

Can the 3rd Hour Value of 100 g Oral Glucose Tolerance Test Be Ignored in the Diagnosis of Gestational Diabetes Mellitus?

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OBJECTIVE: To investigate whether the 3rd hour value of 100 g oral glucose tolerance test (OGTT) can be ignored when diagnosing gestational diabetes.

STUDY DESIGN: During the first 8 months of 2010, 6909 patients between 24 and 28 weeks' of gestation were screened with 50 g glucose challenge test and 140 mg/dl or higher plasma glucose levels were further evaluated with 100 g OGTT to diagnose gestational diabetes mellitus (GDM). 1195 patients' test results were acquired for this retrospective study. For the 100 g OGTT fasting plasma glucose cut-off value was 105 mg/dl, 1 hour cut-off value was 190 mg/dl, 2 hour cut-off value was 165 mg/dl and 3 hour cut-off value was 145 mg/dl. Patients with 2 or more values above the cut-off level were diagnosed as GDM.

RESULTS: Out of 1195, 124 patients (10.4%) were diagnosed as having GDM. 65 patients (52.4%) had high values of first and second hours; 33 patients (26.6%) had high values of first, second and third hours; 19 patients (15.4%) had second and third hours high values; 7 patients (5.6%) had first and third hours high values of 100 gr OGTT out of those 124 patients.

CONCLUSION: 79% of the patients were diagnosed with first and second hour test results but 21% of the patients were diagnosed with blood glucose levels above the third hour cut-off level. Thus, considering the difficulties of 100 gr. OGTT, third hour values is of diagnostic value and cannot be ignored.

Key Words: Gestational diabetes mellitus, Screening, Diagnosis, 100 g oral glucose tolerance test

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Introduction

Diabetes mellitus is a chronic metabolic disease that results in increased plasma glucose concentrations either due to insulin insufficiency or insulin resistance. The pathophysiology of this disease is yet heterogeneous although the main result is glucose intolerance. Diabetes is classified as type 1 diabetes mellitus and type 2 diabetes mellitus. All forms of diabetes can be seen in pregnancy and if it is not treated both mother and fetus may face fatal consequences. For this reason,

it is evident that treatment of diabetes mellitus in pregnancy is essential. 100 g oral glucose tolerance test (OGTT) is a troublesome method that may cause increased stress levels, nausea and vomiting in pregnant women. Our aim is to study if the 3rd hour plasma glucose levels are essential in diagnosis, considering a 2- hour test would be less time consuming, more practical, simpler, and cheaper. Moreover, it would cause less maternal stress.

Material and Method

All pregnant women undergo 50 g glucose challenge test between 24 and 28 weeks' of gestation routinely in our clinics. If the plasma glucose level results are 140 mg/dl or higher, 100 g oral glucose tolerance test is conducted.

During the first 8 months of 2010, 6909 patients between 24 and 28 weeks' of gestation were screened with 50 g glucose challenge test and 140 mg/dl or higher plasma glucose levels were further evaluated with 100 g OGTT. Out of 1611 patients to whom 100 g OGTT was applied 1195 patients' test results were acquired for this retrospective study. Fasting plasma glu-

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∞:Condensation: Our study showed that OGTT third hour values are of diagnostic value and cannot be ignored.

cose cut-off values was 105 mg/dl; 1st hour, 2nd hour and 3rd hour plasma glucose cut-off values were 190 mg/dl, 165 mg/dl and 145 mg/dl, respectively. Patients with one test result above the cut-off value were identified to have impaired glucose tolerance and patients with 2 or more test results above the cut-off values were identified to have gestational diabetes mellitus. It was further analyzed with which hour values of OGTT; patients were diagnosed as having GDM. We used these criteria, because our hospital is still using these criteria.

Blood glucose levels were measured in Fusion optic reader (Johnson & Johnson®) by using glucose oxidase method. This method is linear up to the glucose level of 400 mg/dL.

