The impact of maternal obesity and weight gain on vaginal birth after cesarean section success

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KEY WORDS
Obesity
Body mass index
Vaginal birth after cesarean
Trials of labor

Objective: This study was undertaken to determine the impact of maternal obesity on success of a trial of labor (vaginal birth after cesarean section [VBAC]) after a single low transverse cesarean delivery.

Study design: Individual charts of women with low transverse cesarean delivery in their first viable pregnancy who underwent a VBAC in their second viable pregnancy at our urban tertiary care institution were reviewed. Maternal body mass index (BMI) was classified as underweight (<19.8 kg/m²), normal (19.8-24.9 kg/m²), overweight (25-29.9 kg/m²), or obese (≥30 kg/m²). Clinical characteristics and labor outcomes were assessed. Factors potentially affecting VBAC success were analyzed by univariate analysis. Logistic regressions were performed to determine the impact of maternal pregravid BMI on VBAC success after controlling for confounding factors.

Results: Of 510 women attempting a trial of labor, 337 (66%) were successful and 173 (34%) failed VBAC. Decreased VBAC success was seen in obese (54.6%) but not overweight (65.5%) women compared with women of normal BMI (70.5%), P < .003 and .36, respectively. Underweight women had more VBAC success than women of normal BMI (84.7% vs 70.5%, P = .04). Controlling for other factors, the association between increasing pregravid BMI and BMI ≥ 30 kg/m² with decreased VBAC success persisted, P = .03 and .006, respectively. Normal BMI women who became overweight before the second pregnancy had decreased VBAC success compared with those whose BMI remained normal (56.6% vs 74.2%, P = .006). However, overweight women who decreased their BMI to normal before the second pregnancy did not significantly improve VBAC success (64.0% vs 58.4%, P = .67).

Conclusion: Increasing pregravid BMI and weight gain between pregnancies reduce VBAC success after a single low transverse cesarean delivery.

Obesity complicates 18% to 38% of all pregnancies. Recent studies have shown a strong association between obesity and perinatal complications, including pre-eclampsia, gestational diabetes, macrosomia, and cesarean delivery. Because vaginal birth after cesarean section (VBAC) has been recognized as a safe and acceptable option after a low transverse uterine incision, encouraging women to undergo a trial of labor has been one of the strategies used in an attempt to reduce cesarean delivery rates. In appropriate candidates, 50% to 80% of VBAC attempts are successful. However, certain subgroups of women may have decreased VBAC success.
Increased maternal body mass index (BMI) has been shown to increase the risk of cesarean delivery. These studies did not discuss women attempting VBAC as a separate subgroup. Several studies have shown a reduction in VBAC success with increased maternal pregravid weight. However, these studies included women with prior successful vaginal deliveries. No study has addressed the impact of pregravid BMI during VBAC attempt in women with I prior low transverse cesarean delivery and no prior vaginal deliveries. Therefore, the purpose of our study was to determine the impact of maternal pregravid BMI and weight gain between pregnancies on VBAC success in women after a single low transverse cesarean delivery after excluding those with potentially confounding prior vaginal deliveries or multiple prior cesarean deliveries.

Material and methods

With institutional review board approval, we performed a retrospective review of women who delivered their first live born singleton infant by primary low transverse cesarean delivery and underwent a trial of labor during their subsequent pregnancy at MetroHealth Medical Center’s level III perinatal center between January 1989 and December 2001. Individual medical record review of all women who met study criteria was performed for clinical characteristics and labor outcomes in the subsequent pregnancy. We excluded women with an extension into the upper segment of the uterus or conversion to a T-incision at the time of low transverse cesarean delivery and those with prior uterine surgery in which a trial of labor is contraindicated. Women who delivered an intervening viable pregnancy at another institution, those delivering either the first or second pregnancy before 23 weeks’ gestation, and those with a multiple gestation in the subsequent pregnancy were also excluded. Operative reports for the first pregnancy were reviewed to verify a low transverse uterine incision. Primary analysis of these women has been previously published evaluating the risks and benefits of single-versus double-layer closure after primary low transverse cesarean delivery. For this analysis, charts were reviewed for maternal height and pregravid weight measurements. Clinical characteristics for women attempting VBAC were collected, including maternal age, race, pregravid BMI, and medical complications such as diabetes, labor induction, indication for primary cesarean delivery, gestational age at delivery, infant gender, and birth weight.

Maternal height and pregravid weights were recorded for both the first and second pregnancies. BMI was calculated as weight (kg) divided by height$^2$ (m$^2$). Maternal obesity was defined according to World Health Organization and National Institutes of Health guidelines: overweight (25-29.9 kg/m$^2$) or obese ($\geq$ 30 kg/m$^2$). Underweight was defined as less than 19.8 kg/m$^2$. Univariate analysis was used to determine factors potentially affecting VBAC success, including maternal age, race, pregravid BMI, diagnosis of diabetes, labor induction, gestational age, infant gender, and birth weight. Statistical analysis was conducted with Statview (SAS Institute Inc, Cary, NC). Fisher exact and Student $t$ tests were used where appropriate. Logistic regressions were performed to evaluate the impact of increasing maternal pregravid BMI as a continuous variable and also pregravid BMI $\geq$ 25mg/kg$^2$ or $\geq$ 30 mg/kg$^2$ on VBAC success, controlling for the potentially confounding influence of maternal race, labor induction, gestational age at delivery, and infant birth weight. A $P$ value of < .05 was considered significant.

