

Impact of new diagnostic criteria on the frequency of diabetes mellitus and prediabetic conditions

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Abstract

The American Diabetes Association (ADA) approved new diagnostic criteria for diabetes mellitus in 1997. Altering the diagnostic criteria may result in variable effects on the prevalence of diabetes. In this study, we aimed to evaluate the difference between World Health Organisation (WHO) and ADA criteria in practice and the impact of new criteria on the frequency of diabetes mellitus and prediabetic conditions in patients who need to have their glucose metabolism evaluated.

Two hundred and fifty patients (182 females and 68 males, age 53.1 ± 11.6 years) who were not known to be diabetic were studied. Subjects with a fasting plasma glucose level of 110 mg/dl and above, or with a fasting plasma glucose of 100-109 mg/dl and a risk factor were included in the study. An oral glucose tolerance test with 75 g glucose was performed on all patients. The diagnoses of diabetes, impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) as defined by two different sets of criteria were compared.

When patients were evaluated according to WHO criteria, 115 patients (46.0 %) had normal glucose tolerance, 76 (30.4 %) had IGT and 59 (23.6 %) were diabetic. When patients were evaluated according to ADA criteria, only 19 patients (7.6 %) had normal glucose tolerance, 52 (20.8 %) had IGT, 113 (45.2 %) had diabetes mellitus (DM) and 66 (26.4 %) patients had IFG. There is an important difference in the diagnosis of patients ($\kappa=0.45$). The most striking difference is in the group that has fasting plasma glucose between 110-125 mg/dl, especially because of the definition of IFG in the new criteria.

In conclusion, use of the ADA criteria caused an evident change in the frequency of diabetes mellitus and prediabetic conditions in the study population. These results suggest that the new criteria are more sensitive and useful in diagnosing diabetes and especially prediabetic conditions, and also can be applied more easily. This study only considers patients who needed the evaluation of glucose metabolism. Further studies are needed to evaluate the change in frequency in similar populations.

Keywords : *Diagnostic criteria, Diabetes Mellitus*

Introduction

Commonly accepted diagnostic criteria for diabetes mellitus were developed

by the National Diabetes Group in 1979¹ and the World Health Organisation (WHO) in 1980² and updated in 1985.³ During its annual meeting in 1997, the American Diabetes Association (ADA) approved new diagnostic criteria for diabetes

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mellitus on the basis of recommendations from an Expert Committee on the Diagnosis and Classification of Diabetes Mellitus.^{4,5} New diagnostic criteria for diabetes mellitus are: symptoms of diabetes mellitus plus a random plasma glucose concentration of at least 200 mg/dl (11.1 mmol/l); a fasting plasma glucose level of 126 mg/dl (7.0 mmol/l) or higher; or a two-hour plasma glucose level of 200 mg/dl or more during an oral glucose tolerance test.⁶ Analysis of glucose distributions in populations with a high prevalence of diabetes demonstrates bimodality with a separation point of 200 mg/dl for the 2-hour time point during an oral glucose tolerance test (OGTT). The prevalence of microvascular disease (retinopathy and proteinuria) increases sharply when the 2-hour postprandial plasma glucose concentration during the OGTT exceeds 200 mg/dl and a fasting plasma glucose concentration of 125 mg/dl is equivalent to a 2-hour postprandial glucose concentration of 200 mg/dl in predicting future microvascular complications and discriminating bimodality. Also, recently completed epidemiological studies have demonstrated that the ability of the 2-hour postprandial and fasting plasma glucose concentrations to predict microvascular complications and to discriminate bimodal glucose distributions are equally predictive.⁷ WHO has also recommended the lower fasting glucose cut-off point for the diagnosis of diabetes in a report released in 1999.

