Pregnancy Risks Associated with Obesity

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- Obesity • Pregnancy • Prenatal care • Gestational diabetes • Macrosomia

KEY POINTS
- Obesity has been shown to be associated with increased rates of preeclampsia, gestational diabetes, fetal macrosomia, stillbirth, postterm pregnancy, and increased rates of cesarean delivery.
- Providing prenatal care to obese women is done by all types of prenatal providers and needs to take into consideration the increased risks of complications and challenges of providing such care.
- Because of the issues related to obesity in pregnancy, best practice would be for preconception care to lead to weight loss before pregnancy.

INTRODUCTION

Obesity has increased dramatically in the United States over the last several decades.1 In 1990, states with the highest rates of obesity approached 15%. Today, approximately two-thirds of Americans are overweight or obese.2 The obesity epidemic extends to the pregnant population, with 40% of women qualifying as either overweight or obese,3 and 28% of pregnant women qualifying as obese. In 1999, 1 in every 10 pregnant women weighed more than 250 lb, whereas 1 in 20 pregnant women weighed more than 300 lbs.4

Obesity is defined as having a body mass index (BMI) of 30.0 kg/m² or greater, whereas overweight is defined as a having a BMI of 25.0 to 29.9 kg/m².1 Obesity can further be subclassified into class I (BMI of 30.0–34.9 kg/m²), class II (BMI of 35.0–39.9 kg/m²), and class III (BMI of ≥40.0 kg/m²).5 Recently, these categories have been expanded to include an additional category of super obesity (BMI of ≥50.0 kg/m²). Commonly, those with class II and class III obesity who are not in the super-obese range...
are labeled as having severe obesity. In addition, if a BMI is 35.0 kg/m² or greater and there is a concomitant health condition such as diabetes, this is commonly deemed morbid obesity.

Obesity has been associated with many complications during pregnancy, including preeclampsia, gestational diabetes mellitus (GDM), fetal macrosomia, stillbirth, post-term pregnancy, and cesarean delivery. This article seeks to review the association of obesity with maternal and fetal adverse outcomes in both the antepartum and the intrapartum environments as well as provides recommendations for care of the obese gravida.

MATERNAL COMPLICATIONS OF OBESITY IN PREGNANCY

Hypertensive Disorders of Pregnancy

There is a longstanding, wide-ranging body of literature that supports a relationship between increasing maternal weight and the hypertensive disorders of pregnancy. Several observational studies demonstrate an association between obesity and gestational hypertension, with a reported 2.5-fold to a 3.2-fold increased risk. A link has also been drawn between obesity and preeclampsia, with several studies also demonstrating a linear relationship between BMI and preeclampsia risk. One systematic review found the risk of preeclampsia to double with each increase of 5 to 7 kg/m² in BMI, and one retrospective cohort study found that obese patients of Latina descent have an even greater increase in preeclampsia risk. In another prospective cohort study, increases in BMI between the first and second pregnancies were found to also increase preeclampsia risk. Weight has also been found to correlate with the incidence of both severe preeclampsia and eclampsia.

Diabetes

Many observational studies have examined the link between obesity and gestational diabetes risk, with most showing an association between obesity and an increased risk of GDM. One observational study found a linear relationship between BMI and incidence of GDM, and a systematic review and meta-analysis found that the overall risk for GDM in obese patients was 3.76 times higher than in nonobese patients (OR 3.31–4.28), with the prevalence of GDM increasing by 0.82% for every increase of 1 kg/m² in BMI. Obesity has been shown to be associated with higher rates of GDM in all racial/ethnic groups, with particularly high incidences in Latina and Asian women. Given that obesity predisposes to insulin resistance, many obese patients will have preexisting type 2 diabetes mellitus (T2DM) before pregnancy. Several studies have described the detrimental effect of increasing maternal obesity on perinatal outcomes in women with diabetes. One study examining gestational diabetic women in Japan revealed increased rates of adverse outcomes with increasing BMI. In the United States, another retrospective study demonstrated that increasing BMI among diabetic gravidas increased rates of preeclampsia, macrosomia, and cesarean section.

