OBSTETRICS

Candy twists as an alternative to the glucola beverage in gestational diabetes mellitus screening

Diana A. Racusin, MD; Kathleen Antony, MD; Lori Showalter, MSc; Susan Sharma, PhD; Morey Haymond, MD; Kjersti M. Aagaard, MD, PhD

OBJECTIVE: Screening for gestational diabetes mellitus commonly uses an oral glucose challenge test with a 50-g glucola beverage and subsequent venous puncture. However, up to 30% of pregnant women report significant side-effects, and the beverage is costly. We hypothesized that equivalent glucose loads could be achieved from a popular candy twist (Twizzlers; The Hershey Company, Hershey, PA) and tested it as cost-effective, tolerable alternative with a test of equivalency.

STUDY DESIGN: The glucose equivalent of the 50-g glucola was calculated as 10 candy twists. We initially used a triple crossover design in nonpregnant patients whereby each subject served as her own control; this ensured the safety and equivalency of this load before using it among pregnant subjects. We then recruited pregnant women with an abnormal screening at 1 hour (glucose challenge test) in a double crossover design study. Subjects consumed 10 candy twists with a 1-hour venous blood glucose assessment. All subjects subsequently completed the confirmatory 3-hour glucose tolerance test. Sensitivity, specificity, positive predictive values, negative predictive values, false-referral rates, and detection rates were calculated.

RESULTS: At ≥130 mg/dL, the sensitivity (100%) was the same for candy twists and glucola. However, the false-referral rate (82% vs 90%), positive predictive value (18% vs 10%), and detection rate (18% vs 10%) were improved for candy twists when compared with the 50-g glucola beverage.

CONCLUSION: Our results indicate that strawberry-flavored candy twists are potentially an equally effective screening test, compared with the gold standard glucola beverage but lead to fewer false-positive screens and therefore could be a cost-effective alternative.

Key words: diabetes mellitus, gestational diabetes mellitus, screening

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To meet the metabolic demands of a developing fetus, pregnancy occurs in a state of relative insulin resistance. A nondiabetic pregnant woman experiences mild fasting hypoglycemia, postprandial hyperglycemia, and mild hyperinsulinemia. In contrast, according to the American College of Obstetricians and Gynecologists, *gestational diabetes mellitus* (GDM) is defined as "carbohydrate intolerance that begins or is first recognized during pregnancy."[1] Although the prevalence of GDM varies accordingly with population risk factors and prevalence of type II diabetes mellitus in most populations, the commonly accepted point prevalence varies from 2-5% but can be as high as 14%.[2] Of note, almost 40% of all women with GDM will continue to have elevated glucose values after pregnancy.[3,4] Given the epidemic of obesity at a population-wide level, it is reasonable to anticipate ongoing increased prevalence of GDM in the coming years.[5-7]

The current commonly used sequence of screening for GDM uses a 50-g oral glucose challenge test (GCT) performed between 24 and 28 weeks' gestation. A *positive screen* is defined as a venous blood glucose level of either 130 or 140 mg/dL at 60 minutes.[1,2] The 140 mg/dL cutoff is 10% less sensitive than the 130 mg/dL cutoff but is also less likely to produce a false-positive result.[1] When 130 mg/dL is used as the screening threshold, roughly 25% of all pregnant women will 'screen positive' for GDM.[1] Once a positive screen has been established, the patient then undergoes a fasting 100-g 3-hour glucose tolerance test (GTT) with a 100-g glucose beverage. Venous blood glucose is measured fasting and then at 1-, 2-, and 3-hour intervals after the 100-g glucose drink. Two sets of criteria exist for then

From the Division of Maternal-Fetal Medicine (Dr Aagaard), Department of Obstetrics and Gynecology (Drs Racusin, Antony, and Aagaard and Ms Showalter), and Divisions of Endocrinology and Nutrition, Department of Pediatrics (Drs Sharma and Haymond), Baylor College of Medicine and Texas Children's Hospital, Houston, TX.

