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Association Between Type of Screening for Gestational Diabetes Mellitus and Cesarean Delivery

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Abstract

Objective—To compare maternal and neonatal outcomes using two different testing strategies for gestational diabetes mellitus (GDM) diagnosis: The International Association of the Diabetes and Pregnancy Study Groups (IADPSG) and Carpenter-Coustan approaches. Specifically, we wanted to compare the rates of cesarean delivery between the two epochs.

Methods—This was a retrospective cohort study of women with a singleton pregnancy delivering at 37^{0/7} weeks, between 2010 and 2015, in a single tertiary care center. IADPSG testing was used for GDM diagnosis from December 2010 until July 2013 when institutional guidelines changed to Carpenter-Coustan testing. Maternal and neonatal outcomes were compared between these two different epochs using bivariable and multivariable analyses. The primary outcome was the frequency of cesarean delivery.

Results—The analysis included a total of 23,509 women: 14,074 (60%) from the IADPSG epoch and 9,435 (40%) from the Carpenter-Coustan epoch. The incidence of GDM diagnosis was higher using IADPSG compared to Carpenter-Coustan criteria (8.3% vs. 7.5%, $p=0.042$). The total (27.0% vs. 25.5% $p=0.022$) as well as primary cesarean delivery rates (19.1% vs. 18.0%, $p=0.041$) were higher during the IADPSG epoch. The rates of total (39.1% vs. 37.5%, $p=0.594$) and primary (27.3% vs. 27.0%, $p=0.903$) cesarean delivery among women with GDM did not differ between the two epochs. Secondary outcomes of shoulder dystocia (2.5% vs 2.1%, $p=0.043$) and NICU admission (3.2% vs 2.0%, $p<0.001$) also were significantly higher in women screened during the IADPSG epoch, whereas hypertensive disease of pregnancy (6.9% vs 7.7%, $p=0.018$) was less frequent during the IADPSG epoch. These findings persisted after adjusting for potential confounding factors.

Conclusion—Compared with testing using the Carpenter-Coustan criteria, the IADPSG criteria for diagnosis of GDM were associated with higher rates of GDM, cesarean delivery, shoulder

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dystocia, and NICU admission. Provider knowledge of GDM diagnosis might have affected decision making regarding the route of delivery.

High-quality evidence has demonstrated the association of maternal hyperglycemia with adverse perinatal outcomes, and the ability of treatment of gestational diabetes mellitus (GDM) to reduce these adverse outcomes.^{1–3} However, international consensus is still lacking on the best diagnostic testing strategy for GDM. In much of the U.S., screening and diagnosis for GDM involves a two-step approach with an initial 50-g glucose screen followed by a 3-hour oral glucose tolerance test using the Carpenter-Coustan criteria.⁴ However, in other parts of the world, a one-step approach of a 2-hour 75-g oral glucose tolerance test, recommended by The International Association of the Diabetes and Pregnancy Study Groups (IADPSG), is employed.^{2,4}

In 2013, the National Institute of Child Health and Human Development Consensus Development (NICHD) consensus conference concluded that although there are clear benefits to international standardization with regard to the one-step approach, there was not sufficient evidence to adopt a one-step IADPSG approach.⁵ The conference also called for well-conducted cohort studies to assess the impact of each diagnostic strategy on clinical outcomes. Two large-cohort studies were published since the consensus conference that demonstrated contradictory results both for their primary outcome of large-for-gestational-age neonates as well as for select secondary outcomes, including the total rate of cesarean delivery, primary cesarean delivery, macrosomia and neonatal intensive care unit admission.^{6–7}

At Northwestern University, IADPSG criteria were used for GDM diagnosis after the publication of the Hyperglycemia and Adverse Pregnancy Outcomes (HAPO) study¹ until the consensus conference recommendation⁵, whereupon the Carpenter-Coustan two-step strategy became employed. This circumstance within one large-volume institution provided the opportunity to compare maternal and neonatal outcomes associated with each strategy. Therefore, the objective of this study was to compare maternal and neonatal outcomes using the two different approaches (i.e., IADPSG and Carpenter-Coustan) for GDM diagnosis. The primary outcome of our analysis was the rate of cesarean delivery during each of the screening strategies epochs. Our hypothesis was that the rate of cesarean delivery would be higher during the IADPSG epoch.