The most recent recommendations from the American Diabetes Association are to screen patients with “severe” obesity for pregestational diabetes at the initial prenatal visit, with a screening test at 24 to 28 weeks for GDM if the initial screening test is normal. These guidelines do not specify a BMI cutoff above which patients should receive screening, but using the definitions from above, that would be class II obesity and higher. Additional candidates for early screening according to these guidelines include women with glycosuria, a diagnosis of polycystic ovary syndrome, a strong
family history of T2DM, or a prior history of GDM or delivery of a large-for-gestational-age (LGA) infant. For gravidas with class I obesity, it is reasonable to perform early screening in women who also possess any of the additional risk factors listed above. In addition, because of increased prevalence and an obesity impact at lower BMI, it is also common to perform an early screen on all Latina, Asian, and Native American women with class I obesity and higher. Diagnostic criteria for T2DM include a hemoglobin A1c greater than 6.5%, a fasting glucose greater than 126 mg/dL, a 2-hour plasma glucose greater than 200 after a fasting 75 g glucose tolerance test, or a random plasma glucose greater than 200 in a patient with classic symptoms of hyperglycemia. If a patient meets these criteria at the beginning of her pregnancy, current guidelines recommend diagnosing the patient with overt T2DM rather than GDM. Patients who qualify for early screening but who present for care in the second trimester may not merit a diagnosis of T2DM with a positive test. Nonetheless, these patients should still be screened at their initial prenatal visit.

Even in obese women without frankly diagnosed diabetes mellitus or GDM, a recent study demonstrated higher fasting and postprandial blood glucose levels. Other studies have demonstrated an association between glucose levels not diagnostic of GDM and the risk of macrosomia, potentially providing a basis for the increased risk of macrosomia reported in obese patients. Because the treatment of mild GDM is a carbohydrate-controlled diet and low-impact exercise, it is hard not to see an advantage of this intervention in all obese pregnant women.

**Venous Thromboembolism**

Venous thromboembolism (VTE) is a major cause of maternal mortality, and pregnancy is a well-established risk factor for VTE. Among all pregnant patients, the risk of VTE in pregnancy and the puerperium is increased 4-fold to 5-fold. VTE has an overall incidence of 1.7 per 1000 deliveries and is responsible for 1.1 deaths per 100,000 deliveries. Several observational studies have investigated the potential relationship between obesity and VTE risk, primarily indicating an increased risk of VTE in obese gravidas, with odds ratios (ORs) ranging from 1.7 to 5.3 greater than normal-weight patients. Whether increasing degrees of obesity increase the risk of VTE is currently unknown.

**Fetal and Neonatal Complications of Obesity in Pregnancy**

**Miscarriage and Stillbirth**

Obesity has been associated with a modest increase in the risk of first-trimester miscarriage (OR 1.20; confidence interval [CI] 1.01–1.46) and recurrent miscarriage. A stronger link has been demonstrated between obesity and stillbirth, with one meta-analysis showing just more than twice the risk of stillbirth compared with patients with normal BMI. In addition, many studies cite an even higher risk among morbidly obese women, and with increasing BMI, suggesting that increasing BMI correlates with an increasing risk of stillbirth. Another meta-analysis demonstrated that each 5-unit increase in BMI increased the risk ratio of stillbirth by 1.2. This increased risk has been identified among diabetic women as well as patients without diabetes and in fetuses without congenital anomalies. Postulated theories to explain this association include hyperlipidemia leading to vascular inflammation and obesity-associated sleep apnea with subsequent desaturation events. Increased perinatal mortality has been shown to extend to the neonatal period, with some studies demonstrating an increased risk of neonatal death.
Fetal Anomalies

In addition to the link between obesity and stillbirth, many studies have shown an association between obesity and birth defects. Two meta-analyses on the topic have been recently published and document an increased risk of neural tube defects in offspring of the obese gravida, with pooled ORs of 1.7046 and 1.8747; specific rates of spina bifida were noted to be even higher with an OR of 2.24.47 In a more recent population-based study, increasing BMI was shown again to be associated with an increasing risk for neural tube defects.48

Other congenital abnormalities have been found to have a more moderate association with obesity, including cardiovascular defects,47–50 orofacial clefts,47,48,50,51 ano-rectal atresia, hydrocephaly, limb reduction defects,47 diaphragmatic hernia, and omphalocele.52 Interestingly, obesity has been associated with a decrease in gastro-schisis.47,50,52 Theories to explain these associations include the potential impact of nutritional deficiencies associated with obesity; similar metabolic as well as common fetal structural abnormalities are seen in diabetes, including insulin-resistance, hyperglycemia, and nutritional deficiencies. One study demonstrated lower rates of folate supplementation in women with a BMI greater than 35; dietary differences may also account for variation in folate levels.53

In addition to an increase in prevalence of fetal structural anomalies, obtaining adequate views of fetal anatomy by ultrasound has been shown to be more difficult in obese patients.54 Inadequate views of fetal anatomy decrease the prenatal detection of anomalies, including potentially lethal malformations, thus limiting opportunities for patient counseling and appropriate perinatal care.