Our study is in accordance with the declaration of Helsinki. Since our study is a retrospective one, there is no need for institutional review board approval.

Results

6909 patients who underwent 50 g screening glucose challenge test, and 1611 of these patients (23.3%) had 140 mg/dl or higher test results. Those patients who underwent 100 g OGTT and of whom test results were obtained were 1195 pregnant women.

The mean age of 1195 patients were 27.07 ± 5.32 years (minimum 16, maximum 40). Sixty-five patients (5.4%) were under 20 years of age; 122 patients (10.2%) were 35 years old or older; and the remainder 1008 patients (84.4%) were between 20 and 34 years of age.

131 patients (11%) had impaired glucose tolerance. Impaired plasma glucose implies only one test result to be above the cut-off value. As a consequence, 70 patients (5.9%) had 1st hour results above the cut-off value of 190 mg/dl, 39 patients (3.3%) had 2nd hour results above the cut-off value of

165 mg/dl and 22 patients (1.8%) had 3rd hour results above the cut-off value of 145 mg/dl.

124 of these (10.4%) 1195 patients were diagnosed as GDM. 65 of these (52.4%) had high values of first and second hours; 33 of these (26.6%) had high values of first, second and third hours; 19 patients (15.4%) had second and third hours high values; 7 patients (5.6%) had first and third hours high values of 100 g OGTT. As a result, 79% of the patients were diagnosed with first and second hour test results but 21% of the patients were diagnosed with blood glucose levels above the third hour cut-off level (Table 1).

Discussion

Gestational diabetes mellitus is characterized with increased plasma glucose concentration, diagnosed during gestation and it can cause severe fetal complications. Powers' implies diabetes mellitus is categorized according to its pathogenic processes.¹ Type-1 DM is characterized with insulin deficiency and type-2 DM is caused by abnormal insulin secretion or insulin resistance.

Diabetes mellitus prevalence in all pregnancies is 2-3% and 90% of these are gestational diabetes mellitus.² Our study shows out of 6909 pregnant females 124 patients (1.8%) were diagnosed with GDM. Because the prevalence of diabetes mellitus increases gradually in the world, high risk population groups must be identified, preventing the disease and delaying the pathological process must be one of the main concerns.^{3,4}

Patients diagnosed with GDM show 17-63% risk of having type-2 DM in 5-16 years.⁵ In addition, obesity and glucose intolerance rate increases in children given birth by these patients.⁶⁻⁸ O'Sullivan's study shows 50% of patients with GDM develop diabetes mellitus in a 22-28 year-follow-up.⁹

Table 1: Number of patients above the cut-off levels categorized according to plasma glucose measurement hour of 100 g oral glucose tolerance test

100 g OGTT result	Measurement hour(s) resulting above the cut-off value(s)	Number	Percentage
Impaired Glucose Tolerance (n=131)	Only 1 st hour	70	5.9%
	Only 2 nd hour	39	3.3%
	Only 3 rd hour	22	1.8%
Gestational Diabetes Mellitus (n=124)	1 st and 2 nd hours	65	5.4%
	1 st and 3 rd hours	7	0.6%
	2 nd and 3 rd hours	19	1.6%
	1 st , 2 nd and 3 rd hours	33	2.8%
Negative test results	-	940	78.7%
TOTAL		1195	100.0%

In diabetic pregnant women maternal nephropathy, retinopathy, coronary artery disease, infection, caesarean section, miscarriage, fetal congenital malformation, RDS of the newborn, macrosomy, newborn hypoglycemia, hyperbilirubinemia, polycythemia and mortality rates increase. For this reason diagnosis and treatment of GDM is crucial. There are no established diagnostic criteria for GDM and this makes it a much more important disease to study on.

