Published in final edited form as:
Obstet Gynecol. 2010 January ; 115(1): 60–64. doi:10.1097/AOG.0b013e3181c534ca.

White's Classification of Maternal Diabetes and Vaginal Birth After Cesarean Success in Women Undergoing a Trial of Labor

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Abstract

Objective—To estimate the rate of vaginal birth after cesarean delivery (VBAC) success in diabetic women based on White's Classification.

Methods—This is a secondary analysis of an observational study conducted at 19 medical centers of women attempting VBAC. Diabetic women with singleton gestations, one prior cesarean delivery, and cephalic presentation who underwent a trial of labor (TOL) were included. VBAC success rates, maternal and neonatal complications were compared based on White's Classification.

Results—Of 11,856 women who underwent trial of labor, 624 met all study criteria (Class A_1=356, A_2=169, B=70, C=21, D, R, or F=8). VBAC success in each group was: A1=68.5% (95% confidence interval [CI] 63.4%–73.3%), A2=55% (95% CI 47.2%–62.7%), B=70% (95% CI 57.9%–80.4%), C=47.6% (95% CI 25.7%–70.2%), D/F/R=12.5% (95% CI 0.3%–52.7%). Maternal and neonatal complications were rare, and not found to be different between groups.

Conclusion—Our study provides estimates for VBAC success based on White's classification and indicates a relatively low rate of perinatal complications after VBAC attempt for diabetic women.

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Dr. Spong, Associate Editor of Obstetrics & Gynecology, *was not involved in the review or decision to publish this article.*

Presented in part at the 55th Annual Meeting of the Society for Gynecologic Investigation, March 26–29, 2008, San Diego, CA.

Financial Disclosure: The authors did not report any potential conflicts of interest.

Introduction

More than a fourth of all births in the United States are by cesarean delivery (CD) (1). Attempts to lower the CD rate have focused on encouraging vaginal birth after cesarean (VBAC). An integral part of achieving a lower CD rate through better utilization of VBAC is predicting who is not a good candidate for trial of VBAC (2).

The incidence of diabetes among American adults has increased from 4.9 percent in 1990 to 6.9 percent in 1999 (3). The lifetime risk of diabetes for an American female is approximately 39% (3). Prevalence of gestational diabetes in the United States is reported to be between 1.4 – 14% of pregnancies (4,5). More reproductive age women are being diagnosed with diabetes than ever before, as the incidence of both pre-gestational and gestational diabetes is approaching nearly 5% of all pregnancies (6).

Diabetic women are at increased risk for CD secondary to labor arrest, failed induction, and fetal intolerance to labor (7,8). Furthermore, diabetic women have increased body mass index and weight gain during pregnancy, both of which have a negative impact on VBAC success (8). Large population-based studies have shown VBAC in the non-diabetic population to be a reasonable option for the patient and provider who are motivated to avoid the maternal morbidity associated with repeat CD (9). Currently, there is a paucity of data regarding VBAC outcomes for diabetic women. Coleman et al showed that the VBAC success rate was lower in gestational diabetics when compared to a non-diabetic population (10), while Grinstead et al identified medical conditions, of which diabetes was included, to be a predictor of VBAC failure (11). There is a relationship between increasing CD rates and severity of diabetes (12). VBAC success rate based on disease severity has been examined previously, although that study took place in a single center (13).

The purpose of this study was to estimate the rate of VBAC success in diabetic women by White's classification of diabetes in pregnancy (14). Secondary objectives included estimating maternal and neonatal complication rates in diabetic women attempting VBAC.

Methods

This is a secondary analysis of a 4-year observational study conducted at 19 academic medical centers of the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Maternal–Fetal Medicine Units Network (NICHD-MFMU Network) between 1999 and 2002 (9). Details of the study design have been reported previously (9). Inclusion criteria for this analysis were maternal diabetes, singleton gestation, one prior low-transverse cesarean delivery, gestational age $\geq 37^{0/7}$ weeks and a VBAC attempt. Women with pregnancies complicated by fetal structural or chromosomal abnormalities were excluded.

Maternal demographic, clinical, and outcome data were abstracted from medical records charts by trained research nurses. VBAC success was defined as VBAC attempt that ended in vaginal delivery. A composite outcome of maternal complications which included uterine rupture, uterine dehiscence, need for hysterectomy (by cesarean), deep vein thrombosis, need for transfusion (intra/postop), and maternal death was reported. In a similar fashion, a composite of neonatal complications, which included 5 minute Apgar < 4, umbilical artery pH < 7.0, seizures (confirmed), hypoxic-ischemic encephalopathy, and neonatal death, was reported.