Fetal Macrosomia

Obesity is a well-established risk factor for fetal macrosomia, conferring between a 2-fold and 3-fold increased risk.6,13,14,55–57 This relationship persists even after adjusting for gestational diabetes58 and gestational weight gain and has also been described among obese adolescent gravidas.59 Morbid obesity and increasing BMI have been shown to be associated with higher rates of macrosomia,5,14,60 with other studies showing trends toward increasing LGA8 and birth weight greater than 4000 g11 with increasing BMI.

OBESITY AND DISORDERS OF GESTATIONAL AGE

Preterm Birth

Overall, the literature is conflicting regarding the association between preterm delivery and obesity. Although some studies support an increased risk,13,61 others do not,10,62 particularly when controlling for confounding comorbidities, such as hypertensive disorders, diabetes mellitus, and smoking.63,64 Mild increases in preterm premature rupture of membranes among obese women leading to early delivery have been demonstrated as well.65,66 Specifically, examining medically indicated preterm birth (PTB), several studies show higher rates among obese women65,67,68 with one meta-analysis showing an adjusted odds ratio (aOR) of 1.3 for induced PTB in overweight and obese women.69 Some studies suggest that obese women are less likely to experience spontaneous PTB,65,67 with a recent meta-analysis showing an OR of 0.83.70 This decrease in spontaneous PTB was also observed among obese adolescents71 and twin pregnancies, with an aOR of 0.86.72 However, a more recent population-based cohort study of almost 1.6 million births demonstrated higher rates of spontaneous extremely PTB between 22 and 27 weeks’ gestation among obese gravidas.68 Overall, obesity seems to be associated with increased rates of very early
spontaneous PTB as well as an increased risk of medically indicated preterm delivery due to comorbid illnesses.

**Prolonged and Postterm Pregnancy**

Obesity has been associated with prolonged and postterm pregnancy, with several large population-based studies demonstrating an increased risk of prolonged pregnancy beyond 41 weeks' gestation as well as postterm pregnancy at or beyond 42 weeks' gestation. Two causes have been proposed for this association. One involves gestational dating; because obese women are more likely to be oligo-ovulatory, many may have actually ovulated several days or a week beyond the usual fourteenth day of the menstrual cycle. Thus, standard dating tools may lead to an overestimation of the gestational age in obese women, a problem that can be decreased with routine early dating ultrasounds in obese women.

The second proposed mechanism is that obese women have hormonal differences, in particular, elevated estrogen levels, which may interfere with the onset of spontaneous labor. For example, obesity has been shown to be associated with higher rates of induction of labor, with one meta-analysis demonstrating labor induction rates that were 1.9 times higher in obese patients. This finding is particularly impactful, because several studies have also shown higher rates of cesarean section following induction of labor in obese gravidas.

**INTRAPARTUM COMPLICATIONS OF OBESITY IN PREGNANCY**

**Dysfunctional Labor**

Obesity has been shown to be associated with prolonged or dysfunctional labor. One study investigating prostaglandin inductions found increasing BMI to be associated with longer duration of labor, higher oxytocin requirements, and higher cesarean delivery rates. The link between obesity and longer labor inductions was seen in another prospective study of induction of labor. Other studies have demonstrated a link between obesity and a longer first stage of labor, in both latent labor and active labor. For nulliparous gravidas who reach the second stage, increasing BMI was not found to be associated with a longer second stage of labor or increased cesarean risk, with one study even demonstrating a shorter second stage of labor in obese women. Whether these longer labors are due to differences in hormonal balance or variation in volume of distribution needs further elucidation.