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Corresponding author: Kjersti M. Aagaard, MD, PhD. aagaardt@bcm.tmc.edu

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definitively diagnosing GDM: the National Diabetes Data Group Criteria and the Coustan Criteria. Although the cutoff values differ in these criteria sets, both require at least 2 of the 4 values to be elevated to diagnose the patient with GDM.[1]

Notably, up to 30% of pregnant women cannot tolerate the traditional 50-g glucola screening test.[8,9] Reported side-effects include nausea, emesis, bloating, abdominal pain, diarrhea, sweating, and headache. Given this side-effect profile, pregnant women may be unwilling or unable to complete screening for GDM with the glucola beverage.[8-10] There are limited reports (PubMed, 1990-present) that provide viable alternatives to the glucola beverage.[8-11] For example, studies that have investigated jelly beans demonstrated lower sensitivity than the glucola (80% sensitivity when the 'screen positive' cutoff is a blood glucose value of 140 mg/dL, 90% sensitivity when the 'screen positive' cutoff is a blood glucose value of 130 mg/dL). However, subjects documented that jelly beans were better tolerated by the study participants than the glucola drink.[8,9,11]

The effects of hyperglycemia/GDM are well-known in obstetric populations. Infants of mothers with diabetes mellitus are at higher risk of macrosomia, fetal malformations, shoulder dystocia, hypoglycemia, hypocalcemia, respiratory distress syndrome, and thus neonatal intensive care unit admissions. As adults, children of mothers with diabetes mellitus are at higher risk of obesity and the development of type II diabetes mellitus.[5,12-16] This is thought to be secondary to "metabolic memory" from an intrauterine diabetic milieu.[15,17] The mothers, themselves, are at higher risk for hypertension, preeclampsia, future type II diabetes mellitus, shoulder dystocia, and operative/cesarean delivery. Furthermore, maternal obesity is associated independently with adverse pregnancy outcomes and greater severity of outcomes,[15-19] and treatment of even mild GDM results in improved maternal and fetal morbidity.[4,20,21] Ergo, it is imperative that the cost-effective and well-tolerated means of screening are used.

In this study, we sought to identify an alternative, possibly better tolerated, screening method for GDM. We chose to substitute an equivocal 50-g glucose load with the use of strawberry-flavored twist candy (Twizzlers; The Hershey Company, Hershey, PA) as an alternative to the glucola beverage. To establish safety, we initially tested and confirmed equipoise in a nonpregnant cohort.[22] In this study, we hypothesized that strawberry twists would demonstrate equipoise in screening for GDM when compared with the glucola beverage in pregnant women but at a fraction of the cost.

Materials and Methods

Study cohort

After institutional review board approval (Institutional Review Board Project# H-26324, renewal approved on June 24, 2013), recruitment for the study was open to all pregnant women seen at the high-risk obstetrics clinic at Ben Taub General Hospital between July and October of 2013 who underwent either universal or risk-based screening with the 50-g 1-hour GCT and screened positive, thus requiring a confirmatory 3-hour GTT. Written informed consent was obtained, and subjects were reimbursed for their participation. Mean gestational age at the time of testing was 24.6 weeks n for glucola and 28.2 weeks for candy twists. In our institution, a positive screen is defined as 140 mg/dL. Demographics of our study cohort are presented in Table 1. We did not exclude women with a history of GDM.

Choice and amount of candy

To calculate the oral intake necessary to achieve a 50-g load, nutritionists who specialized in diabetes mellitus consulted product information regarding calories, total and saturated fat, carbohydrates, sugars (including sugar alcohols), and protein in candy twists in a per piece calculation. This yielded 50-g calculated consumption of 10 strawberry-flavored candy twists in 5 minutes. Nutritional calculations were confirmed with the University of Minnesota Nutrition Data System for Research (http://www.ncc.umn.edu/products/ndsr.html). Ten strawberry-flavored candy twists yielded 47.408 g of sugars, mostly comprised of sucrose. Other major sugars in the composition were fructose, maltose, and glucose; 91.968% of the calories were derived from carbohydrates; 4.527% of the calories were derived from fat, and 3.515% of the calories were derived from protein.[23] In the pilot study population, there was no significant difference in the mean serum glucose after consumption. Initially, a nonpregnant cohort was assembled to investigate this hypothesis. We found that candy twists provide an equivalent screening alternative to the glucola beverage in nonpregnant women.[22] In this study, we set out to test these findings in a pregnant population.

TABLE 1
Demographics of study cohort

Demographic	Subjects (n = 20), n
Age, y	
17-30	9
31-40	9
41-50	2
Body mass index, kg/m^2	
<25	3
25-29.9	3
≥30	14
Parity	
Nulliparous	3
Parous	17
Race/ethnicity	
White	1
Black	2
Asian	1
Hispanic	16

Most of our cohort was Hispanic and multiparous. The mean age of our population was 30.3, and the mean body mass index was 33.83 kg/m^2. The median interval between the glucose challenge test and the candy twists challenge was 2 weeks. The median gestational age at glucola testing was 24.6 weeks and at candy twists testing was 28.2 weeks.

Racusin. Candy twists as an alternative to glucola. Am J Obstet Gynecol 2014.

Study protocol

Subject recruitment was limited to those who had already 'screened positive' for