The fundamental changes from the 1985 WHO criteria are: a fall in the diagnostic fasting plasma glucose from 140 to 126 mg/dl (7.8 to 7.0 mmol/l); a recommendation that use of the oral glucose tolerance test be abolished (thus shifting diagnosis exclusively to

the use of fasting glucose); and the identification of impaired fasting glucose (IFG), a fasting plasma glucose of 110-125 mg/dl (6.1-6.9 mmol/l).⁸ Changing the diagnostic criteria is likely to have variable effects on the prevalence of diabetes in different populations.⁹ In this study, we aimed to evaluate the difference between WHO and ADA criteria in practice and the impact of new criteria on the frequency of diabetes mellitus and prediabetic conditions in patients needing evaluation of glucose metabolism with oral glucose tolerance test.

Materials and Methods

Two hundred and fifty patients (182 females and 68 males, age 53.1 ± 11.6 years) who were not known to be diabetic were studied. They were admitted to the hospital for different reasons other than diabetes mellitus. Patients with fasting plasma glucose levels between 100 and 139 mg/dl were included and patients with fasting plasma glucose of < 100 mg/dl were excluded from the study. Oral glucose tolerance test with 75 g glucose was performed in all subjects with fasting plasma glucose of 110 mg/dl and above, and in subjects with fasting plasma glucose of 100-109 mg/dl and having risk factors (women who have delivered infants above 4 kg, obese and family history of diabetes). Patients with fasting plasma glucose of 140 mg/dl and above were not included in the study because they were diabetic by both WHO and ADA criteria.

Oral glucose tolerance test results were classified as normal, impaired glucose tolerance and diabetic according to WHO criteria. Results were again classified according to the 1997 diagnostic criteria of ADA. For this purpose, patients with a fasting plasma

Table 1: Classification of patients according to World Health Organisation (WHO) and American Diabetes Association (ADA) diagnostic criteria.

(N: Normal, IGT: Impaired Glucose Tolerance, DM: Diabetes Mellitus, IFG: Impaired Fasting Glucose)

Fasting Plasma Glucose	NUMBER OF PATIENTS								Total
	WHO			ADA					
	N	IGT	DM	N	IGT	DM	IFG		
100-109 mg/dl	21	9	1	19	11	1	0	31	
110-125 mg/dl	77	30	14	0	41	14	66	121	
126-139 mg/dl	17	37	44	0	-	98	-	98	
Total	115	76	59	19	52	113	66	250	

glucose level of 126 mg/dl and above were defined as diabetic, and other patients were evaluated with 2-hour results of oral glucose tolerance tests. The diagnoses of diabetes, IGT and IFG made with two different sets of criteria were then compared and the differences were investigated.

Patients were divided into three groups: fasting plasma glucose level of 100-109 mg/dl, 110-125 mg/dl and 126-140 mg/dl. Diagnosis of patients were compared one by one in three groups according to two diagnostic criteria. If the patient was diagnosed as diabetic, this patient was not included into impaired glucose tolerance or impaired fasting glucose groups.

Using SPSS program, Kappa (κ) analysis was performed to evaluate the relevance of two diagnostic criteria.

Results

When patients were classified according to WHO criteria, 115 patients (46.0 %) had normal glucose tolerance, 76 (30.4 %) had impaired glucose tolerance and 59 (23.6 %) were diabetic. When patients were classified according to ADA criteria, only 19 patients (7.6 %) had normal glucose tolerance, 52 (20.8 %) had IGT, 113 (45.2 %) had DM and 66 (26.4 %) patients had IFG. There is a significant difference in the diagnosis of patients between two diagnostic criteria ($\kappa=0.45$).

Patients were classified again in different groups according to their FPG results. In group 1 that had FPG between 100-109 mg/dl, 21 patients were found normal, 9 had impaired glucose tolerance and only 1 patient was diabetic according to WHO criteria. And according to ADA criteria, 19 were evaluated as normal,

11 as impaired glucose tolerance, and only 1 as diabetic. The differences are not significant in this group. In group 2 that had FPG between 110-125 mg/dl, 77 patients had normal glucose tolerance, 30 had impaired glucose tolerance and 14 had diabetes mellitus according to WHO criteria. When this group was classified according to ADA criteria, 41 patients had impaired glucose tolerance, 14 had diabetes mellitus and 66 patients had impaired fasting glucose. The most striking difference in diagnosis of patients is in this group, especially because of the definition of impaired fasting glucose in the new criteria. In the third group that had FPG between 126-139 mg/dl, 17 patients were normal, 37 had impaired glucose tolerance and 44 had diabetes mellitus according to WHO criteria. 98 patients had diabetes mellitus according to ADA criteria. In this group too, a significant difference was found between the two diagnostic criteria (Table 1).

