Anesthetic Management for the Morbidly Obese, Medically Complicated Parturient

Obesity is becoming a worldwide public health problem reaching epidemic proportions. In some countries obesity affects more than 25% of the population. During pregnancy, obesity is a common high-risk problem seen by the anesthesiologist. The most common criteria used to define obesity is the body mass index (BMI) measure.

\[ \text{BMI} = \frac{\text{Wt (kg)}}{\text{Ht (m)}^2} \]

- BMI > 25 kg/m², overweight
- BMI > 30 kg/m², obese
- BMI > 35 kg/m², morbid obesity

Obesity creates strain on the body's most vital organ systems. The most significant pathophysiologic changes occur in the pulmonary, cardiovascular, gastrointestinal and endocrine systems. Obesity during pregnancy increases the risk of death for mothers and their newborns. Obesity exaggerates the normal physiologic changes of pregnancy creating more work for an already stressed cardiorespiratory system.

**Obstetric Complications**

**Antepartum**
Obese mothers tend to be older than non-obese mothers, which may account for some of the co-existing medical problems. Obesity during pregnancy is associated with hypertension, preeclampsia and gestational diabetes. Chronic hypertension has been reported in 12% and pre-eclampsia in 6% of obese parturients, but the incidence of eclampsia is not increased. Gestational diabetes also occurs in approximately 10% of the obese pregnant patient. Independent of medical problems, obesity alone puts a patient into a "high risk" category and can complicate the obstetric course. Obesity prior to pregnancy, weight gain during pregnancy and gestational diabetes can lead to fetal macrosomia, a problem which may dramatically alter the course of labor and delivery.

**Intrapartum**
Obese parturients are at greater risk for late or failed spontaneous onset of labor. For this reason, medical induction of labor frequently occurs. Fetal macrosomia, defined as birth weight more than 4 kg, may lead to cephalopelvic disproportion (CPD) and cesarean section. Induction of labor, fetal macrosomia and obesity are independent risk factors for cesarean section. In fact, at the author’s institution the incidence of cesarean section is twice that of normal weight parturients. If cesarean section is needed, prolonged surgery time and increased blood loss can be anticipated.

**Postpartum**
Underlying medical problems and a complicated obstetric course put the obese parturient at an increased risk for adverse outcome. Common postpartum complications include wound infection, urinary tract infection, blood loss, pneumonia and pulmonary embolism. Post-surgical wound infection is related to larger incisions, protracted surgery times, excess operative traction causing to tissue trauma and the inability of adipose tissue to resist infection secondary to diabetes mellitus. Restoration of normal pulmonary function may take several days following abdominal surgery and atelectasis may lead to pneumonia. With the obesity related increase in deep vein thrombosis and the pregnancy related hypercoagulative state, pulmonary thromboembolism is another problem.

**Fetal Complications**
Newborns of obese parturients are at increased risk for complications and death. Prenatal fetal anomalies may be undiagnosed because ultrasonographic visualization is impaired with morbid obesity. Macrosomia, the biggest threat, is correlated with birth trauma, shoulder dystocia and asphyxia. Neonatal hypoglycemia can alter newborn thermoregulation and decrease cardiac output. Infants of obese mothers have increased admissions to the neonatal intensive care unit.
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Dr. Medge D. Owen
USA
mowen@wfubmc.edu

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Anesthetic Considerations

Early anesthetic consultation is important and should focus on the airway and coexisting medical problems. One should question the patient regarding difficulty during previous anesthesia but keep in mind that a previous uneventful anesthetic is no guarantee for a problem free anesthetic during pregnancy. A history of obstructive sleep apnea may suggest the potential for mechanical airway obstruction when the level of consciousness is decreased. It is important to discuss anesthetic interventions in advance, particularly regional anesthesia techniques and awake fiberoptic intubation.

Equipment

Equipment must be available to accommodate the patient's size and weight. Standard hospital beds are usually adequate, but the operating table may have a weight limit (usually 120-140 kg). The patient must be well secured to the operating table because the abdomen may shift markedly when the patient is tilted leftward. In some cases it may be necessary to use the labor bed as an operating table. It is important to have extra personnel available to safely transport the patient, especially if she is immobilized due to regional anesthesia.

