Jelly beans as an alternative to a fifty-gram glucose beverage for gestational diabetes screening


TRANSACTIONS OF THE NINETEENTH ANNUAL MEETING OF THE SOCIETY FOR MATERNAL-FETAL MEDICINE--CONTINUED

Jelly beans as an alternative to a fifty-gram glucose beverage for gestational diabetes screening

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Key words

Gestational diabetes

glucola

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Temple, Texas

Objective: This study tested the hypothesis that a standardized dose of jelly beans could be used as an alternative sugar source to the 50-g glucose beverage to screen for gestational diabetes mellitus.
Study Design: One hundred sixty pregnant women at 24 to 28 weeks gestation were recruited for a prospective study to compare 2 sugar sources for serum glucose response, side effects, preference, and ability to detect gestational diabetes mellitus. Patients were randomly assigned to consume 50-g glucose beverage or 28 jelly beans (50 g simple carbohydrate). Serum glucose values were determined 1 hour later. The test was later repeated with the other sugar source. Finally, a 100-g 3-hour oral glucose tolerance test was performed. Participants completed a questionnaire recording subjective outcome variables. American Diabetes Association criteria were used to interpret all test results.

Results: Among 136 participants completing the study no significant differences were found between 1-hour serum glucose values (116.5 ± 27 mg/dL with 50-g glucose beverage, 116.9 ± 23.6 mg/dL with jelly beans; \( P = .84 \), frequency of discrepant results \( P = .47 \), sensitivity, specificity, or predictive value. Jelly beans yielded fewer side effects (38% with 50-g glucose beverage, 20% with jelly beans; \( P < .001 \) and were preferred by 76% of participants \( P < .001 \). Five cases (3.7% incidence) of gestational diabetes mellitus were diagnosed, 3 with 50-g glucose beverage alone, 1 with jelly beans alone, and 1 with both sugar sources. Conclusions: Jelly beans may be used as an alternative to the 50-g glucose beverage as a sugar source for gestational diabetes mellitus screening. The 2 sources provoke similar serum glucose responses. Patients report fewer side effects after a jelly bean challenge than after a 50-g glucose beverage challenge. (Am J Obstet Gynecol 1999;181:1154-7.)

Gestational diabetes mellitus is among the most common medical complications of pregnancy, affecting 2% to 4% of pregnancies. Gestational diabetes mellitus, defined as glucose intolerance developing or recognized during pregnancy,[1] is associated with increased perinatal morbidity and mortality if untreated.[2] The primary complication of gestational diabetes mellitus is increased fetal weight leading to possible macrosomia, with subsequent dystocia and infant and maternal birth trauma.[1][3] An asymptomatic disease, gestational diabetes mellitus is recognized only through screening. The most popular screening test uses as its sugar source the 50-g glucose beverage,[4] a 50-g glucose challenge in the form of a sweet liquid, followed by determination of the serum glucose level 1 hour later. Abnormal results (\( \geq 140 \text{ mg/dL} \)) prompt the clinician to perform the diagnostic criterion standard, the 100-g 3-hour oral glucose tolerance test.

Although the 50-g glucose challenge has proved to be an effective screening tool, the 50-g glucose beverage has common side effects, including nausea, emesis, diaphoresis, headache, and dizziness. Numerous alternative sugar sources have been reported,[5][8] but the 50-g glucose beverage remains the most commonly used in the screening test. Boyd et al[9] reported using a standardized dose of jelly beans to provide the glucose load. They failed to provide an adequate amount of glucose, requiring a rescaling of The American College of Obstetricians and Gynecologists threshold value of 140 mg/dL to maintain acceptable sensitivity. After adjusting the jelly bean "dose" to provide 50 g simple sugar, as does the 50-g glucose beverage, we proceeded to study the hypothesis that jelly beans can be used as a better-tolerated alternative to the 50-g glucose beverage as a sugar source for screening of gestational diabetes mellitus.

Material and methods

**Patient population**

The patient population consisted of pregnant women recruited from the general obstetric population at our institution. Pregnant women were considered eligible for inclusion if they were \( \geq 18 \) years old, were between 24 and 28 weeks' gestation, and had no history of overt insulin-dependent diabetes mellitus outside pregnancy. The study design was approved by the Scott and White Institutional Review Board.