GDM is diagnosed during gestation and it is specific for gestation. Most GDM cases show normal fasting plasma glucose levels. Thus, screening tests are performed to all pregnant females. Although only patients with risk factors for GDM underwent screening test previously, studies showed that patients without risk factors may also suffer from the disease. In a study in which 6200 pregnant women 30 years or older were screened and although they had risk factors for GDM Coustan et al. showed 35% of these patients were not diagnosed.⁶ Elder age, high BMI and glycemic media are risk factor in GDM¹¹ and patients who have these risk factors develop GDM in earlier stages like 2nd trimester.¹² Patients without these risk factors generally develop GDM in 3rd trimester and these patients do not have insulin resistance unlike patients with risk factors.¹² Insulin sensitivity decreases progressively towards the end of pregnancy and this is a physiologic response in many patients. But in some patients this ends in glucose intolerance and may progress to GDM.¹³

Diagnostic criteria of GDM have evolved during years and many definitions were made up till now.¹⁴ First diagnostic criteria were suggested by O'Sullivan and Mahan in 1964 that three-hour-OGTT measurement would be made by Somogyi-Nelson method.¹⁵ Threshold for the diagnosis of GDM was blood glucose levels of 90 mg/dl, 165 mg/dl, 145 mg/dl and 125 mg/dl (fasting, 1st, 2nd and 3rd hours respectively). In 1979, The National Diabetes Data Group (NDDG) suggested measuring plasma glucose levels with thresholds of 105 mg/dl, 190 mg/dl, 165 mg/dl and 145 mg/dl.¹⁶ In 1982 Carpenter and Coustan suggested the threshold values to be 95 mg/dl, 180 mg/dl, 155 mg/dl and 140 mg/dl.¹⁶ Two or more values above cut-off values are required to diagnose GDM according to both NDDG and Carpenter and Coustan. In 1982 Sacks et al studied 995 pregnant females' blood and plasma glucose concentrations and determined more extensive thresholds (96 mg/dl, 172 mg/dl, 152 mg/dl, 131 mg/dl).¹⁷ In our hospital, we are using NDDG criteria, therefore we evaluated the results of our study according to these criteria.

Patients with obesity, previous GDM history or LGA infant bearing history, glycosuria, PCOS, family history of type-2 DM must be screened for GDM according to The American Diabetes Association (ADA) at the beginning of gestation.¹⁸ If

these risk factors are not present but the patient is older than 25 years old, overweight, African-American or has previous bad history of obstetrics, family history of DM or previous history of glucose intolerance, she should be screened between 24 and 28 weeks' of gestation. The American College of Obstetrics and Gynecology (ACOG) has similar suggestions.¹⁹ But World Health Organization (WHO) recommends all pregnant to be screened for GDM between 24 and 28 weeks' of gestation.²⁰

In 2010, The International Association of Diabetes and Pregnancy Groups (IADPSG) proposed new criteria for the diagnosis of GDM on the basis of Hyperglycemia and Adverse Pregnancy Outcomes (HAPO) study. According to this, only one result at or above the cut-off value is enough for diagnosis of GDM with 75 g OGTT. (Fasting plasma glucose level 92 mg/dl, 1st hour value 180 mg/dl, 2nd hour value 153 mg/dl).²³

American Diabetes Association (ADA) accepts two different approaches in GDM screening. In the first one, after 50 g glucose challenge test if the 1st hour plasma glucose level is above 130 mg/dl or 140 mg/dl, 100 g OGTT is done. In the second one, 100 g OGTT is directly done and if two or more results are above the threshold values the patient is diagnosed as GDM.

50 g glucose challenge test for screening can be done either when fasting or not. It is noted that if the test is done when fasting, the sensitivity would increase.^{24,25} Coustan et al showed 10% of gestational diabetic women to have 130 mg/dl-139 mg/dl screening test results.¹¹ In addition this study revealed increased sensitivity in screening GDM, but also the expenses would increase in conjunction.

GDM is an important disease known now for many years yet researches failed to determine sufficient diagnostic criteria. Many researchers studied the threshold values of fasting, 1st, 2nd and 3rd hours of 100 g OGTT and diversified them. There are no studies discussing how to perform 100 g OGTT in shorter time and causing less maternal stress by eliminating 3rd hour threshold. Our study indicates 3rd hour values of 100 g OGTT is crucial when diagnosing GDM.

