



First Hour Plasma Glucose in 75 gr Oral Glucose Tolerance Test And Risk of Developing Diabetes Mellitus

Fettah Acıbcu^{1,a*}, Suat Şen^{2,b}, İbrahim Erdem^{2,c}, Ceren Susan^{2,d}, Şekure Demet Küçük^{1,e}

¹ Department of Internal Medicine, Endocrinology Division, University of Health Sciences - Adana Health Practice and Research Center, Adana, Turkey.

² Department of Internal Medicine, University of Health Sciences - Adana Health Practice and Research Center, Adana, Turkey.

*Corresponding author

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ABSTRACT

Introduction: Early detection of dysglycemia is critical for avoiding the development of type 2 diabetes mellitus (T2D). The risk of developing type 2 diabetes is assessed using fasting plasma glucose (FPG) and 2-hour plasma glucose (PG) after a 75 gr oral glucose tolerance test (OGTT). Intermediate steps taken during an OGTT may reveal additional details about a person's diabetes risk in the future. The aim of our study was to assess the risk of developing diabetes in patients with high one hour plasma glucose level in a 75 gr OGTT.

Method: Patients who received 75 g OGTT were included in the study. During the 75gr OGTT, patients with FPG below 100 mg/dl and 2-hour PG below 140 mg/dl but first hour PG above 200 mg/dl were included in this study. We evaluated whether the patients diagnosed with T2D by hospital data, e-nabız (an online public healthcare data system) and via direct contact with patients. American Diabetes Association (ADA) criteria was used for T2D diagnose.

Results: We have included 73 patients which were 31 male and 42 female in our study. The youngest patient was 23 and the oldest one was 74. The median age was 51. We have found that the mean FPG in OGTT was 92.55±5.12mg/dl, 1-hour PG was 215.42±17.94mg/dl and 2- hour PG was 112.01±22.92mg/dl. Patients were followed minimum of 20 months and maximum of 65 months. The median was 37 months. During the follow up 30 patients (%41.1) have developed T2D in 28.17±14.25 months. There were no direct correlation between age and sex with developing T2D. We found no correlation between 1-hour PG levels and T2D developing time in patients who developed T2D (r:0.118, p=0.536). There were no evidence of correlation between T2D developing time and age (p:0.980 r:0.005). There was no difference between patients with and without T2D in terms of age, FPG, 1-hour PG, 2-hour PG and follow-up time.

Conclusion: Despite the limitations of our study, we think that checking the PG level in the first hour during OGTT will be useful in early detection of individuals at risk for diabetes and preventing diabetes.

Keywords: 75gr OGTT, 1-hour plasma glucose, type 2 diabetes mellitus

75-g Oral Glukoz Tolerans Testinde 1.Saat Plazma Glukozu ve Diyabet Gelişim Riski

Süreç

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Öz

Giriş: Disgliseminin erken tespiti, tip 2 diyabetes mellitus (T2D) gelişimini önlemek için kritik öneme sahiptir. Tip 2 diyabet gelişme riski, açlık plazma glukozu (APG) ve 75 gr'lık oral glukoz tolerans testi (OGTT) sonrasında 2 saatlik plazma glukozu (PG) kullanılarak değerlendirilir. OGTT sırasında yapılan ara ölçümler, bir kişinin gelecekte diyabet riski hakkında ek bilgiler ortaya çıkarabilir. Biz çalışmamızda 75 gr OGTT'de 1.saat plazma glukozu yüksek olan hastalarda diyabet gelişme riskini belirlemeyi amaçladık.

Yöntem: Çalışmamıza 75gr OGTT yapılan ve APG 100mg/dl ve 2.saat PG 140mg/dl nin altında olan 1.saat PG değeri 200mg/dl'nin üzerinde olan hastalar dahil edildi. Hastaların hastane verileri, e-nabız verileri ve telefonla ulaşılarak tip 2 DM tanısı konup konmadığı değerlendirildi. Tip 2D tanısında Amerikan Diyabet Derneği (ADA) kriterleri kullanıldı.

Bulgular: Çalışmamıza 31 erkek, 42 kadın toplam 73 hasta dahil edildi. Çalışmamıza katılan hastaların median yaş 51, minimum 23, maksimum 74 idi. OGTT'de ortalama APG 92.55±5.12mg/dl, 1.saat PG 215.42±17.94mg/dl (min:200mg/dl, max: 311mg/dl, median:210mg/dl), 2.saat PG 112.01±22.92mg/dl olarak tespit edildi. Hastaların takip süresi median 37 ay, minimum 20 ay ve maksimum 65 aydı (39.73±13.73 ay). Takip süresi boyunca hastaların 30'unda (%41.1) T2D geliştiği tespit edildi. T2D gelişim süresi 28.17±14.25 ay (min:7 ay, max: 56 ay, median:26 ay) olarak tespit edildi. Yaşla ve Cinsiyetle diyabet gelişimi arasında bir ilişki tespit edilemedi. T2D gelişmiş hastalarda 1.saat PG ile diyabet gelişim süresi arasında anlamlı bir korelasyon bulunamadı (r:0.118, p=0.536), yaş ile diyabet gelişim süresi arasında anlamlı bir korelasyon bulunamadı (p:0.980 r:0.005). T2D gelişen ve gelişmeyen hastalar arasında yaş, APG, 1.saat PG, 2.saat PG ve takip süresi açısından farklılık bulunmadı.