Maternal and neonatal characteristics and outcomes were stratified by White's class (A_1, A_2, B, C, or D/F/R)(14) and compared with the exact Cochran-Armitage test of trend (15). Continuous variables were compared with the use of Wilcoxon rank-sum test and categorical variables were compared with the use of chi-squared or Fisher's exact test. Multivariable logistic regression was used to adjusting for gestational age and labor induction for the primary

outcome of successful VBAC. Nominal two-sided p values are reported with statistical significance defined as a P value <0.05. No adjustment was considered for multiple comparisons. SAS (SAS Institute, Cary, NC) was used for the analysis except the exact tests and confidence intervals (Clopper-Pearson)(16), which were computed by Cytel Studio 8. Approval for the original study was obtained at each of the originally participating institutions. Approval for this secondary analysis was obtained from the University of Texas Health Science Center in Houston Institutional Review Board.

Results

In the overall cohort 11,856 women underwent trial of labor. There were 1,358 women with diabetes; 624 (45.9%) attempted VBAC. The rate of VBAC attempt by White's class was: 48.7% for A1, 45.3% for A2, 44.9% for B, 33.3% for C, and 23.5% for D/F/R. Comparisons of demographic and clinical characteristics by White's class groups are presented in Table 1. Gestational age at delivery and BMI (pre-pregnancy) were different between the White's class groups. The frequency of chronic hypertension and labor induction also increased with advancing class. In women with unsuccessful VBAC, fetal indications (cord prolapsed, NRFT and abruption) for CD were common; A1=25%, A2=29%, B=43%, C=18% and D/F/R= 57%. Figure 1 describes the VBAC success rate by White's class. The overall VBAC success rate was 63.6%. VBAC success in each White's class group was: A1=68.5% (95% CI 63.4%–73.3%), A2=55% (95% CI 47.2%–62.7%), B=70% (95% CI 57.9%–80.4%), C=47.6% (95% CI 25.7%–70.2%), D/F/R=12.5% (95% CI 0.3%–52.7%).

In the initial analysis, an unadjusted test of trend was performed which indicated decreased VBAC success with advancing White's class (p=0.004). However, when adjusted for gestational age and labor induction, the only differences in VBAC success rates were between Class A-1 (OR 12.7, 95 % CI 1.5–109.1) and B (OR 16.0, 95 % CI 1.8–143.5) when compared to the D/F/R group. Maternal and neonatal complications are described in Table 2. There were no differences in major adverse outcomes between groups.

Discussion

Our study evaluated VBAC outcomes for over 600 diabetic women and noted that VBAC success rate was 64%, while in the non-diabetic women from the original cohort the success rate was 73.6% (9). When examining individual White's class groups, both Class C and D/F/R diabetics had unadjusted VBAC success rates that were below 50%. Due to the relatively low number of women in these categories studied (n= 29), we are unable to draw strong conclusions. Given the lack of prior data and the clinical importance, it is relevant to offer some discussion regarding the potential causes. Prior studies have shown a higher rate of fetal growth restriction for women with advanced diabetes (17), and given the high rate of CD for fetal indication in these groups, this may be one reason for the relatively low success rates. Long-standing diabetes, and its associated vasculopathy, could predispose those patients to VBAC failure due underlying uteroplacental insufficiency and fetal intolerance to labor. Additionally, clinicians may be less willing to tolerate abnormal FHR patterns due to maternal disease status or have bias towards lower threshold for cesarean due to maternal disease status. We also noted that maternal and neonatal complications were rare and not different across White's class groups. Our findings are similar to Blackwell et al, who also specifically looked at VBAC success in diabetics (13). Their results showed a higher cesarean rate in diabetics undergoing VBAC (56.3%) compared to diabetics who did not have a history of previous cesarean (26.3%). They also showed no significant difference in frequency of major maternal or neonatal complications. However, they did not compare the patients in their study based on White's class.