Other related problems include monitoring and difficult intravenous access. A standard blood pressure cuff will give falsely high measurements when placed on a large, funnel shaped arm. Conversely, an oversized cuff will give falsely low readings. As an alternative, a standard sized cuff may also be placed on the forearm. Establishing intravenous access may require ultrasound guidance. Central venous lines and intra-arterial catheters are rarely indicated.

Positioning

With an obese parturient, a 15 degree head up and 15 degree lateral position through labor and delivery improves lung expansion and minimizes cardiovascular stress. In this position, the panniculus is displaced off the abdomen, reducing intraabdominal pressure and allowing greater diaphragmatic excursion during respiration. The supine position should be avoided because aortocaval compression is exacerbated with the weight of a large panniculus. Head elevation also reduces premature airway closure thus reducing hypoxemia. Oxygen administration is helpful and provides a margin of safety to the mother and fetus throughout labor and delivery.

Analgesia for Labor and Delivery

The options for pain relief during labor and delivery are the same for obese as for normal weight parturients. Parenteral analgesics during labor, supplemented with pudendal block and perineal local infiltration at delivery are useful but these techniques are often ineffective in providing complete analgesia. Maternal respiratory depression may occur from systemic opioid administration. Furthermore, this technique is suboptimal during complicated vaginal delivery which requires profound anesthesia.

Epidural

In obese parturients, the best technique for labor pain relief is epidural analgesia. An epidural can be utilized for surgical anesthesia if cesarean section is indicated and allows for controlled drug administration. Other benefits of epidural analgesia include decreased oxygen consumption, decreased work of breathing, improved oxygenation, and decreased catecholamine secretion.

Early epidural catheter placement is important because it takes longer to position the patient and to place the block. Catheter placement before active labor will minimize patient movement and improve cooperation, thus increasing the chance for success. In obese parturients, block placement can be technically challenging due to obscured anatomical landmarks. The sitting position provides easier identification of midline. When sitting, the patient's fat folds fall away from midline whereas in the lateral position, the fat folds fall across midline increasing the depth to the epidural space. Initial epidural catheter failure is as high as 42% in obese parturients but ultimate success can be achieved when catheters are placed early and repeated if analgesia is inadequate. We have reported a 94% epidural success rate in patients weighing more than 300 pounds, similar to the 98% success rate in normal sized parturients.
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The increased depth to the epidural space contributes to the high failure rate by increasing the incidence of unilateral block. The increased depth exaggerates minor directional errors and increases the chance of identifying a lateral portion of the epidural space (figure). When it is difficult to palpate the midline, the patient can usually indicate if the needle is in a lateral position. In most obese parturients a standard epidural needle is sufficient but occasionally a longer needle is needed. Once the epidural space is identified, one should avoid injecting local anesthetic through the epidural needle. It is important to establish good epidural catheter function early in the event of cesarean section. Once inserted, an epidural catheter secured to the skin can become dislodged when the patient shifts from side to side due to skin and adipose tissue elasticity. For this reason, it is best to leave at least 6 cm in the epidural space. Also, if cesarean section is indicated, it may be necessary to dose the catheter in the operating room to prevent catheter dislodgement during transport.

When initiating labor analgesia, it is best to use local anesthetics alone to establish catheter function. Opioid administration by any route produces some degree of pain relief and may mask a malpositioned catheter. Once the catheter function is proven and a bilateral block as been established, epidural opioids can be administered to minimize local anesthetic requirements and motor block. Local anesthetic requirements may be reduced with obesity due to a reduction in epidural volume by fatty infiltration or engorged epidural veins. In our institution, however, epidural dosing requirements are usually similar among obese and non-obese parturients.

Combined spinal epidural (CSE)
In obese parturients, the CSE technique is possible for labor analgesia but not recommended. The CSE technique delays recognition of a poorly functioning epidural catheter and this can be a problem if emergency cesarean section occurs. Obese patients are at risk for cesarean section and airway related problems with general anesthesia; therefore, one should insure epidural catheter function. The incidence of epidural catheter failure with CSE in the obese patient population is unknown. Some studies indicate that a successful CSE may improve subsequent catheter function because when cerebrospinal fluid is obtained, a midline needle position is more likely. However, epidural catheters can fail after successful spinal analgesia and until further study, it is best to limit CSE use for labor analgesia in this patient population. The benefit of a faster onset of labor analgesia is not worth the risk of epidural catheter failure in the event of an emergency cesarean section.

