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Evaluating the Obstetrical Implications of Antenatal Testing for Women with Morbid Obesity: Maternal and Fetal Outcomes of Increased Surveillance

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Abstract

Objectives—Despite limited data, antenatal testing has been initiated in many institutions for women with morbid obesity given their increased risk of stillbirth. Therefore, our objective was to evaluate the obstetrical implications of antenatal testing in the morbidly obese population.

Study Design—We performed a retrospective cohort study of women undergoing antenatal testing from January 2011 through December 2012 who delivered at our institution. The exposed group was women undergoing antenatal testing with morbid obesity (body mass index [BMI] ≥ 40 kg/m²). This group was subdivided into two groups: group 1, which included women undergoing testing for morbid obesity alone, and group 2, which included women undergoing testing for morbid obesity with an additional medical comorbidity. The unexposed group (group 3) comprised nonmorbidly obese women (BMI < 35 kg/m²) undergoing antenatal testing for similar medical comorbidities. Our primary outcomes were induction of labor and gestational age at delivery.

Results—A total of 512 women met inclusion criteria. Group 1 had a lower induction rate as compared with groups 2 and 3 (22.2, 32.5, and 37.6%, respectively; $p = 0.003$). Additionally, women delivered at a later gestational age in group 1 (39.3 weeks [38.4–40.2]) compared with groups 2 (38.5 weeks [36.1–40.3]) or 3 (37.1 weeks [37.0–38.2]), $p = 0.04$. There were no significant differences in our secondary outcomes including rate of cesarean delivery ($p = 0.11$) or rate of nonreactive nonstress test ($p = 0.4$).

Conclusions—While it remains unknown whether antenatal testing decreases the stillbirth risk in morbidly obese women, this population does not appear to be at increased risk of induction of labor or delivery prior to 39 weeks secondary to testing. Future studies should evaluate neonatal implications and cost-effectiveness of antenatal testing in this group.

Keywords

morbid obesity; antenatal testing; nonstress test; induction of labor

Obesity affects 30% of reproductive-age women in the United States,¹ with half of all pregnant women being obese. Of obese pregnant women, between 8 and 20% are morbidly

obese with a body mass index (BMI) ≥ 40 kg/m².² Obesity has been associated with a myriad of complications in pregnancy, including gestational diabetes, hypertensive disorders, failed induction of labor, and cesarean delivery.^{3–5} Morbid obesity has also been associated with an increased risk of stillbirth, estimated at almost double that of the general population.⁶

Antenatal testing is widely used in women thought to be at high risk for stillbirth to assess fetal wellbeing and to intervene if there are any concerns. The exact etiology of the increased rate of stillbirth in morbidly obese women is not clearly understood. While there are scarce data about the impact that antenatal testing has on maternal or neonatal outcomes, many institutions have initiated antenatal testing in this population.

It is plausible that antenatal testing may lead to a higher rate of obstetrical interventions, including a higher rate of induction of labor as well as delivery prior to 39 weeks of gestation. While an increase in these interventions may be acceptable when the goal is to prevent stillbirth, it is important to understand the outcomes of antenatal testing in certain populations.

To that end, the objective of this study was to evaluate the rate of induction of labor and gestational age at delivery among women who had antenatal testing for morbid obesity as compared with nonmorbidly obese women having antenatal testing. Our hypothesis is that women who undergo antenatal testing for morbid obesity alone have a lower rate of induction of labor and a later gestational age at delivery compared with women undergoing antenatal testing for obesity with other comorbidities.

Study Design

A retrospective cohort study of women who underwent routine antenatal testing was performed with approval from the institutional review board at the University of Pennsylvania. Antenatal testing at our institution consists of twice-weekly nonstress tests (NSTs) with concurrent evaluation of the amniotic fluid index, beginning at 32 weeks of gestational age and continuing through delivery. Antenatal testing for morbid obesity began at our institution in 2009.

Women who underwent antenatal testing and delivered at our institution between January 2011 and December 2012 were identified through a computerized perinatal database. Demographic information, BMI, indication and outcome for antenatal testing, delivery information, and neonatal outcome data were abstracted by the primary author (P. K. E.) from the electronic medical record. The measured and documented weight at the first prenatal visit and reported height were used to calculate BMI.

The exposed group comprised women undergoing antenatal testing with morbid obesity (BMI ≥ 40 kg/m²). This group was subdivided into two smaller subgroups: group 1 included women undergoing testing for morbid obesity alone, and group 2 included women undergoing testing for morbid obesity with an additional medical comorbidity. The unexposed group (group 3) comprised nonmorbidly obese women (BMI < 35 kg/m²) undergoing antenatal testing for similar medical comorbidities. For the purposes of this

study, we defined medical comorbidity as any maternal medical condition that warranted antenatal testing and did not initially meet exclusion criteria as noted below. Once included within a testing group, the patients were not subsequently excluded if they developed exclusion criteria during the course of their antenatal testing.