Material and Methods

This was a retrospective cohort study of women with a singleton pregnancy delivering between December 2010 and February 2015 at Northwestern Memorial Hospital. IADPSG criteria were used in our institution from December 2010 until June 2013, while Carpenter-Coustan criteria were used from July 2013 onward, with the cut-off of 135mg/dL used as abnormal screening threshold for the 1-hour glucose challenge during the Carpenter-Coustan epoch. Throughout the entire study duration, women at increased risk for GDM based on ACOG criteria⁴ were screened at the first prenatal visit with a hemoglobin A1C. Women were included in this cohort if they were at least 18 years of age, had a singleton non-anomalous gestation, and delivered at 37^{0/7} weeks. Women with pre-gestational diabetes,

either with a documented diagnosis of Type 1 or Type 2 diabetes, or with hemoglobin A1C of $\geq 6.5\%$ at first prenatal visit were excluded. If a woman had more than one pregnancy during the study period only the first pregnancy was included so as to not violate the assumption of independence.

Institutional guidelines for women diagnosed with GDM did not change throughout the course of the study: women with GDM received medical nutritional therapy as first-line intervention. Fasting and one hour post-prandial venous blood glucoses were measured weekly. Adjuvant medication, with insulin typically being first line, was initiated if a woman failed two weeks of medical nutritional therapy defined as consistently having fasting venous blood glucoses of at least 95 mg/dL or a one hour post-prandial venous blood glucose of at least 140 mg/dL. If medications were initiated, the patient was provided a glucometer and recorded blood glucoses four times daily on average (one fasting and three postprandial values). Adherence with treatment was assessed by review of the weekly blood glucose log as well as periodic evaluation of the Hemoglobin A1C. Fetal growth assessment was done at 30–32 weeks and at 37–38 weeks. Timing of delivery was at the discretion of the provider but was typically prior to 41 weeks for women with A1GDM and during the 39th week for women with A2GDM.

Maternal characteristics and pregnancy outcomes were compared between the two GDM diagnostic epochs. Medical records were abstracted for sociodemographic and clinical characteristics, including maternal age, body mass index (BMI) at the time of delivery, race and ethnicity, obstetric history, prior medical history and obstetric course. Data derived directly from clinical data entered by physicians and used in the care of patients. Furthermore, missing variables were abstracted by the first four authors (A.P., K.S., T.C., and A.N.)

The primary outcome was the rate of cesarean delivery during each of the epochs as we hypothesized that provider decision making regarding route of delivery would be affected by the label of GDM. Secondary outcomes included the rate of primary cesarean delivery, large-for-gestational-age (LGA) infant (defined as a birthweight greater than the 90th percentile for gestational age and gender⁸), shoulder dystocia (defined as an application of additional obstetric maneuvers following failure of gentle downward traction on the fetal head to enable delivery of the fetal shoulders⁹ as determined by the delivering obstetrician), postpartum hemorrhage (PPH), hypertensive disease of pregnancy (preeclampsia or gestational hypertension), neonatal intensive care unit (NICU) admission, neonatal respiratory distress syndrome, neonatal hypoglycemia (defined as a glucose level of less than 40mg per deciliter), neonatal hyperbilirubinemia (defined as a total serum or plasma bilirubin level greater than the 95th percentile on the hour-specific Bhutani nomogram),¹⁰ and perinatal death.

All analyses were performed with Stata version 12.0 (StataCorp College Station, TX). All tests were two-tailed and $P < .05$ was used to define significance. Univariable comparisons were performed using Student's t test, χ^2 , Fisher's exact test, and Mann-Whitney U test as appropriate. Multivariable logistic regression was used to estimate whether the type of GDM diagnostic testing strategy was associated with the rate of GDM, as well as with the primary

and secondary outcomes. Covariates entered into the regressions were those that in univariable analysis differed between the two epochs at a level of $P < .05$. Approval for this study was obtained prior to its initiation from the Northwestern University Institutional Review Board (STU00200748)