Strengths of this study include the considerable sample size, multicenter and standardized data collection and methodology. Also, as a multicenter study, our sample population represents a diverse group of patients. Our study has some limitations. The relatively small number of women with White's class D/F/R diabetes makes point estimation regarding the VBAC success in this group difficult, as evidenced by the large confidence interval surrounding the VBAC success rate. Also, given the overall low frequency of maternal or neonatal complications, we did not have adequate power to detect small differences between groups. While we adjusted for confounders such as induction of labor and gestational age at time of delivery, we did not adjust for other clinical factors (e.g. parity, cervical status). Because this was a multicenter study, center to center variability likely occurs. Other factors such as inter-physician variability with regard to decision to attempt VBAC or threshold for converting from VBAC attempt to CD was also not evaluated. Because the original study upon which this analysis was performed was observational, no specific directives were given to practitioners with regard to those decisions. Therefore, due to the nature of the dataset, we cannot rule out selection bias.

This study provides useful data for the counseling of diabetic women with previous CD who are evaluating the risks and benefits of VBAC. Our study provides estimates for VBAC success based on White's class and indicates a relatively low rate of perinatal complications following VBAC attempt for diabetic women. The decision for a diabetic woman to attempt VBAC should be made jointly with her and her physician on a case by case basis.

Acknowledgments

Supported by grants from the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (HD21410, HD21414, HD27860, HD27861, HD27869, HD27905, HD27915, HD27917, HD34116, HD34122, HD34136, HD34208, HD34210, HD40500, HD40485, HD40544, HD40545, HD40560, HD40512, and HD36801).

The authors thank Francee Johnson, RN, BSN, and Francee Johnson, RN, BSN, for protocol development and coordination between clinical research centers and Elizabeth Thom, PhD and Sharon Gilbert, MS, MBA, for protocol and data management and statistical analysis.

References

1. Martin JA, Sutton PD, Ventura SJ, Menacker F, Munson ML. Births: The Final Data for 2003. Natl Vital Stat Rep 2005;54:1–116.
2. Durnwald C, Mercer B. Vaginal birth after Cesarean delivery: predicting success, risks of failure. J Matern Fetal Neonatal Med 2004;15(6):388–93. [PubMed: 15280110]
3. ADA. Economic costs of diabetes in the U.S. in 2002. Diabetes Care 2002;26:917–32.
4. Dabelea D, Snell-Bergeon JK, Hartsfield CL, Bischoff KJ, Hamman RF, McDuffie RS. Increasing prevalence of gestational diabetes mellitus (GDM) over time and by birth cohort: Kaiser Permanente of Colorado GDM screening program. Diabetes Care 2005;28(3):579–84. [PubMed: 15735191]
5. Getahun D, Nath C, Ananth CV, Chavez MR, Smulian JC. Gestational diabetes in the United States: temporal trends 1989 through 2004. Am J Obstet Gynecol 2008;198(5):e1–5. [PubMed: 18279822]
6. Laolia A, Dalfra MG, Fedele D. Pregnancy complicated by type 2 diabetes: An emerging problem. Diabetes Res Clin Pract 2008;80(1):2–7. [PubMed: 18201793]
7. Cousins L. Pregnancy complications among diabetic women: Review 1965–1985. Obstet Gynecol Surv 1987;42 (3):140–9. [PubMed: 3104845]
8. Juhasz G, Gyamfi C, Gyamfi P, Tocce K, Stone JL. Effect of body mass index and excessive weight gain on success of vaginal birth after cesarean delivery. Obstet Gynecol 2005;106(4):741–6. [PubMed: 16199630]
9. Landon M, Hauth JC, Leveno KJ, Spong CY, Leindecker S, Varner MW, et al. for The NICHD/MFMU Network. Maternal and perinatal outcomes associated with a trial of labor after prior cesarean delivery. NEJM 2004;351(25):2581–9. [PubMed: 15598960]
10. Coleman TL, Randall H, Graves W, Lindsay M. Vaginal birth after cesarean among women with gestational diabetes. Am J Obstet Gynecol 2001;45:987–90.

11. Grinstead J, Grobman WA. Induction of labor after one prior cesarean: Predictors of vaginal delivery. Obstet Gynecol 2004;103(3):534–38. [PubMed: 14990418]
12. Blackwell SC, Hassan SS, Wolfe HW, Michaelson J, Berry SM, Sorokin Y. Why are cesarean delivery rates so high in diabetic pregnancies? J Perinat Med 2000;28(4):316–20. [PubMed: 11031703]
13. Blackwell SC, Hassan SS, Wolfe HW, Michaelson J, Berry SM, Sorokin Y. Vaginal birth after cesarean in the diabetic gravida. J Repro Med 2000;45(12):987–90.
14. White P. Classification of obstetric diabetes. 1978;130(15):228–30.
15. Mehta CR, Patel NR, Senchaudhuri P. Exact Power and Sample-Size Computations for the Cochran-Armitage Trend Test. Biometrics 1998;54:1615–1621.
16. Clopper CJ, Pearson E. The use of confidence or fiducial limits illustrated in the case of binomial. Biometrika 1934;26:404–413.
17. Becker T, Vermuelen MJ, Wyatt PR, Meier C, Ray JG. Prepregnancy diabetes and risk of placental vascular disease. Diabetes Care 2007;30(10):2496–8. [PubMed: 17586740]
18. Kruskal WH, Wallis WA. Use of ranks in one-criterion variance analysis. Journal of American Statistical Association 1952;47:583–621.