Results

Over the 12-year study period, 510 women met inclusion criteria. Of those studied, 35.7% were African American and 82.9% had government insurance. Of all women undergoing a trial of labor, 337 (66%) had a successful VBAC and 173 (34%) failed VBAC. Clinical characteristics of women with successful and failed VBAC are listed in Table I. Women with successful and failed VBAC were similar in age, type of insurance, diagnosis of diabetes, and gender of fetus. Women with successful VBAC were less likely to be of African American descent, to undergo labor induction, or to have a recurring indication for primary cesarean delivery than those who had failed VBAC. Earlier gestational age at delivery and smaller infant birth weight were also associated with successful VBAC. Table II further delineates indication for primary cesarean delivery in the first pregnancy and rates of successful VBAC during a trial of labor in the second pregnancy.

Maternal pregravid BMI was calculated for all women before each pregnancy. Of women undergoing a trial of labor in the second pregnancy, 59 (11.5%) were underweight, 173 (33.9%) had a normal BMI, 115 (22.5%) were overweight, and 163 (32%) were obese. Obese women had a significant reduction in VBAC success compared with women who had a normal BMI (54.6% vs 70.5%, $P = .003$). Overweight women (65.5%) had similar rates of VBAC success compared with women of normal BMI, $P = .36$. In contrast, underweight women (84.7%) had significantly improved VBAC success compared with their normal BMI counterparts, $P = .04$.

After controlling for maternal race, labor induction, gestational age at delivery, and infant birth weight by logistic regression, VBAC success decreased in women with increasing pregravid BMI and pregravid BMI $\geq$ 30kg/m$^2$, $P = .03$ and .006, respectively, but
We also evaluated women whose BMI classification changed between pregnancies to determine potential effects of weight change on VBAC success. Of the women who had a normal BMI before the first pregnancy, 83 (33.7%) became overweight before their second pregnancy and 163 (66.3%) maintained a normal BMI between pregnancies. Of the women who were overweight before the first pregnancy, 25 (11.9%) decreased their BMI to normal between pregnancies and 185 (88.1%) remained overweight between pregnancies. The average weight loss in overweight women who decreased their BMI to normal before the second pregnancy and 163 (66.3%) maintained a normal BMI between pregnancies. Of the women who were overweight before the first pregnancy, 25 (11.9%) decreased their BMI to normal between pregnancies and 185 (88.1%) remained overweight between pregnancies. The average weight loss in overweight women who decreased their BMI to normal between pregnancies was 25 lb. Women whose BMI was normal before the first pregnancy who became overweight (BMI ≥ 25 kg/m²) before the second pregnancy had decreased VBAC success compared with those women whose BMI remained normal (56.6% vs 74.2%, P = .006). In contrast, women who were overweight before the first pregnancy and decreased their BMI to normal before the second pregnancy did not significantly improve their VBAC success over those who remained overweight (64.0% vs 58.4%, P = .67).

Comment

We have shown a reduction in VBAC success in women with increasing pregravid BMI and with obesity (BMI ≥ 30 kg/m²) who undergo a trial of labor after a single low transverse cesarean delivery and no prior vaginal deliveries. Although previous studies used an arbitrary assignment of weight to classify obesity, we chose BMI as a more accurate and reproducible measure of adiposity. Our findings using BMI are consistent with those that show a reduction in VBAC success with increasing maternal prepregnancy weight.3,7 Previous studies evaluating the impact of maternal obesity on VBAC success also included women with prior vaginal deliveries.3,7 It has been shown that a history of prior vaginal delivery favorably influences VBAC success.9-13 In our study, we evaluated a unique subset of women undergoing a trial of labor after a primary low transverse cesarean delivery in their first pregnancy with no prior vaginal deliveries.

We found a stepwise decrease in the rate of VBAC success with increasing maternal pregravid BMI. In our study, underweight women were most likely to have a successful vaginal delivery (85%) when undergoing a trial of labor. This finding is consistent with a previous study showing pregravid BMI <19.8 kg/m² was protective against cesarean delivery.14 Women with a normal BMI (70.5%) had higher rates of VBAC success than overweight (65.5%) women, although this did not reach statistical significance. However, obese women had a significant reduction in VBAC success (54.6% vs 70.5%) compared with women of normal BMI. This stepwise reduction in VBAC success rates may be an important part of the counseling process regarding the likelihood of vaginal delivery during a subsequent trial of labor. The reduction of VBAC success with obesity from 71% to 55% is of a similar order of magnitude to that seen with a “recurring” indication for primary cesarean delivery (eg, arrest of dilatation) as opposed to a “non-recurring” indication (eg, fetal malpresentation).15-17