Results

During the study period, a total of 23,509 women met inclusion criteria; 14,074 (60%) pregnancies occurred during the IADPSG epoch and 9,435 (40%) pregnancies occurred during the Carpenter-Coustan epoch. Maternal and neonatal characteristics are shown in Table 1. Although the actual differences were small, women who were screened using IADPSG criteria were statistically significantly younger ($31.6y \pm 5.2$ vs. $31.7y \pm 5.1$, $p=0.031$), were more likely to be non-Hispanic white (50.9% vs. 50.7%, $p=0.003$), and had lower rates of chronic hypertension (1.6% vs. 2.0%, $p=0.006$) and thyroid disease (5.3% vs. 6.3%, $p=0.003$). The incidence GDM diagnosis was 8.3% (1,167) and 7.5% (715) during the IADPSG and the Carpenter-Coustan epochs, respectively ($p=0.042$).

Maternal and neonatal outcomes are depicted in Table 2. The primary outcome, the rate of cesarean delivery, was significantly higher in women diagnosed by IADPSG rather than Carpenter-Coustan testing. Secondary outcomes of primary cesarean delivery, shoulder dystocia and NICU admission also were higher among women diagnosed during the IADPSG epoch. In contrast, the rate of hypertensive disease of pregnancy was higher during the Carpenter-Coustan epoch. The rates of LGA, PPH, neonatal respiratory distress syndrome, neonatal hypoglycemia, neonatal hyperbilirubinemia and perinatal death did not differ between the two groups. A sub-group analysis including only women who were diagnosed with GDM was done to compare cesarean delivery rates between the two epochs. It showed similar rates of total (39.1% vs. 37.5%, $p=0.594$) as well as primary (27.3% vs. 27.0%, $p=0.903$) cesarean delivery during the IADPSG and the Carpenter-Coustan epochs.

After adjusting for potential confounding variables (maternal age, race, ethnicity, chronic hypertension and thyroid disease) in multivariable regressions, odds of all cesarean delivery, primary cesarean delivery, shoulder dystocia and NICU admission remained significantly higher during the IADPSG epoch, whereas the odds of hypertensive disease of pregnancy remained lower during the IADPSG epoch (Table 3).

Discussion

In this study we have shown that the use of IADPSG testing, compared to Carpenter-Coustan testing, for diagnosis of GDM was associated with an increase in the rate of GDM diagnosis, cesarean deliveries, shoulder dystocia and NICU admission. These associations persisted after adjusting for potential confounders, suggesting they were not clearly attributable to differences in the patient population during the different epochs.

Several prior studies that assessed outcomes of different diagnostic testing for GDM performed the analysis by assessing outcomes of women who had been classified as normal by Carpenter-Coustan criteria but who would have been diagnosed with GDM if the IADPSG criteria had been used instead.^{11–14} However, these studies cannot account for the

impact of provider knowledge of GDM-status in clinical decision-making nor for what outcomes would have been with treatment after IADPSG diagnosis. In our search of the literature we found only two retrospective cohorts that compared the treatment effect on maternal and neonatal outcomes between groups who received Carpenter-Coustan versus IADPSG testing.⁶⁻⁷ Huang and Hsieh⁶ found that, compared to women who underwent Carpenter-Coustan testing, those who underwent IADPSG testing had lower rates of LGA (6.3% vs. 7.8%, adjusted OR 0.74, 95% CI 0.61–0.89), but had no change in the rate of cesarean delivery, NICU admission, or preeclampsia as it was underpowered to identify differences in many of these outcomes. A second before-and-after cohort study by Feldman et al⁷ found no differences in rates of LGA neonates in a Carpenter-Coustan versus a IADPSG epoch. They did, however, find that the use of IADPSG testing was associated with a higher rate of primary cesarean delivery (20% vs. 16%, adjusted OR 1.2, 95% CI 1.01–1.42).