**Shoulder Dystocia**

The literature is conflicting regarding the risk of shoulder dystocia among obese gravidas. Although 2 large retrospective cohort studies found that shoulder dystocia risk is increased among obese women, an even larger population-based cohort study including more than 400,000 pregnant women found obesity to be associated with increased rates of macrosomia but not an increased incidence of shoulder dystocia. The lack of association between obesity and shoulder dystocia is further supported by a large case-control study, a large retrospective cohort study, and a smaller study examining women without gestational diabetes. One potential reason for these differing findings may be related to whether birthweight is controlled for in multivariable models. Because macrosomia is on the causal pathway from obesity to shoulder dystocia, some methodologists would recommend not controlling for birthweight. As birthweight is unknown before delivery, obese women are at increased risk of macrosomia compared with normal weight woman, and therefore, the risk of shoulder dystocia is likely elevated in obese gravidas.
Operative Vaginal Delivery

Few studies support a link between obesity and operative vaginal delivery. One small case-control study in India showed a statistically significant increase in instrumental deliveries among obese women, whereas another population-based study only found an increased risk of operative vaginal delivery among morbidly obese gravidas. A larger study did not find an association between BMI and operative vaginal delivery risk. One reason for differing findings may be that the association is related to clinician bias, which may vary geographically and in different cultures.

Cesarean Delivery

Although the causal relationship between obesity and operative vaginal delivery remains unclear, an increased risk of cesarean delivery in obese patients has been repeatedly demonstrated, especially in morbidly obese women. There appears to be a dose-response effect, with multiple studies showing an increasing risk of cesarean delivery with increasing BMI. One meta-analysis demonstrated obese gravidas had a cesarean risk that was 2.05 times higher than patients with normal weight (OR 1.86–2.27), whereas severe obese gravidas had a cesarean risk that was 2.89 times higher than normal weight patients (OR 2.28–3.79). Another meta-analysis demonstrated the risk of cesarean section to be 2.26 times higher for women with a BMI of 30–35 (OR 2.04–2.51) and 3.38 times higher for women with a BMI greater than 35 (OR 2.49–4.57). A more recent retrospective study examining women with “super obesity,” defined as having a BMI greater than 50, found super-obese women to be at increased risk of having a cesarean section in comparison with obese women, with a rate of cesarean section of nearly 50%. Examining the interaction of race and obesity, increased rates of cesarean section have been noted among obese African American women (OR = 1.50) and Asian women (OR = 1.73).

Cesarean section in the first stage of labor has been shown to be higher in obese women, with a rate of 31% compared with 13% in normal weight women, whereas the rate of cesarean section in the second stage remains similar comparing obese, overweight, and normal weight women. Obese women have also been shown to have an increased risk of emergent cesarean delivery.

Cesarean Complications

Cesarean deliveries in obese gravidas can be more technically challenging, and increasing BMI has been associated with increasing operative times in one study. Higher rates of postoperative wound complications have been described among obese women. The risk of infection has been reported to be 1.43 times higher after a cesarean delivery and more than doubled in obese diabetic women. Several studies demonstrated increased rates of cesarean complication with increasing BMI. In women with a BMI greater than 50, one study cited a 30% wound complication rate with 90% of complications involving wound disruptions, with higher risks seen in smokers and patients with subcutaneous drains in place. Wound separations can be decreased by closing the subcutaneous fat with suture in patients with adipose depth greater than 2 cm. In addition, a prospective, randomized controlled trial examining the use of drains in obese women after cesarean section did not demonstrate any improvement in complication rates using this technique.

Some practitioners have suggested using vertical skin incisions or higher transverse incisions to improve wound complications, and one study examining morbidly obese women undergoing cesarean delivery found an increased use of vertical skin incisions in older, heavier patients. Vertical skin incisions have been associated with higher
rates of classic hysterotomy. Although 2 studies found no difference in wound complications with supraumbilical vertical skin incisions, a larger study found a lower rate of wound complications in patients with a vertical skin incision after adjusting for confounding factors. Prospective studies are needed to elucidate the ideal skin incision for cesarean delivery in obese women.