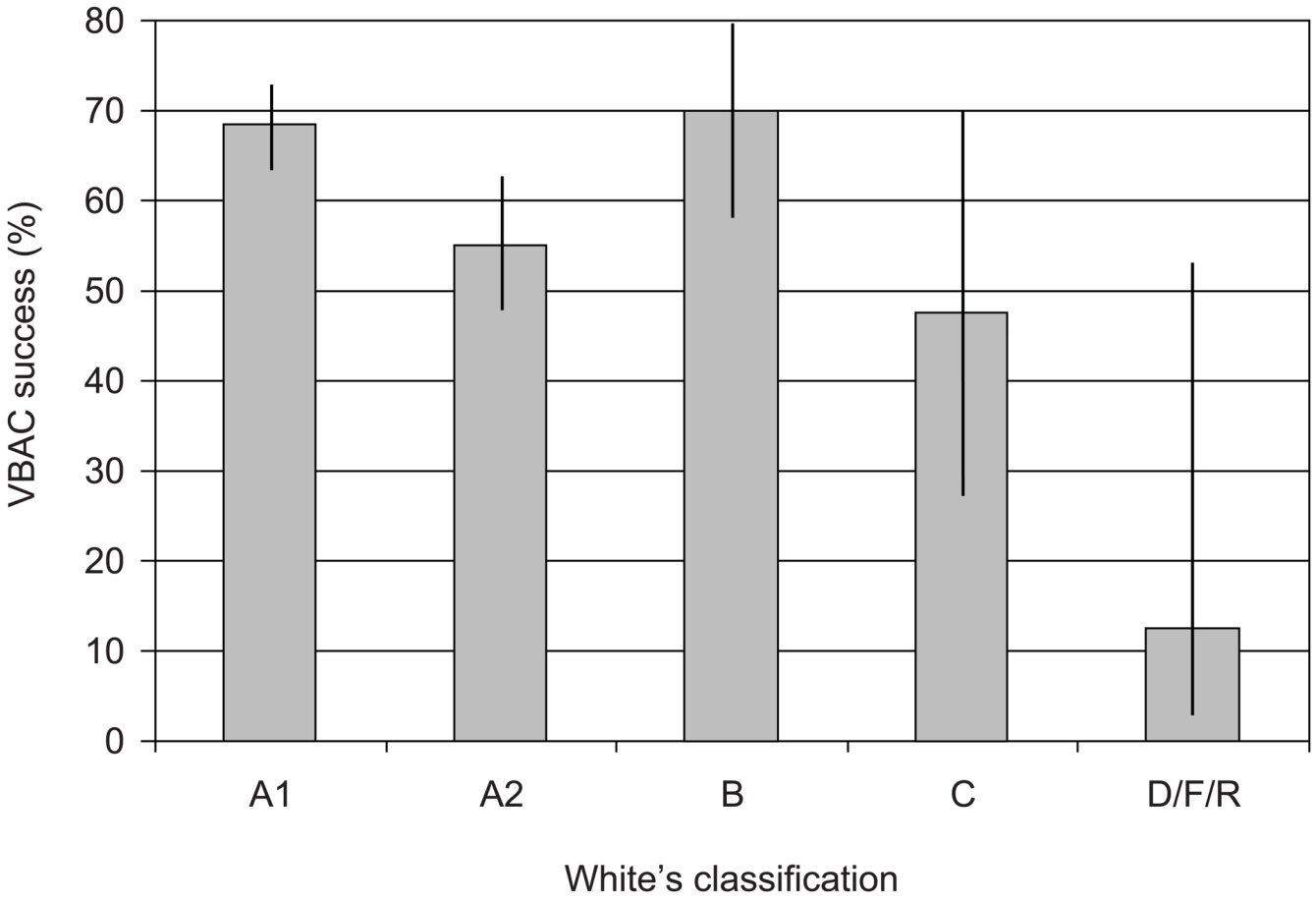

Figure 1.
Vaginal birth after cesarean (VBAC) success by White's classification. Error bars= 95% confidence interval. White's class A1, diet-controlled gestational diabetes; A2, insulin-controlled gestational diabetes; B, diabetes less than 10 years in duration or age of onset after 20 years; C, diabetes of 10 to 20 years in duration or age of onset between 10 and 20 years; D/F/R, more than 20 years in duration or age of onset less than 10 years or presence of nephropathy or retinopathy.