Conclusion

In this study, we would like to further evaluate the patients, when 3rd hour values of OGTT was not in diagnostic criteria, whether GDM diagnosis could be made. Our study showed that OGTT third hour values are of diagnostic value and cannot be ignored. GDM is a disease which can cause both maternal and fetal severe complications and no solid agreement for screening or diagnostic criteria up-to-date endorses upcoming studies on the subject.

Gestasyonel Diabetes Mellitus Tanısında 100 gr OGTT Testinin 3. Saati İhmal Edilebilir mi?

AMAÇ: Gebelikte diabetes mellitus tanısı için yapılan 100 g. OGTT 3. saatinin tanı koymada ihmal edilebilir olup olmadığını araştırdık.

GEREÇ VE YÖNTEM: Hastanemizde 50 g. glukoz tarama testi 24-28. gestasyonel haftalardaki tüm gebelere uygulanmaktadır. 2010 yılının ilk 8 ayı içinde, gebeliklerinin 24-28. haftalarında başvuran 6909 hastanın 50 g'lık tarama testi sonucunda, kan şekeri değeri 140 mg/dl ve üzeri olan hastalara, gestasyonel diabetes mellitus (GDM) açısından riskli görülerek, 100 g'lık OGTT yapıldı. 100 g'lık tanısız test uygulanan 1611 hastadan, sonuçlarına ulaşabildiğimiz 1195 hastanın sonuçları retrospektif olarak değerlendirildi. Hastanemizde, açlık 105 mg/dl, 1. saat 190 mg/dl, 2. saat 165 mg/dl, 3. saat 145 mg/dl eşik değerleri alınarak yapılan 100g'lık tanısız OGTT'de, tek değer eşik değeri üzerinde çıkarsa glukoz tolerans bozukluğu, 2 veya daha fazla değer eşik değeri üzerinde çıkarsa GDM tanısını koyduk. GDM tanısı alan ve test sonucunda glukoz tolerans testi bozuk olarak değerlendirilen hastaların, bu tanıları hangi saatte alınan değerlere göre aldıkları değerlendirildi.

BULGULAR: Hastanemizde 50 g. glukoz tarama testi yapılan 6909 hastadan 1611'inin (%23.3) değeri 140 mg/dl üzerinde bulundu. Bu hastalardan sonuçlarına ulaşılabilen ve 100 g. OGTT yapılan 1195 hastanın 124'üne (%10,4) GDM tanısı kondu, ayrıca 131 hastanın (%11) da glukoz toleransı bozuktu. GDM tanısı alan 124 hastanın 65'inin tanısı (%52,4) birinci ve ikinci saat değerlerinin yüksekliği; 33'ünün tanısı (%26,6) birinci, ikinci ve üçüncü saat değerlerinin yüksekliği; 19'unun tanısı (%15,4) ikinci ve üçüncü saat değerlerinin yüksekliği; 7'sinin tanısı (%5,6) birinci ve üçüncü saat değerlerinin yüksekliği ile konmuştu. Böylece hastaların %79'una ilk iki saatteki değerlerin yüksekliği ile tanı konulurken, %21'inin tanısı üçüncü saat değerinin yüksekliği sonucunda tanı konulmuştur.

SONUÇ: Hastaların %21'ine 3. saatteki kan şekeri eşik değeri ile tanı konulması bize, 3. saat değerinin GDM tanısı konulmasında ihmal edilemeyecek bir ölçüm olduğunu gösterdi. Bu nedenle hasta açısından zorluklarına rağmen, üç saat süren 100 g'lık OGTT, GDM tanısında halen geçerliliğini korumaktadır.

Anahtar Kelimeler: Gestasyonel diabetes mellitus, Tarama, Diagnosis, 100 g oral glukoz tolerans testi

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