The decrease in VBAC success with increasing pregravid BMI and BMI ≥ 30 kg/m² persisted after controlling for the influence of maternal race, labor induction, gestational age at delivery, and infant birth weight. We chose to exclude recurring indications for primary cesarean delivery (labor dystocia) in our logistic regression. The risk of labor dystocia is strongly influenced by a woman’s obesity and therefore cannot be independently evaluated as a factor for VBAC success in

### Table I

Clinical characteristics associated with successful or failed VBAC attempt in women with 1 prior cesarean delivery and no prior vaginal deliveries

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Successful VBAC (n = 337)</th>
<th>Failed VBAC (n = 173)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age (y)*</td>
<td>24.2 (7.1)</td>
<td>25.0 (6.2)</td>
<td>.21</td>
</tr>
<tr>
<td>African American (%)</td>
<td>32.3</td>
<td>42.2</td>
<td>.03</td>
</tr>
<tr>
<td>Government insured (%)</td>
<td>85.2</td>
<td>78.6</td>
<td>.08</td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td>2.4</td>
<td>5.2</td>
<td>.12</td>
</tr>
<tr>
<td>Maternal pregravid BMI (kg/m²)*</td>
<td>26.7 (7.5)</td>
<td>29.1 (7.2)</td>
<td>.0004</td>
</tr>
<tr>
<td>Labor induction (%)</td>
<td>7.0</td>
<td>10.1</td>
<td>.01</td>
</tr>
<tr>
<td>Recurring indication</td>
<td>47.2</td>
<td>62.4</td>
<td>.001</td>
</tr>
<tr>
<td>Interdelivery interval (y)*</td>
<td>2.5 (1.5)</td>
<td>2.8 (1.7)</td>
<td>.09</td>
</tr>
<tr>
<td>Gestational age (wks)*</td>
<td>39.2 (2.1)</td>
<td>39.6 (1.9)</td>
<td>.05</td>
</tr>
<tr>
<td>Male infant (%)</td>
<td>49.3</td>
<td>55.5</td>
<td>.19</td>
</tr>
<tr>
<td>Infant birth weight (g)*</td>
<td>3199 (527)</td>
<td>3416 (549)</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

* Mean (SD)

### Table II

Rates of successful versus failed VBAC based on indication for primary low transverse cesarean delivery in first pregnancy

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Successful VBAC</th>
<th>Failed VBAC</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed induction (%)</td>
<td>8 (53.3)</td>
<td>7 (46.7)</td>
<td>.28</td>
</tr>
<tr>
<td>Arrest of labor (%)</td>
<td>151 (59.9)</td>
<td>101 (40.1)</td>
<td>.004</td>
</tr>
<tr>
<td>FHR abnormality (%)</td>
<td>79 (63.7)</td>
<td>45 (36.3)</td>
<td>.52</td>
</tr>
<tr>
<td>Malpresentation (%)</td>
<td>89 (84.8)</td>
<td>16 (15.2)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Other (%)</td>
<td>13 (76.5)</td>
<td>4 (23.5)</td>
<td>.44</td>
</tr>
</tbody>
</table>

FHR, Fetal heart rate.
obese women. However, our findings did not change when we included recurring indication for primary cesarean delivery in the regression model.

In univariate analysis, a significant relationship between indication for primary cesarean delivery and likelihood of successful VBAC was found for arrest of labor and malpresentation only.

To determine whether change in weight between pregnancies impacts VBAC success, we evaluated women whose BMI classification changed before the second pregnancy. When overweight women lost weight achieving a normal BMI before the second pregnancy, there was no significant improvement in rates of successful vaginal delivery during a subsequent trial of labor. However, women of normal BMI before the first pregnancy who became overweight before the second pregnancy had a significant reduction in VBAC success compared with those women whose BMI remained normal between pregnancies. Women undergoing a primary cesarean delivery should be counseled that avoidance of weight gain would improve their likelihood of successful VBAC in a future pregnancy. Alternatively, these findings suggest that women who decrease their BMI to normal before the second pregnancy may still have long-term effects of obesity despite subsequent weight loss. It is possible that adiposity accrued when a woman was overweight may not decrease enough to increase her likelihood of VBAC success comparable to those women who have always had a normal BMI. This adiposity may be disproportionately distributed in the pelvis and may alter a woman’s pelvimetry, thus increasing the likelihood of dystocia. In our study, only 25 overweight women lost weight and decreased their BMI to normal between pregnancies. Of these women, 9 of 25 (36%) had a failed trial of labor. Of those that failed, 6 of 9 (66.7%) had a repeat cesarean section for labor dystocia.

It is possible that our study lacks adequate power to fully evaluate this subgroup. A post hoc power analysis of our data was conducted. Our study was underpowered to detect a difference in VBAC success between those women who were overweight (BMI 25-29.9 kg/m²) before the first pregnancy and changed their BMI to normal between pregnancies. However, our findings did not change in ways that may have impacted their choices regarding mode of delivery that we are unable to discern through a chart review. Furthermore, obesity may influence the manner in which and how aggressively a physician counsels a woman inquiring about a trial of labor. However, our findings are relevant to those who have made the decision to proceed to a trial of labor.

References