All women who underwent antenatal testing and delivered at our institution between January 1, 2011, and December 31, 2012, were included. Women with multiple gestations or fetal anomalies were excluded. Women were also excluded if they were undergoing antenatal testing for vaginal bleeding concerning for placental abruption, postterm pregnancy, decreased fetal movement, intrauterine growth restriction, or oligohydramnios, as we believed that physicians would have a lower threshold to deliver these patients. Women with a BMI between 35 and 39.9 kg/m² were also excluded to better differentiate the BMIs between the exposed and unexposed groups.

The primary outcomes for the study were induction of labor and gestational age at delivery. Patients were deemed to have an induction of labor if an induction was documented by their care provider in the chart. Both maternal and fetal indications for induction were included as an outcome regardless of whether the induction was recommended based on antenatal testing findings. The secondary outcomes included cesarean delivery, rate of nonreactive NST, testing abnormality requiring further evaluation on labor and delivery, delivery after being sent for further evaluation, birth weight, and neonatal intensive care unit (NICU) admission. Abnormality on testing requiring further evaluation included maternal, fetal, or labor indications.

Nonparametric and parametric data were analyzed using the Kruskal–Wallis tests and analysis of variance, where appropriate. Categorical variables were analyzed using chi-square tests. Logistic regression was used to calculate odds ratios (ORs).

A priori sample size calculations were performed. The study was powered to see the smallest difference between two groups that was thought to be clinically relevant. To see a difference of 10% (baseline of 25% at our institution) with a two-sided type 1 error of 5 and 80% power, we would need 116 patients in each arm.

Data analysis was performed using STATA 12.0 for Windows (STATA Corporation, College Station, TX). Statistical significance of $p < 0.05$ was used for all analyses.

Results

A total of 2,370 women were identified from our perinatal database as having antenatal testing between January 2011 and December 2012. In total, 512 women met inclusion criteria (group 1: $n = 203$; group 2: 120; group 3: 189 women) (►Fig. 1).

►Table 1 shows the demographic data for our study. Women testing for morbid obesity alone (group 1) were younger compared with the other two groups, and ~90% of women in groups 1 and 2 were African American.

Obstetrical outcomes are presented in ►Table 2. We found a significant difference in both induction rates and gestational ages at delivery among the three groups.

Women testing for morbid obesity alone (group 1) were 41% (OR, 0.59 [0.36–0.98]; $p = 0.04$) less likely to undergo an induction compared with women in group 2 and 53% (OR, 0.47 [0.30–0.74]; $p = 0.001$) less likely to undergo an induction compared with women in group 3. When specifically evaluating the rate of delivery prior to 39 weeks of gestation, the group with morbid obesity alone also had a significantly lower rate of delivery prior to 39 weeks ($p < 0.001$). There were no significant differences in our secondary outcomes, including cesarean delivery, birth weight, or admission to the NICU.

Outcomes of antenatal testing are presented in ►Table 3. There was no difference in the number of antenatal testing appointments or the rates of nonreactive NST between the groups. There was also no difference in the percentage of women that needed further evaluation on labor and delivery or who were ultimately delivered after finding an abnormality during testing. Notably, women in groups 1 and 2 were more likely to be sent to labor and delivery for a fetal indication, whereas women in group 3 were more likely to be sent to labor and delivery for maternal indications ($p = 0.05$).

Discussion

To our knowledge, this is the first study to evaluate the obstetrical outcomes of antenatal testing in morbidly obese women. Consistent with our hypothesis, we found that women undergoing testing for morbid obesity alone have a lower rate of induction of labor and a later gestational age at delivery compared with women undergoing antenatal testing with medical comorbidities. Importantly, those testing for morbid obesity alone have a similar rate of induction when compared with the overall induction rate at our institution (25%). Additionally, it is known that morbidly obese women are at a higher rate of failed induction of labor.⁷ Evidence continues to emerge regarding the improved neonatal outcomes when a delivery occurs after 39 weeks of gestation.^{8,9} Given the current emphasis on reducing the number of nonmedically indicated deliveries prior to 39 weeks, we found that antenatal testing for morbid obesity alone did not increase the rate of delivery < 39 weeks as compared with antenatal testing for other comorbidities. Finally, we discovered that testing in this population did not change outcomes including rates of cesarean delivery, birth weight, or admission to the NICU as compared with antenatal testing for other comorbidities.

Our findings are largely consistent with what is published in the existing literature regarding antenatal testing in other populations. Similar to previous studies that evaluated antenatal testing for indications such as postterm pregnancy and advanced maternal age,^{10–12} we found that implementing antenatal testing in morbidly obese women did not increase the induction rate above our institution's baseline rates of ~25%. Furthermore, our results support the findings of Brown and colleagues,¹³ who reported that obese women were not at increased risk of a nonreactive NST as compared with normal-weight women.

Our study has several strengths. It was performed at a single large urban institution that is a high-risk referral center. We have a high prevalence of morbidly obese women with ~15% of

our patient population meeting this definition. Data abstraction was performed by one abstractor (P. K. E.), limiting errors and discrepancies with abstraction. To best demonstrate the true impact that morbid obesity alone has on testing outcomes, we compared three different groups. The group of women undergoing testing for morbid obesity alone was compared with women with morbid obesity plus a comorbidity and with women without morbid obesity plus a comorbidity.