Continuous spinal analgesia
A subarachnoid catheter can be dosed incrementally or by continuous infusion for labor analgesia. The block can be quickly augmented in the event of cesarean section and unilateral block is less likely than with epidural anesthesia. However, several potential problems exist with this technique. First, during a long course of labor, tachyphylaxis may develop to intrathecal local anesthetics making assessment difficult. More commonly, one worries that if 5 cm or more of the catheter rests in the spinal canal, entanglement or entrapment of spinal nerve roots can occur. With 4 cm or less of subarachnoid catheter, patient movement can cause catheter dislodgement. Finally, there is a risk that a spinal catheter may be mistaken as an epidural catheter and that large amounts of local anesthetic could be accidentally injected creating profound hypotension and total spinal anesthesia.

Anesthesia for Cesarean Section
Cesarean section is a common mode of delivery for obese parturients. During cesarean section, obesity increases the risk of maternal mortality. Most anesthesia-related maternal deaths occur due to airway related problems encountered during general anesthesia. For this reason, general anesthesia should be avoided if at all possible.

Epidural
When an obese patient requires an operative delivery, a well functioning epidural catheter is of great benefit to have. For surgical anesthesia, some have found epidural local anesthetics requirements to be reduced by approximately 20% in obese parturients. If the block exceeds the desired sensory level, then
slight head up flexion of the operating table lessens patient complaints without adversely affecting the surgery. Epidural anesthesia generally provides better hemodynamic control than spinal anesthesia because the block is slower to set up. Having an epidural catheter also allows the administration of opioid and local anesthetic solutions for postoperative analgesia. In an emergency, a well-functioning labor epidural can be quickly extended for surgical anesthesia but establishing a block de novo may take too long and a spinal technique may be preferable.

Spinal
Spinal anesthesia is an option for cesarean section but as with other regional techniques in obese patients, placement can be difficult. Fatty deposits about the hips can lead to false identification of the superior iliac crests with inadvertently high spinal placement. This is important because spinal cord damage can occur if a needle is placed at L1-L2 or above. Some studies have shown that customary doses of local anesthetics for cesarean section produce higher than expected blocks in obese patients. Reasons for the exaggerated anesthetic spread may include higher than anticipated block placement, decreased cerebral spinal fluid volume and large buttocks placing the vertebral column in a relative Trendelenburg position. Accordingly, when executing spinal anesthesia in obese patients, one should slightly elevate the head of the operating table to minimize high block spread. A T4 sensory level is usually required to ensure patient comfort with abdominal traction but above this level, ventilation may become inadequate. Surgery can extend beyond the duration of single-shot spinal anesthesia so the continuous spinal or CSE technique may be a better option. These techniques similarly provide rapid anesthesia but a catheter is in place for subsequent dosing if necessary. Furthermore, a smaller initial spinal dose can be given, minimizing hypotension and block spread but if insufficient, supplemental local anesthesia can be administered. Because the patient is immobilized for surgery, catheter dislodgement is less likely.