**Trial of Labor After Cesarean Section**

Several studies have compared trial of labor after cesarean section (TOLAC) success rates in obese and normal weight women. One study found obese women to have lower TOLAC success rates in comparison with normal weight women (54.6% vs 70.5%). Another case series described a 13% vaginal birth after cesarean section (VBAC) success rate in women weighing greater than 300 lb, much lower than rates seen in patients weighing less than 200 or between 200 and 300 lb. Another study found increasing BMI to be inversely associated with successful TOLAC. In morbidly obese women attempting TOLAC, more complications have also been demonstrated in patients with failed TOLAC, including higher infectious morbidity, composite morbidity, and neonatal injury. Similar risks were reported in a study comparing obese women attempting VBAC and elective repeat cesarean delivery. Given equivalent costs and an increased risk of complications with failed TOLAC in comparison with an elective repeat cesarean delivery, it may be reasonable for obese gravidas with low likelihood for TOLAC success to elect for a repeat cesarean delivery, particularly if they are interested in permanent sterilization with their delivery. This factor must be weighed against the risks for future pregnancy morbidity as well as the lower morbidity of a successful VBAC.

**Postpartum Hemorrhage**

Although 2 retrospective cohort studies found no increased risk in postpartum hemorrhage (PPH) in obese women, most literature demonstrates a mild increase in the risk of PPH, including 4 retrospective cohort studies, as well as a meta-analysis done in 2008 that showed an OR of 1.2 (95% CI 1.16–1.24). Several studies have also demonstrated a higher risk for hemorrhage in morbidly obese women. In addition, a recent population-based cohort study of 1.1 million women supported the increased risk of PPH and also demonstrated an increasing risk of atonic PPH with increasing BMI. The increased volume of distribution for uterotonics in obese women and the difficulty in identification of the fundus and with performing bimanual massage likely contribute to this risk.

**Anesthesia Complications**

Analgesia is an important consideration for all laboring patients. Given the previously discussed associations of obesity with complications of labor and an increased risk of cesarean section, anesthesia becomes a particularly important issue for the obese gravida. Placing regional anesthesia has been shown to be more difficult in obese patients, often requiring multiple attempts at needle insertion and more frequently resulting in failure of regional anesthesia placement. Intubation for general anesthesia can also be more difficult in obese patients. Thus, the obese patient may benefit from placement of a functioning epidural catheter early in labor. In addition to providing analgesia and alleviating elevated blood pressures during labor, a working epidural catheter can help to avoid the risks of general anesthesia for a patient who needs an emergency cesarean section. As operative times for cesarean deliveries in obese patients can be prolonged, the use of combined spinal epidural anesthesia can offer flexibility in prolonging anesthesia as necessary for longer surgeries. In any
case, it is important to consult with anesthesia providers early in labor to discuss management options and ensure more time to place a functioning epidural, or even to obtain antenatal anesthesia consultation for very challenging obese patients.

**WEIGHT MANAGEMENT AND PREGNANCY**

Ideally, weight loss with the goal of a normal BMI should be attempted before conception, because the degree of weight loss required to yield improvements in hypertension, hyperlipidemia, and diabetes could potentially be harmful during pregnancy. The American College of Obstetricians and Gynecologists (ACOG) recommends weight loss through a healthy diet of caloric restriction in combination with aerobic exercise. Weight change between the first and second pregnancies has been studied, with upward changes in BMI categories between pregnancies associated with increased risks of preeclampsia, LGA birth, and risk of cesarean delivery, whereas decreasing BMI categories between pregnancies attenuates the risk of LGA birth and cesarean delivery.

Gestational weight gain in pregnancy has also been extensively studied, with the Institute of Medicine (IOM) releasing guidelines for weight gain during pregnancy according to prepregnancy BMI. For obese gravidas, the recommended weight gain is between 11 and 20 lb, with some recommending even less weight gain for women with higher classes of obesity. Many studies have examined the impact of weight gain greater and less than that recommended by the IOM. Excessive weight gain of 25 or more pounds in obese women increases the risk of cesarean delivery and preeclampsia. An increase in LGA babies has also been seen in women who exceeded the recommended gestational weight gain guidelines (aOR 6.71, 95% CI 4.83–9.31). Decreased complications overall have been demonstrated in obese gravidas with weight gain less than 10 lb. Another study demonstrated decreased rates of preeclampsia, cesarean delivery, and LGA but increased small for gestational age among patients with class II and III obesity who gained less than 10 lbs. To achieve recommended gestational weight gain goals, referral to a nutritionist can be helpful for obese gravidas. In addition, many antenatal dietary interventions have been investigated to limit gestational weight gain. A recent meta-analysis showed that antenatal dietary interventions can decrease total gestational weight gain by 6.5 kg without adverse impact on neonatal birth weight. This evidence suggests that dietary restrictions in pregnancy may potentially improve maternal and neonatal outcomes and lower the likelihood of neonatal harm.