The increase in the rate of primary cesarean delivery associated with IADPSG testing observed by Feldman et al⁷ as well as in our study parallels the increase in the frequency with which GDM was diagnosed during this epoch. As the rates of LGA were similar between the two epochs, fetal size should not be the factor responsible for the higher odds of cesarean delivery during the IADPSG epoch. Rather, the mere application of the label of GDM may lead to a tendency toward cesarean delivery. This shift in obstetrical practice style, regardless of fetal size, has been shown in earlier studies of GDM, even when GDM was treated and the rates of macrosomia and LGA were reduced.¹⁷⁻¹⁷ Similarly, a recent study demonstrated that knowledge of an ultrasonographic estimated fetal weight increases the risk of cesarean, even above the impact of the fetal size itself¹⁸. As the incidence of LGA did not increase across epochs, our data corroborate the finding that provider concern of potential adverse delivery outcomes related to fetal weight may influence decision-making beyond that supported by the clinical data.

Our study has several strengths. First, it is a large cohort that assessed the association of two different diagnostic strategies for GDM with perinatal outcomes. Our sample size allowed us to evaluate more uncommon outcomes, such as shoulder dystocia. Another strength is that the management of pregnancies complicated by the diagnosis of GDM did not change at our institution over time and therefore should not account for differences between the two epochs.

Our study is not without limitations. First, we cannot rule out the presence of additional unmeasured confounders that may have contributed to the differences in the outcomes. One of these may be related to a joint publication by NICHD, ACOG and Society of Maternal Fetal Medicine workshop released towards the end of the IADPSG epoch regarding strategies to prevent the first cesarean delivery,¹⁹⁻²⁰ which may have impacted practice during the later Carpenter-Coustan epoch. In addition, the rate of GDM during the IADPSG epoch in our patient population seems to be lower than previously reported by the HAPO study of 17.8%¹, although the range of GDM in the participating centers in the HAPO trial was 9.3 –25.5%.²¹

In summary, in this large retrospective cohort study we found that use of IADPSG testing, compared to Carpenter-Coustan testing, for GDM diagnosis, was associated with higher rates of overall cesarean delivery, primary cesarean delivery, shoulder dystocia and NICU admission. While the absolute risk difference is low, as over 1.1 million cesareans are performed annually in the United States²², the public health impact of even a marginal change may still be large. These data suggest that the more frequent diagnosis of GDM does not necessarily translate into better health outcomes, and that randomized trials demonstrating outcome improvement should be undertaken before new testing strategies for GDM are employed.

References

1. Metzger BE, Lowe LP, Dyer AR, Trimble ER, Chaovarindr U, Coustan DR, et al. Hyperglycemia and adverse pregnancy outcomes. *N Engl J Med*. 2008; 358:1991–2002. [PubMed: 18463375]
2. Crowther CA, Hiller JE, Moss JR, McPhee AJ, Jeffries WS, Robinson JS. Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. *N Engl J Med*. 2005; 352:2477–86. [PubMed: 15951574]
3. Landon MB, Spong CY, Thom E, Carpenter MW, Ramin SM, Casey B, et al. A multicenter, randomized trial of treatment for mild gestational diabetes. *N Engl J Med*. 2009; 361:1339–48. [PubMed: 19797280]
4. ACOG Practice Bulletin No. 137: Gestational diabetes mellitus. *Obstet Gynecol*. 2013; 122:406–16. [PubMed: 23969827]
5. Vandersten JP, Dodson WC, Espeland MA, Grobman WA, Guise JM, Mercer BM, et al. NIH Consensus State Sci Statements. NIH consensus development conference: diagnosing gestational diabetes mellitus. 2013; 29:1–31.
6. Hung TH, Hsieh TT. The effects of implementing the International Association of Diabetes and Pregnancy Study Groups criteria for diagnosing gestational diabetes on maternal and neonatal outcomes. *PLoS One*. 2015;10.
7. Feldman RK, Tieu RS. Gestational diabetes screening: the international association of the diabetes and pregnancy study groups compared with Carpenter-Coustan screening. *Obstet Gynecol*. 2016; 127:10–17. [PubMed: 26646142]
8. Duryea EL, Hawkins JS, McIntire DD, Casey BM, Leveno KJ. A revised birth weight reference for the United States. *Obstet Gynecol*. 2014; 124:16–22. [PubMed: 24901276]
9. ACOG Practice Bulletin No. 178: Shoulder dystocia. *Obstet Gynecol*. 2017; 129:e123–e133. [PubMed: 28426618]
10. American Academy of Pediatrics Subcommittee on Hyperbilirubinemia. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. *Pediatrics*. 2004; 114:297–316. [PubMed: 15231951]
11. Lapolla A, Dalfrà MG, Ragazzi E, De Cata AP, Fedele D. New International Association of the Diabetes and Pregnancy Study Groups (IADPSG) recommendations for diagnosing gestational diabetes compared with former criteria: a retrospective study on pregnancy outcome. *Diabet Med*. 2011; 28:1074–7. [PubMed: 21658125]
12. Bodmer-Roy S, Morin L, Cousineau J, Rey E. Pregnancy outcomes in women with and without gestational diabetes mellitus according to the International Association of the Diabetes and Pregnancy Study Groups criteria. *Obstet Gynecol*. 2012; 120:746–52. [PubMed: 22996090]
13. Benhalima K, Hanssens M, Devlieger R, Verhaeghe J, Mathieu C. Analysis of Pregnancy Outcomes Using the New IADPSG Recommendation Compared with the Carpenter and Coustan Criteria in an Area with a Low Prevalence of Gestational Diabetes. *Int J Endocrinol*. 2013; 2013:248121. [PubMed: 23365571]
14. Ethridge JK Jr, Catalano PM, Waters TP. Perinatal outcomes associated with the diagnosis of gestational diabetes made by the international association of the diabetes and pregnancy study groups criteria. *Obstet Gynecol*. 2014; 124:571–8. [PubMed: 25162258]