General Anesthesia
In obese parturients, general anesthesia for cesarean section should be avoided when at all possible. Difficult intubation has been reported in 33% of obese parturients having cesarean section, compared to 13% in obese patients undergoing abdominal surgery. Whenever possible, two anesthesia providers should be present for induction since maintaining the airway may be complicated and the primary anesthesia provider can fatigue quickly. In the obese, the complexity of intubation coupled with the propensity for rapid desaturation can be disastrous. Assorted laryngoscope blades, a variety of endotracheal tubes, a gum elastic bougie, standard and intubating laryngeal mask airways and equipment for transtracheal ventilation should be immediately available. A short-handled laryngoscope is also useful because limited extension of a short, thick neck and pendulous breasts often hamper insertion with a standard length handle. A large tongue and airway soft tissue engorgement can further complicate the process. When preparing for general anesthesia in an obese patient, proper positioning is very important. When supine, adipose tissue on the upper back ("buffalo hump") can elevate the chest in relation to the skull. This impairs the alignment of the oro-glottic axis making vocal cord visualization difficult. It may be necessary to elevate the head more than usual to obtain the proper "sniffing" position. Be aware that if the head is positioned midline and the body tilted leftward, visualization may be obscured. These preparatory measures will improve the speed with which intubation can be accomplished. In obese parturients, swift intubation is important because rapid desaturation occurs despite pre-oxygenation due to the decreased FRC and increased oxygen requirements. Hypoxemia and hypercarbia can precipitate sudden pulmonary hypertension and cardiac arrhythmias. If mask ventilation becomes necessary, airway obstruction and high abdominal pressure can impede ventilation. Gas can preferentially enter the stomach leading to regurgitation. Obesity impairs identification of the cricoid ring making it difficult to properly apply cricoid pressure and to perform cricothyrotomy in an emergency. If a difficult intubation appears likely, awake intubation should be performed. Topical anesthesia for awake intubation requires time and if fetal distress occurs, an anesthesiologist may feel compelled to proceed with rapid sequence induction. However, induction of general anesthesia should not proceed if intubation is expected to be difficult and doing so may make matters worse.
Within 30 minutes of surgery, 30 ml of a non-particulate antacid should be given. Prior to anesthesia induction, 100% oxygenation should be administered through a tight fitting mask for at least 3 minutes with several maximum capacity breaths just before induction. If the airway appears normal, rapid sequence induction and intubation is mandatory. The induction agent of choice is sodium thiopental and a dose of 4 mg/kg up to 500 mg is usually sufficient. Administration of a larger dose may prolong awakening in case of failed intubation. The increased volume of distribution in obesity prolongs the elimination half-life of thiopental but unless very large doses are given, this is usually irrelevant. Succinylcholine is the muscle relaxant of choice for intubation in doses of 1-2 mg/kg of actual body weight up to 200 mg.

Obesity alters the distribution and response of many anesthetic drugs limiting the choice of agents. Once the airway is secured a balanced anesthetic technique is recommended. For muscle relaxation, atracurium, mivacurium and cisatracurium are suitable non-depolarizing agents because metabolism is not organ dependent. Fentanyl is the preferred opioid exhibiting similar elimination in obese and non-obese patients whereas, sufentanil and alfentanil, may have longer elimination times. Isoflurane is the volatile anesthetic agent of choice because it is least significantly metabolized. A concern with other volatile anesthetics is the accumulation of serum fluoride that can be organ toxic but this is unlikely a problem during short procedures. While no single anesthetic regimen has been shown to be superior in obese patients, it is logical that the shortest acting agents be used to lessen the residual anesthetic effect into the post-partum period.

Intraoperatively, ventilation should be controlled with a tidal volume of 10-12 ml/kg ideal body weight to maintain oxygenation. With the use of large tidal volumes, PEEP is rarely indicated and can worsen hypoxemia. The large tidal volume coupled with low chest wall compliance can produce high peak inspiratory pressures. High-inspired oxygen fractions may be required and limit the use of nitrous oxide. End-tidal capnography may be a poor guide to the adequacy of ventilation due to a large alveolar-to-arterial difference in carbon dioxide. During pregnancy, it is important to maintain pCO2 levels in the low to mid 30's and arterial blood gas analysis may be required.

Following surgery, residual anesthetic effects, increased sensitivity to opioid analgesics, and neuromuscular blocking agents may postpone tracheal extubation. Prior to extubation the gastric contents should be orally suctioned and there should be a sustained response to 50 Hz tetanus with a peripheral nerve stimulator. The patient should also be awake and able to follow commands. Shivering increases oxygen consumption and should be prevented. The morbidly obese are at increased risk for postoperative respiratory insufficiency and supplemental oxygen is should be provided for several days. Pain control is important to encourage deep breathing but systemic opioid administration can cause respiratory depression. Subcutaneous and intramuscular opioid injection should be avoided since absorption is unreliable. Epidural patient-controlled analgesia is best because it produces less drowsiness, nausea, and respiratory depression and improves respiratory function and mobilization.

Summary

The obese parturient presents many challenges to the anesthesiologist. The best plan for management is one made in advance. Epidural analgesia is the technique of choice for labor and delivery. For cesarean section, the use of regional anesthesia avoids the problems associated with general anesthesia and provides safer and more effective postoperative analgesia.
Suggested Readings

11. Figure. As the depth of the epidural space increases from normal to obese, there is an increased lateral displacement of the needle.
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