**Study design**

During routine prenatal visits in the clinic setting, patients were contacted by the study group for possible enrollment. Enrollees were randomly assigned to receive either jelly beans or the 50-g glucose beverage as a sugar source for the first screening test within 3 to 10 days of enrollment. Random assignment was performed by means of ordered sealed envelopes that contained assignments made with a table of computer-generated random numbers. Patients were then scheduled for a second test within 1 week with the alternate sugar source. Finally, the 3-hour oral glucose tolerance test was performed within the next 7 to 10 days. For all assays venous blood samples were delivered to the institutional laboratory for automated serum glucose level measurement by the glucose oxidase method. We interpreted all results according to the American Diabetes Association recommendations.[10] For the 50-g screening test a 1-hour posttest serum glucose level \( \geq 140 \text{ mg/dL} \) was considered abnormal.

For the 100-g glucose tolerance test, \( \geq 2 \) serum glucose values above the threshold, \( \geq 105, \geq 190, \geq 165, \) and \( \geq 145 \text{ mg/dL} \) while fasting or at 1, 2, or 3 hours after ingestion, respectively, were considered diagnostic of gestational diabetes mellitus. After every phase of testing each patient completed a questionnaire describing her impression of the test substrate and side effects. In the final evaluation each participant was asked to compare the glucola beverage and jelly beans and express a preference.

**Composition of jelly beans**
The jelly beans used in the study were Brach No. 110 Jelly Beans (EJ Brach Manufacturing, Chicago, Ill), which are packaged as a mixed assortment of 9 colors and 10 flavors. Jelly beans are made primarily from sugar, corn syrup, modified cornstarch, and dextrose. Brach performed a nutritional assessment on 4 separate packages of jelly beans to confirm consistent carbohydrate content among mixed samples. On the basis of this analysis we determined that 28 jelly beans provides 280 calories and contains 72 g total carbohydrate, with 50 g in the form of simple sugar and a total variance in sugar content anticipated to be <8%. We distributed 30 jelly beans to each patient with instructions to eat 28 within a 10-minute period.

Statistical considerations

Sample size was determined by following the example of Boyd et al. In that study statistical significance was achieved with 13 women with gestational diabetes. Attainment of a similar number of women with diabetes was predicted to require 160 test subjects in our population.

We evaluated each participant's response to the 2 sugar sources by using a paired t test and by calculating the correlation coefficient ($R^2$). In addition we used the t test to compare the mean glucose responses for the 2 glucose challenges. When we compared both screening tests with the established standard for diagnosis of gestational diabetes mellitus, the 100-g 3-hour oral glucose tolerance test, we calculated the sensitivity, specificity, and positive and negative predictive values. We compared the numbers of discordant screening test results by means of the McNemar chi-squared test. In all cases $P < .05$ was considered statistically significant.

Results

Among 160 patients enrolled, 136 completed all phases of the study. Participants had a mean age of 26 ± 5.3 years (range, 18-40 years). Twenty-five percent were nulliparous. Seventy-two percent were white and 27% were Hispanic or African American.

The serum glucose values (mean ± SD) were not different after ingestion of jelly beans (116.9 ± 23.6 mg/dL) and of 50-g glucose beverage (116.5 ± 27.0 mg/dL). For individual persons the mean difference between the 2 carbohydrate challenge tests was 0.4 ± 26.3 mg/dL ($P = .84$ for the statistical comparison with 0). The participants' serum glucose results (mean ± SD) for the 100-g 3-hour oral glucose tolerance test were also normal: fasting, 79.6 ± 10.8 mg/dL; 1 hour after sugar consumption, 132.6 ± 34.2 mg/dL; 2 hours after sugar consumption, 114.7 ± 29.2 mg/dL; and 3 hours after sugar consumption, 94.8 ± 25.8 mg/dL. Fig 1 graphically demonstrates the correlation between each participant's responses to the 2 glucose challenges.

Table I shows a nonbiased distribution of the 31 discrepant test results (those normal according to one screening test and abnormal according to the other; $P = .47$).

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**Fig. 1.** Comparison of glucose serum levels after administration of 2 sugar sources. *Line,* Linear regression of paired measurements.
<table>
<thead>
<tr>
<th>Result with jelly beans</th>
<th>Result with 50-g glucose beverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>Negative</td>
<td>Negative</td>
</tr>
</tbody>
</table>
Table II shows a significantly lower incidence of side effects after consumption of the jelly beans.

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th></th>
<th>Negative</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9</td>
<td>13</td>
<td>18</td>
<td>96</td>
</tr>
</tbody>
</table>

**Table II. Comparison of side effects and preferences**

<table>
<thead>
<tr>
<th></th>
<th>50-g glucose beverage</th>
<th>Jelly beans</th>
<th>Statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Any side effects noted (n = 136)</td>
<td>52/136</td>
<td>38</td>
<td>27/136</td>
</tr>
<tr>
<td>Specific side effects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nausea</td>
<td>41/136</td>
<td>30</td>
<td>17/136</td>
</tr>
<tr>
<td>Dizziness</td>
<td>15/136</td>
<td>11</td>
<td>4/136</td>
</tr>
<tr>
<td>Headache</td>
<td>12/136</td>
<td>9</td>
<td>5/136</td>
</tr>
<tr>
<td>Preference (n = 133)</td>
<td>32/133</td>
<td>24</td>
<td>101/133</td>
</tr>
</tbody>
</table>

Seventy-six percent of the participants preferred the jelly beans to the 50-g glucose beverage.