**Gastric Bypass Surgery**

Bariatric surgery refers to a heterogeneous group of procedures that include laparoscopic adjustable gastric banding, vertical-banded gastroplasty, Roux-en-Y gastric bypass, and biliopancreatic diversion/duodenal switch. Such procedures are appropriate for women with a BMI of 40 or greater or with BMI of 35 or greater with comorbidities such as diabetes, coronary artery disease, and severe sleep apnea. Recent randomized controlled trials have also demonstrated that bariatric surgery may achieve better glycemic control than medical treatment alone. Many studies have demonstrated improved pregnancy outcomes with gastric bypass surgery before conception, particularly when comparing women with prior gastric bypass surgery to obese controls. Among maternal outcomes examined when comparing obese controls and women after various types of bariatric surgery, decreases in the rates of preeclampsia, chronic hypertensive disorders of
Pregnancy, and gestational diabetes\textsuperscript{137} have been reported after bariatric surgery, whereas one smaller case-control study did not find a decrease in these outcomes.\textsuperscript{138} Decreased rates of cesarean section have been demonstrated as well.\textsuperscript{139} In examining perinatal outcomes, it was found that gastric bypass is associated with decreased rates of macrosomia,\textsuperscript{138,140} although another study found no difference in macrosomia rates after gastric banding.\textsuperscript{141}

Concerns exist in the literature for some worsened pregnancy outcomes in women with a prior history of bariatric surgery. Studies comparing outcomes of women who have had prior gastric bypass surgery to controls with normal BMI show increased rates of complications.\textsuperscript{142–145} In particular, in one study examining 298 women with bariatric surgery to 158,912 controls in the general obstetric population, patients were more likely to have had a prior cesarean delivery, develop gestational diabetes, and give birth via cesarean delivery.\textsuperscript{142} However, these studies may reflect intrinsically different pregnancy outcomes between patients with normal BMI and obese patients with a history of bariatric surgery. A more appropriate comparison group might include only obese gravidas who have not had surgery. Bariatric surgery has also been shown to be associated with increased rates of small for gestational age fetuses.\textsuperscript{137} However, rates of preterm delivery\textsuperscript{138,141} and intrauterine fetal demise were similar after bariatric surgery.\textsuperscript{143}

The current recommendations according to ACOG are to avoid pregnancy for 12 to 18 months after bariatric surgery to avoid the risks to the fetus of rapid maternal weight loss,\textsuperscript{131} although pregnancy outcomes may be similar among patients with a surgery-to-conception interval of less than 18 months and patients who wait longer than 18 months to conceive\textsuperscript{146} or even patients who conceive at less than 12 months after surgery.\textsuperscript{147} Common nutritional deficiencies after Roux-en-Y gastric bypass include protein, iron, vitamin B12, vitamin D, and calcium, and monitoring for these deficiencies should be considered.\textsuperscript{131} In addition, absorptive surfaces along the gastrointestinal tract often change following bariatric surgery. Care should be taken when prescribing nonsteroidal anti-inflammatory drugs to avoid gastric ulceration in women with smaller gastric pouches.\textsuperscript{148}

The presentation of operative complications resulting from bariatric surgery, such as anastomotic leaks, bowel obstructions, internal hernias, ventral hernias, band erosion, and band migration, can mimic the common nausea and vomiting of pregnancy. For patients who have nausea or vomiting due to adjustable gastric bands, these bands can be adjusted to improve emptying and alleviate symptoms.\textsuperscript{149} All patients with a history of gastric bypass who present with nausea and vomiting should be evaluated carefully for these complications because maternal deaths have been reported resulting from postoperative complications of bariatric surgery during pregnancies following bariatric surgery.\textsuperscript{150}

**PREGNANCY MANAGEMENT**

Although obesity is associated with a wide range of complications, these women are certainly not just under the purview of maternal-fetal medicine specialists. Because obesity is increasingly common, all clinicians who provide prenatal care will care for these patients. Given the wide range of issues that may impact pregnancy in obese women, the following issues should be addressed throughout gestation.