Table 1

Clinical characteristics of study population based on White's Class

	White's Class					
	A_1	**A_2**	**B**	**C**	**D,R, F**	**p****
	N=356	**N=169**	**N=70**	**N=21**	**N=8**	
Maternal age* (yrs)	30.9 ± 5.2	32.3 ± 5.5	32.2 ± 5.9	27.4 ± 7.2	30.8 ± 7.1	0.004
Gestational age* (wks)	39.3 ± 1.1	38.9 ± 1.0	38.6 ± 1.1	38.3 ± 1.1	37.9 ± 0.6	<0.001
Race						
Caucasian (%)	37.9	33.1	27.1	42.9	37.5	0.411
African-American (%)	30.1	37.9	54.3	42.9	62.5	0.001
Hispanic (%)	24.7	19.5	12.9	14.3	0	0.073
BMI* (kg/m^2)	28.6 ± 6.8	32.3 ± 7.9	32.3 ± 7.9	27.8 ± 6.8	29.0 ± 6.0	<0.001
Prior vaginal delivery (%)	48.5	51.5	60.0	28.6	37.5	0.106
Vaginal delivery since prior CD (%)	34.0	34.9	44.3	23.8	12.5	0.218
Recurring CD indication (%)	35.6	42.8	31.3	52.6	14.3	0.140
Labor induction (%)	37.8	63.4	64.2	80.0	85.7	<0.001
Birth weight* (grams)	3473 ± 463	3535 ± 542	3500 ± 444	3424 ± 542	3203 ± 789	0.403
Chronic Hypertension (%)	3.9	4.1	12.9	0	25	0.006***
Preeclampsia (%)	4.2	5.3	5.7	9.5	12.5	0.363***

* Mean±Standard Deviation

** p-value based on Kruskal-Wallis rank sum test (17) or Chi-square test.

*** p-value based on Fisher's exact test.

Table 2

Maternal and Neonatal Complications by White's Class Group [N (%)]

	White's Class					
	A_1	A_2	B	C	D,R, F	p*
	N=356	N=169	N=70	N=21	N=8	
Any Maternal Complication	12 (3.4)	9 (5.3)	1 (1.4)	0 (0)	1 (12.5)	>0.999
Uterine rupture	4 (1.1)	2 (1.2)	0 (0)	0 (0)	0 (0)	0.578
Uterine dehiscence	3 (0.8)	2 (1.2)	0 (0)	0 (0)	0 (0)	0.798
Need for hysterectomy	1 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)	>0.999
Deep vein thrombosis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	-
Need for transfusion	6 (1.7)	5 (3.0)	1 (1.4)	0 (0)	1 (12.5)	0.494
Maternal death	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	-
Any Neonatal Complication	7 (2.0)	1 (0.6)	3 (4.3)	0 (0)	1 (12.5)	0.369
5-minute Apgar < 4**	2 (0.6)	1 (0.6)	2 (2.9)	0 (0)	1 (12.5)	0.059
Umbilical artery pH < 7.0***	4 (3.5)	0 (0)	1 (2.9)	0 (0)	0 (0)	0.560
Seizures****	2 (0.6)	0 (0)	0 (0)	0 (0)	0 (0)	0.657
Hypoxic-ischemic encephalopathy	1 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)	>0.999
Neonatal death*****	1 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)	>0.999

* p-value based on the exact Cochran-Armitage Test for Trend.

** Based on 356, 169, 69, 21 and 8 patients with observations in different White's classes.

*** Based on 115, 66, 34, 6 and 7 patients with observations in different White's classes.

**** Based on 355, 168, 68, 21 and 7 patients with observations in different White's classes.

***** Based on 355, 168, 68, 21 and 7 patients with observations in different White's classes.

****** Based on 355, 168, 68, 21 and 7 patients with observations in different White's classes.