Five cases of gestational diabetes mellitus were identified among 136 participants, for an incidence of 3.7%. Three cases were identified by 50-g glucose beverage testing alone and 1 was identified by the jelly bean screen alone; results of both screens were positive for only 1 subject. Table III shows no statistically significant difference in screening performance for jelly beans and the 50-g glucose beverage.

**Table III. Comparison of efficacies of jelly beans and 50-g glucose beverage as sugar sources in detection of gestational diabetes in 136 subjects completing protocol**

<table>
<thead>
<tr>
<th></th>
<th>50-g glucose beverage</th>
<th>Jelly beans</th>
<th>95% Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>80%</td>
<td>Calculated value</td>
<td>28%-99%</td>
</tr>
<tr>
<td>Specificity</td>
<td>82%</td>
<td>Calculated value</td>
<td>75%-88%</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>15%</td>
<td>Calculated value</td>
<td>4%-34%</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>99%</td>
<td>Calculated value</td>
<td>95%-100%</td>
</tr>
</tbody>
</table>

Comment

The purpose of this study was to explore the possibility that a standardized dose of jelly beans can be an effective and well-tolerated alternative to the 50-g glucose beverage for the screening of women for gestational diabetes. Boyd et al. [9] previously demonstrated that jelly beans can be used to screen for gestational diabetes mellitus. The "dose" of jelly beans in that study provided <50 g simple carbohydrate, however, necessitating a shift to a threshold below the standard 140 mg/dL to maintain acceptable sensitivity. That limitation would hamper implementation of the test by requiring that an institution maintain 2 criteria for abnormal results. Our study, which used a larger jelly bean "dose," showed an excellent correlation between the 1-hour serum glucose level after consumption of 28 Brach jelly beans and that after consumption of the 50-g glucose beverage. The degree of discordance between the results for each participant's jelly bean challenge and 50-g glucose beverage challenge (0.4 mg/dL) was less than the mean difference of 17 mg/dL noted by Sachs et al.[11] for pregnant women without diabetes during the third trimester who repeated the 50-g glucose beverage challenge test on subsequent days.[11] Different rates of absorption for the 50-g glucose beverage and jelly beans also may contribute to the variation in serum glucose response, although a directional bias was not detected in this study at 1 hour. Because of their solid form and additional complex carbohydrates, however, jelly beans may create a different serum glucose response through the course of several hours. We therefore would not suggest substituting a "double dose" of jelly beans in a diagnostic 100-g glucose challenge test. In this study side effects were significantly less...
common after jelly bean consumption than after 50-g glucose beverage consumption, and participants preferred jelly beans 3 to 1 over the 50-g glucose beverage.

The ultimate test of jelly beans as a sugar source for the screening of gestational diabetes is the ability to identify patients with gestational diabetes mellitus at least as well as with the standard 50-g glucose beverage. The 3.7% incidence of gestational diabetes mellitus among the 136 study patients was lower than expected, probably because of underrepresentation of Hispanic and African American participants. We recognize that the lack of any detected significant difference between the 2 glucose challenges in sensitivity, specificity, and predictive values may reflect a type II statistical error because of the small number of women with gestational diabetes in the study. This potential error seems most likely for the sensitivity of the jelly bean challenge, for which the 40% sensitivity was not significantly different (P = .6 by pair test comparison) from the 80% sensitivity of the 50-g glucose beverage challenge test. An ideal screening test must have a high sensitivity. If confirmation of sensitivity for the jelly bean challenge in the range reported here were to be achieved with a sufficient sample of women with gestational diabetes, the low value would prevent its application for general screening.

Our results show that a standardized dose of jelly beans that provides a "dose" of simple carbohydrate similar to that delivered by the 50-g glucose beverage may provide a better-tolerated alternative sugar source in screening for gestational diabetes. Although the suboptimal screening sensitivity documented in this study limits widespread clinical applicability, the jelly bean challenge has immediate application for those patients unable or unwilling to drink the 50-g glucose beverage. A recommendation for wider use awaits the results of further research to determine whether jelly beans prove equal to the 50-g glucose beverage for the detection of gestational diabetes mellitus.

REFERENCES


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