There are several limitations of the study. The high-risk urban population may not be similar to other communities, making these findings less generalizable to a lower risk population. Additionally, the person performing chart abstraction was not blinded to the exposure as documentation of initial BMI and medical comorbidities were part of the abstraction. However, our outcomes of induction of labor and gestational age of delivery are not subjective and the nonblinded nature of this study should not introduce significant bias.

Due to the fortunate rarity of stillbirths, we were unable to evaluate differences in the rates of this outcome, which would be an ideal outcome to evaluate the impact of antenatal testing. We were, however, powered for the primary outcome, induction of labor. Finally, because it is standard of care at our institution to perform antenatal testing for all morbidly obese women, we were unable to compare morbidly obese women with antenatal testing to morbidly obese women without testing.

Although it is unclear as to the direct impact that antenatal testing has on prevention of stillbirth, it is reassuring that antenatal testing for morbid obesity does not appear to be leading to an increase in the rate of induction of labor, deliveries prior to 39 weeks, or cesarean deliveries as compared with antenatal testing for other comorbid conditions. Future studies should evaluate the economic implications for antenatal testing in this population.

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Fig. 1.
Recruitment of subjects. MO, morbidly obese.

Table 1

Demographics

	Group 1: morbid obesity alone (<i>n</i> = 203)	Group 2: morbid obesity + comorbidity (<i>n</i> = 120)	Group 3: nonmorbid obesity + comorbidity (<i>n</i> = 189)	<i>p</i>-Value
BMI (kg/m ²) ^{<i>a</i>}	45.8 (6.4)	44.2 (5.8)	28.7 (5.3)	0.01
Age (y) ^{<i>a</i>}	27.0 (5.1)	29.2 (5.5)	29.6 (6.3)	0.01
Race ^{<i>b</i>}				
African American	184 (91.1)	105 (89.0)	136 (63.3)	<0.001
White	11 (5.5)	4 (3.4)	49 (22.8)	
Other	7 (3.5)	9 (7.6)	30 (14)	
Parity	1 (0–2)	1 (0–2)	1 (0–2)	0.06
Prenatal care ^{<i>b</i>}				
Resident practice	139 (68.5)	81 (67.5)	94 (51.0)	<0.001
Attending practice	34 (16.8)	31 (25.8)	72 (38.3)	
Family medicine	28 (13.8)	7 (5.8)	16 (8.5)	
Other	2 (1.0)	1 (0.8)	6 (3.2)	

Abbreviation: BMI, body mass index.

^{*a*} Mean ($\pm$ standard deviation).

^{*b*} Number (percentage).

Table 2

Obstetric outcomes

	Group 1: morbid obesity alone (<i>n</i> = 203)	Group 2: morbid obesity + comorbidity (<i>n</i> = 120)	Group 3: nonmorbid obesity + comorbidity (<i>n</i> = 189)	<i>p</i>-Value
Induction of labor ^{<i>a</i>}	45 (22.2)	39 (32.5)	71 (37.6)	0.003
Gestational age at delivery (wk) ^{<i>b</i>}	39.3 (38.5–40.2)	39.1 (37.6–39.5)	38.6 (37.2–39.2)	<0.001
Delivery prior to 39 weeks of gestation	61 (30.2)	54 (45.4)	97 (51.3)	<0.001
Cesarean delivery ^{<i>a</i>}	86 (42.4)	50 (41.7)	67 (35.4)	0.11
Birth weight (g) ^{<i>c</i>}	3,405 (3,090–3,755)	3,350 (2,910–3,755)	3,200 (2,808–3,598)	<0.001
NICU admission	27 (13.3)	14 (11.7)	32 (16.9)	0.6

Abbreviation: NICU, neonatal intensive care unit.

^{*a*}Mean ($\pm$ standard deviation).

^{*b*}Number (percentage).

^{*c*}Median (interquartile range).

Table 3

Antenatal testing outcomes

	Group 1: morbid obesity alone (<i>n</i> = 203)	Group 2: morbid obesity + comorbidity (<i>n</i> = 120)	Group 3: nonmorbid obesity + comorbidity (<i>n</i> = 189)	<i>p</i>-Value
Testing appointments ^{<i>a</i>}	5 (3–9)	7 (3–11)	5 (3–10)	0.17
Nonreactive nonstress test ^{<i>a</i>}	61 (30.1)	38 (31.7)	45 (23.8)	0.35
Further evaluation on labor and delivery after testing ^{<i>b</i>}	24 (11.8)	19 (15.8)	33 (17.5)	0.28
Indication for sending to labor and delivery ^{<i>b</i>}				
Fetal	14 (58.3)	11 (58.0)	14 (42.2)	0.05
Maternal	5 (20.8)	6 (31.6)	18 (54.5)	
Labor	5 (20.8)	2 (10.5)	1 (3.0)	
Delivery	18 (75)	15 (79.5)	27 (81.8)	

^{*a*}Mean (± standard deviation).^{*b*}Number (percentage).