15. Goldman M, Kitzmiller JL, Abrams B, Cowan RM, Laros RK Jr. Obstetric complications with GDM. Effects of maternal weight. *Diabetes*. 1991; 40(Suppl 2):79–82. [PubMed: 1748271]
16. Naylor CD, Sermer M, Chen E, Sykora K. Cesarean delivery in relation to birth weight and gestational glucose tolerance: pathophysiology or practice style? Toronto Trihospital Gestational Diabetes Investigators. *JAMA*. 1996; 275:1165–70. [PubMed: 8609683]
17. Langer O, Yogev Y, Most O, Xenakis EM. Gestational diabetes: the consequences of not treating. *Am J Obstet Gynecol*. 2005; 192:989–997. [PubMed: 15846171]
18. Little SE, Edlow AG, Thomas AM, Smith NA. Estimated fetal weight by ultrasound: a modifiable risk factor for cesarean delivery? *Am J Obstet Gynecol*. 2012; 207:309e1–6. [PubMed: 22902073]
19. Spong CY, Berghella V, Wenstrom KD, Mercer BM, Saade GR. Preventing the first cesarean delivery: summary of a joint Eunice Kennedy Shriver National Institute of Child Health and Human Development, Society for Maternal-Fetal Medicine, and American College of Obstetricians and Gynecologists Workshop. *Obstet Gynecol*. 2012; 120:1181–93. [PubMed: 23090537]
20. Caughey AB, Cahill AG, Guise JM, Rouse DJ. American College of Obstetricians and Gynecologists (College); Society for Maternal-Fetal Medicine. Safe prevention of the primary cesarean delivery. *Am J Obstet Gynecol*. 2014; 210:179–93. [PubMed: 24565430]
21. Sacks DA, Hadden DR, Maresh M, Deerochanawong C, Dyer AR, Metzger BE, et al. Frequency of gestational diabetes mellitus at collaborating centers based on IADPSG consensus panel-recommended criteria: the Hyperglycemia and Adverse Pregnancy Outcome (HAPO) Study. *Diabetes Care*. 2012; 35:526–8. [PubMed: 22355019]
22. Martin JA, Hamilton BE, Osterman MJ, Driscoll AK, Mathews TJ. Births: Final Data for 2015. *atl Vital Stat Rep*. 2017; 66:1. J.