Sonuç: Bizim çalışmamızın kısıtlılıkları olmasına rağmen OGTT esnasında 1.saat PG düzeyine bakmanın diyabet açısından riskli bireylerin erken tespitinde ve diyabete gidişi önlemede faydalı olacağını düşünmekteyiz.

Anahtar sözcükler: 75gr OGTT, 1.saat plazma glukozu, tip 2 diyabetes mellitus

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^a facibucu@hotmail.com

^c erdem_610@hotmail.com

^e demetarslan86@hotmail.com

^{ib} <https://orcid.org/0000-0002-2252-2112>

^{ib} <https://orcid.org/0000-0003-4062-7900>

^{ib} <https://orcid.org/0000-0003-3175-1256>

^b drsutsen@gmail.com

^d m.cerensusan@gmail.com

^{id} <https://orcid.org/0000-0003-1303-662X>

^{id} <https://orcid.org/0000-0002-3745-6592>

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Introduction

Diabetes mellitus (DM) describes a group of metabolic disorders characterized by high blood sugar levels ¹. The prevalence of type 2 diabetes (T2D) is rapidly increasing in association with obesity, diet and physical inactivity. The prevalence of diabetes in adults aged 18-99 is estimated to increase from 8.4% in 2017 to 9.9% in 2045 ². Diabetes is diagnosed by fasting plasma glucose (FPG) of ≥ 126 mg/dl (7mmol/l) and/or 75 gr oral glucose tolerance test (OGTT) 2-hour plasma glucose (PG) ≥ 200 mg/dl (11.1mmol/l) and/or HbA1C $\geq 6.5\%$ (48 mmol/mol) or the classic symptoms of hyperglycemia with plasma glucose ≥ 200 mg/dL (11.1 mmol/L). Fasting plasma glucose level between 100-125 mg/dL and/or after 75 gr OGTT test, the 2-hour plasma glucose level being 140-199 mg/dL is considered as "impaired glucose tolerance (IGT)" and/or HbA1c values of 5.7-6.4% are defined as prediabetes ³.

Diabetes patients are more likely to experience a variety of severe life-threatening health conditions, resulting in higher medical costs, a lower quality of life, and a higher mortality rate ¹. In people with impaired fasting glucose (IFG) or IGT, several epidemiologic studies have published estimates of the absolute and relative risks of diabetes progression ⁴. Easy lifestyle changes have been shown in randomized trials to effectively prevent type 2 diabetes in people with impaired fasting glucose and/or impaired glucose tolerance, and preventive programs in high-risk communities have been suggested as an alternative approach to combat T2D ⁵. It is important to identify prediabetic and high-risk individuals for diabetes in order to reduce the progression to T2D and the morbidity and mortality associated with diabetes. The risk of developing T2D is assessed using fasting plasma glucose and 2-hour plasma glucose after a 75 gr OGTT ⁶. Intermediate steps taken during an OGTT may reveal additional details about a person's diabetes risk in the future ⁷. In current guidelines, 1-hour plasma glucose measurement during OGTT is not recommended. In this study, we investigated the risk of developing diabetes in patients who had normal fasting plasma glucose and 2-hour plasma glucose during OGTT and were considered as a normoglycemic but had high 1-hour plasma glucose values.

Materials and Methods

In our study, we included the patients who applied to the clinics of Health Sciences University Adana City Training and Research Hospital, Endocrinology and Metabolic Diseases and Internal Diseases between 01.01.2015-31.12.2019 and had a 75 gr oral glucose tolerance test with a fasting

plasma glucose of less than 100 mg/dl, a second-hour plasma glucose of less than 140 mg/dl, and a first-hour plasma glucose level of more than 200 mg/dl. Patients previously diagnosed with T2D and tested for gestational diabetes mellitus (GDM) were excluded. We evaluated whether the patients diagnosed with T2D by hospital data, e-nabız (an online public healthcare data system) and via direct contact with patients. ADA criteria was used for T2D diagnose which are by fasting plasma glucose of ≥ 126 mg/dl (7mmol/l) and/or 75 gr OGTT 2-hour plasma glucose ≥ 200 mg/dl (11.1mmol/l) and/or HbA1C $\geq 6.5\%$ (48 mmol/mol) or the symptoms of hyperglycemia with plasma glucose ≥ 200 mg/dL (11.1 mmol/L) ³. In patients with developing T2D, the time to diagnosis and the total follow-up periods were determined. These periods were stated in months. This study was approved by the Local Ethics Committee.

Statistical analysis was performed using the Statistical Package for Social Sciences version 24 (IBM, Armonk, NY) software to evaluate the data. Descriptive statistics were expressed as mean, standard deviation, minimum-maximum values, frequency, and percentile. Kolmogorow- smirnow test was used to determine the normal distribution of the data set. Mann- whitney U test was used to evaluate the relation between development of diabetes mellitus and first hour blood glucose levels. Pearson correlation analysis was used to evaluate the correlation between numerical values. P value of less than 0.05 was considered statistically significant with a 95% confidence level.