In the first trimester, there are several additional tests or considerations for the obese gravida. First, because of the increased risk of undiagnosed T2DM, class II obese and higher patients should be screened at their initial prenatal visit, with either hemoglobin A1C, fasting glucose, or a 2-hour glucose tolerance test. Given the increased risks of preeclampsia and other hypertensive disorders of pregnancy,
providers should consider checking baseline preeclampsia laboratory tests, including a uric acid test and a liver function test, as well as a 24-hour urine protein collection to ensure normal values at baseline. In addition, a rigorous attempt to determine baseline blood pressure and to ensure proper cuff size should be made to screen for chronic hypertension. Because of the concern for oligo-ovulation in obese patients and the increased risk of dizygotic twinning among obese patients, an early first-trimester dating ultrasound in obese women is recommended to help determine timing of aneuploidy screening and third-trimester management.

Prenatal diagnosis also can be complicated in obese women. The new noninvasive prenatal testing using cell-free fetal DNA in the maternal circulation appears to be less effective in obese women with a lower rate having an adequate fetal fraction of the cell-free DNA and therefore not getting a result. For prenatal diagnosis, amniocentesis is always more challenging in obese women as is transabdominal chorionic villus sampling (CVS). Although CVS has not been specifically associated with increased rates of pregnancy loss among obese patients, interestingly, women with a BMI of 40 or greater have been shown to have a 2-fold increase in pregnancy loss rates after amniocentesis.

Obese pregnant women should undergo nutrition counseling, preferably by a trained nutritionist. Pregnant women have been shown to change behavior to reduce adverse pregnancy outcomes after counseling, so clinicians should focus on the potential benefits to pregnancy outcomes from appropriate diet, exercise, and gestational weight gain. As previously described, the IOM currently recommends 11 to 20 lb of weight gain in pregnancy in obese women, with perhaps even lower levels in higher levels of obesity.

In the second trimester, obese women should have a fetal anatomy ultrasound, given their elevated risk of fetal anomalies. Such women should also be counseled that the images are more challenging because of their habitus, which may lead to a greater chance of anomalies not being able to be identified or additional ultrasounds required to complete screening. Throughout the second trimester, along with diabetes screening, a continued focus on diet, exercise, and gestational weight gain should persist to reinforce these goals.

In the third trimester, obese women should be monitored closely for development of preeclampsia and gestational hypertension. If fundal heights are challenging to follow, some clinicians will obtain a third-trimester growth ultrasound to screen for macrosomia or intrauterine growth restriction. Because these women are at increased risk for stillbirth, some individuals have proposed antenatal testing, but there is no specific evidence from clinical trials to support this practice.

Concerning labor and delivery, obese women should receive an early anesthesia consult to ensure adequate anesthesia in an emergent setting can be obtained. Obese women may have different labor curves than women of normal weight, and this should be considered when diagnosing failed induction, active phase arrest, and failure to descend. Particularly, for the latter diagnosis, care should be taken to identify the ischial spines as landmarks for the estimation of fetal station, because the fetuses of obese women may seem to be higher on vaginal examination than of nonobese women.

Throughout pregnancy and the postpartum period, obese patients are at increased risk for VTE. Thromboprophylaxis for 1 week postpartum can be considered in morbidly obese patients with additional risk factors for VTE, although these recommendations are based on expert opinion. In the postpartum period, patients can benefit from continued focus on diet and exercise to support the idea that these lifestyle changes are not just for pregnancy, but rather should be a lifelong behavioral
change. For obese patients with pregnancies complicated by GDM or either chronic or gestational hypertension, addressing these issues postpartum is important. Obese women should be specifically encouraged to breastfeed for maternal benefits, including decreased postpartum weight retention and lifelong reduction of T2DM as well as decreasing their child’s risk for obesity and metabolic syndrome. Postpartum contraception requires special attention in obese women, who have been reported to be less likely to use contraception. As in women of normal weight, the intrauterine device is often the most consistent form of contraception, and obese women benefit in particular from the progestogenic impact on the uterine endometrium.

SUMMARY

Obesity is an increasingly common condition complicating pregnancy, and the consequences of obesity for the mother and neonate are numerous. Pregnancy represents a unique opportunity to counsel women appropriately to reduce these complications not only during their pregnancy but also in the future. Further research is needed to characterize optimal strategies to improve neonatal and maternal outcomes among obese women.

REFERENCES