Table 1

Baseline characteristics stratified by GDM diagnostic criteria

	IADPSG (N = 14,074)	Carpenter-Coustan (N =9,435)	P
Maternal characteristics			
Maternal age (years)	31.6 ± 5.2	31.7 ± 5.1	0.031
Body mass index (kg/m ²)	30.1 ± 5.5	30.2 ± 5.3	0.172
	5,986 (42.5)	4,131 (43.8)	0.074
Race/ethnicity			0.003
Non-Hispanic white	7,164 (50.9)	4,784 (50.7)	
Non-Hispanic black	1,393 (9.9)	991 (10.5)	
Hispanic	2,449 (17.4)	1,698 (18.0)	
Other	915 (6.5)	679 (7.2)	
Missing	2,153 (15.3)	1,283 (13.6)	
Nulliparous	7,429 (52.8)	4,959 (52.6)	0.676
Gestational diabetes	1,167 (8.3)	715 (7.5)	0.042
A1GDM	941 (6.7)	545 (5.7)	0.005
A2GDM	226 (1.6)	170 (1.8)	0.838
Prior cesarean delivery	1,379 (9.8)	906 (9.6)	0.575
Induction of labor	2,734 (19.4)	1,898 (20.1)	0.146
Chronic hypertension	219 (1.6)	192 (2.0)	0.006
Asthma	952 (6.8)	641 (6.8)	0.955
Thyroid disease	749 (5.3)	590 (6.3)	0.003
Neonatal characteristics			
Gestational age at delivery (wk)	39.4 ±1.0	39.5 ±1.1	<.001
Male gender	7,068 (50.2)	4,776 (50.6)	0.588

All data presented as mean ± standard deviation or N (%)

IADPSG = The International Association of the Diabetes and Pregnancy Study Groups

Table 2

Pregnancy outcomes stratified by GDM diagnostic criteria

	IADPSG (N = 14,074)	Carpenter-Coustan (N =9,435)	P
Cesarean delivery	3,800 (27.0)	2,406 (25.5)	0.022
Primary cesarean delivery	2,668 (19.1)	1,698 (18.0)	0.041
Repeat cesarean delivery	1,112 (7.9)	708 (7.5)	0.192
Birthweight (kg)	3.41 ± 0.44	3.42 ± 0.45	0.231
Large-for-gestational-age	1,309 (9.3)	934 (9.9)	0.111
Shoulder dystocia	358 (2.5)	201 (2.1)	0.043
Hypertensive disease of pregnancy *	971 (6.9)	726 (7.7)	0.018
Postpartum hemorrhage	732 (5.2)	453 (4.8)	0.160
Admission to NICU	450 (3.2)	196 (2.0)	<0.001
Respiratory distress syndrome	69 (0.5)	37 (0.4)	0.309
Neonatal hypoglycemia	258 (1.8)	169 (1.8)	0.801
Neonatal hyperbilirubinemia	467 (3.3)	345 (3.7)	0.171
Fetal or neonatal death	9 (0.1)	12 (0.1)	0.276

All data presented as mean ± standard deviation or N (%)

IADPSG = The International Association of the Diabetes and Pregnancy Study Groups, NICU = neonatal intensive care unit

* Preeclampsia/Gestational hypertension

Table 3

Unadjusted and adjusted odds ratios with the Carpenter-Coustan as the referent group

	IADPSG (N = 14,074)	Carpenter-Coustan (N =9,435)	OR (95% CI)	aOR* (95% CI)
Cesarean delivery	3,800 (27.0)	2,406 (25.5)	1.07 (1.01–1.14)	1.09 (1.03–1.16)
Primary cesarean delivery	2,668 (19.1)	1,698 (18.0)	1.07 (1.01 – 1.15)	1.08 (1.01 – .16)
Shoulder dystocia	358 (2.5)	201 (2.1)	1.20 (1.01– 1.42)	1.19 (1.02 – 1.42)
Hypertensive disease of pregnancy **	971 (6.9)	726 (7.7)	0.89 (0.80 – 0.98)	0.90 (0.82 – 0.99)
Admission to NICU	450 (3.2)	196 (2.0)	1.60 (1.34 – 1.88)	1.62 (1.36 – 1.92)

IADPSG, The International Association of the Diabetes and Pregnancy Study Groups; NICU, neonatal intensive care unit.

* Adjusted for maternal age, race/ethnicity, chronic hypertension and thyroid disease

NICU = neonatal intensive care unit

** Preeclampsia/Gestational hypertension