Results

We have included 73 patients which were 31 male and 42 female in our study. The youngest patient was 23 and the oldest one was 74. The median age was 51. We have found that the mean FPG in OGTT was 92.55 ± 5.12 mg/dl, 1-hour PG was 215.42 ± 17.94 mg/dl and 2-hour PG was 112.01 ± 22.92 mg/dl. Patients were followed minimum of 20 months and maximum of 65 months. The median was 37 months (39.73 ± 13.73). During the follow up 30 patients (41.1%) have developed T2D in 28.17 ± 14.25 months (min: 7 months, max: 56 months and median of 26 months). There were no direct correlation between age and sex with developing T2D (p:0.056, p:0.722, respectively). We found no correlation between 1-hour PG levels and T2D developing time in patients who developed T2D (r:0.118, p=0.536). There were no evidence of correlation between T2D developing time and age (p:0.980 r:0.005). There was no difference between patients with and without T2D in terms of age, FPG, 1-hour PG, 2-hour PG and follow-up time (Table 1).

Table 1. Differences between the patients with and without T2D

	DM+	DM-	P
Patients number(n)	30	43	
Age (year)	53.17±9.59	48.05±11.99	0.063
FPG (mg/dl)	92.83±5.27	92.35±5.06	0.585
1st hour PG (mg/dl)	219.37±24.31	212.67±11.16	0.533
2nd hour PG (mg/dl)	112.17±25.48	111.91±21.27	0.541
Follow-up time(month)	41.37±14.90	38.58±12.90	0.590

DM: Diabetes Mellitus, FPG: Fasting Plasma Glucose, PG: Plasma Glucose

Discussion

While T2D may be preventable, early detection is critical⁸. Traditionally, the FPG and 2-hour PG after a 75 gr OGTT have been used to distinguish people at risk for T2D⁶. Normal glucose tolerance (NGT) refers to people who have normal fasting plasma glucose and normal plasma glucose levels at 2 hours and are thought to have a low risk of developing diabetes in the future⁹. Postload 1-hour PG is a better indicator of dysglycemia than FPG, 2-hour PG, or glycated hemoglobin (HbA1c), according to reports, and 1-hour PG is predictive of not only type 2 diabetes but also cardiovascular disease and mortality^{7,10-14}. Another risk factor for T2D has been indicated to be a 1-hour plasma glucose cut point of 155 mg/dL during an OGTT¹⁵.

In our study, we aimed to determine the rate of development of T2D in patients with normal FPG and 2-hour PG values during OGTT, but with a 1-hour PG value above 200 mg/dl. Included patients mean 1-hour PG in OGTT was 215.42 ± 17.94 mg/dl. Our patients were followed up for a median of 37 months, a minimum of 20 months and a maximum of 65 months. 30 (41.1%) of the patients developed T2D during the follow-up period. T2D development time was determined as 28.17 ± 14.25 months.

Studies have been shown that 16.7% of NGT patients with a 1-hour PG of ≥155 mg/dL develop T2D over a period of 7-8 years^{15,16}. The fact that more people developed diabetes in a shorter period of time in our study may be because we included patients with higher 1-hour PG values, but in our study, no significant correlation was found between 1-hour PG and diabetes development time in patients with DM. There was no difference between patients who developed and not developed T2D in terms of 1-hour PG and follow-up time. Other risk factors may be a factor in the development of T2D. In our study, we could not find a relationship between age and gender and diabetes development, and we could not find a significant correlation between age and the duration of

diabetes development. Assessment could not be made because risk factors such as body mass index and family history of diabetes were not known. This situation constituted the missing part of our study.

A Japanese occupational cohort study found that higher 1-hour PG levels raised the risk of type 2 diabetes, and that 1-hour PG had greater predictive potential for future diabetes than FPG and 2-hour PG¹⁷. According to Alyass et al., 1-hour PG outperformed HbA1c in predicting potential T2D progression (11). According to Gopal et al, a combination of HbA1c and 1-hour PG was substantially better than HbA1c alone, but not 1-hour PG⁶.

In our study, we could not evaluate HbA1c because it was not measured during the OGTT, but we found that diabetes developed in 41.1% of the patients with high plasma glucose in the first hour during the median follow-up of 26 months. This situation indicates that the 1-hour plasma glucose level is an important risk factor for the progression to diabetes.

Since 1-hour plasma glucose values are a better predictor of dysglycemia than HbA1c and are cheaper, measuring 1-hour plasma glucose during OGTT may be more advantageous in determining patients with dysglycemia with normal fasting and 2-hour plasma glucose values. In a study performed by Joshi and Karne, the importance of not only FPG and 2-hour PG values, but also the intermediate 1-hour PG value, which has the potential to prevent diabetes, was mentioned during OGTT¹⁸. Despite the limitations of our study, we think that checking the 1-hour plasma glucose level during OGTT will be useful in the early detection of individuals at risk for diabetes and in preventing diabetes.

Disclosure Statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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