioid requirements.54

Because obesity and postoperative respiratory complications have been identified as significant risk factors for anesthesia-related mortality,10 respiratory monitoring must be vigilant. A recent survey suggests that the level of care provided for postanesthesia recovery from CS in North American academic institutions may not meet the guidelines established by the American Society of PeriAnesthesia Nurses. In addition, obstructive sleep apnea is common and often undiagnosed in this patient population.55 The American Society of Anesthesiologists has published recommendations for the care of these patients although they are not pregnancy-specific.54 Included in the guidelines are recommendations for postoperative monitoring:

- Regional anesthetic techniques should be considered to reduce or eliminate the requirements for systemic opioids in patients with OSA.
- If neuraxial anesthesia is planned, the benefits and risks of using an opioid or opioid-local anesthetic mixture as compared to local anesthetic alone must be considered.
- If patient-controlled systemic opioids are used, continuous background infusions should be avoided or used with extreme caution.
- Nonsteroidal anti-inflammatory agents and other modalities should be considered to reduce opioid requirements.
- Supplemental oxygen should be administered continuously to all patients who are at increased perioperative risk from OSA until they are able to maintain their baseline oxygen saturation while breathing room air.
- Hospitalized patients at increased risk of respiratory compromise from OSA should be monitored with continuous pulse oximetry after discharge from the recovery room.
CONCLUSION
A complete understanding of the physiology, pathophysiology, comorbidities and their implications for analgesia and anesthesia in morbidly obese parturients should lead to improved safety and anesthetic care. Communication between the anesthesiologist, obstetrician, nursing staff, and patient is imperative in caring for these patients. The mother’s life should not be endangered to save a compromised fetus.

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