Discussion

The American Diabetes Association (ADA) approved new diagnostic criteria for diabetes mellitus in 1997. The ADA Expert Committee on the Diagnosis and Classification of Diabetes Mellitus pointed out that majority of newly diagnosed diabetic subjects with a 2-hour plasma glucose ≥ 200 mg/dl in the 75 g OGTT have shown an FPG < 140 mg/dl in many previous studies, suggesting that an FPG value of 140 mg/dl identified more severe hyperglycemia than a 2-hour plasma glucose of 200 mg/dl. Several studies have shown that the FPG cut-off point equivalent to a 2-hour plasma glucose of 200 mg/dl in 75 g OGTT was in the range of 120-126 mg/dl and that the FPG threshold for diabetic retinopathy is also 120-130 mg/dl.^{4,10}

After the use of new criteria for diagnosis of diabetes mellitus, the change in the prevalence of diabetes was examined by many investigators. Some of the studies showed that the prevalence was lower with the ADA criteria than with the WHO criteria,¹¹ but many studies demonstrated that it was higher with the ADA than with the WHO criteria.^{5,12} Concerns about overestimation include the harm induced by anxiety and the risks and costs of unnecessary treatment. On the other hand, under diagnosing a condition is harmful if early treatment can make a difference in patient outcome, especially if the treatment is relatively benign.¹³ In this study, we aimed to ascertain the difference in practice, by evaluating a group of patients who needed to have glucose metabolism assessed. We found higher frequency of diabetes with the ADA criteria than with the WHO criteria. The frequency of impaired glucose tolerance did not change. However, the main difference was in the group of patients defined as normal glucose tolerance. With the WHO criteria, 115 patients (46 %) had normal glucose tolerance, but only 19 patients (7.6%) had normal glucose tolerance with the ADA criteria. The striking difference was in this group because of the definition of impaired fasting glucose.

There is poor agreement between the WHO category of IGT and the ADA category of IFG.¹⁴ But, patients with isolated impaired fasting glucose and isolated impaired glucose tolerance show similar impairments in insulin action.¹⁵ IFG and IGT refer to a metabolic stage intermediate between normal glucose homeostasis and diabetes, and both are believed to be risk factors for future diabetes and cardiovascular disease.¹⁶ The lower cut-off fasting glucose value proposed

by the ADA criteria should facilitate detection of diabetes, and raise clinicians' awareness of the possibility of a prediabetic condition in their patients.¹⁷ Therefore, changing the diagnosis from normal glucose tolerance to impaired fasting glucose according to new diagnostic criteria results in an important difference.

In the subsequent step, we evaluated the patients with impaired fasting glucose according to new ADA criteria, and we found that all patients in this group were normal according to WHO criteria. This is an expected result because of the study design. Patients with IFG have fasting plasma glucose of 110-125 mg/dl, but they have no DM or IGT with OGTT. So, these patients are normal under the WHO criteria, but they are named as IFG under the ADA diagnostic criteria. In another large series of 285 subjects diagnosed with impaired fasting glucose by the 1997 ADA criteria, 195 (68.4%) were classified as having normal glucose tolerance by the 1985 WHO criteria.¹⁸

Compared with the WHO criteria, the use of FPG to diagnose diabetes, as recommended by the ADA, was a more reproducible test. Although lowering of the cut-off value from 140 mg/dl (7.8 mmol/l) to 126 mg/dl (7.0 mmol/l) increased the number of diagnoses among subjects with low FPG, the omission of the 2-hour postprandial plasma glucose would lead to fewer subjects having their diabetes diagnosed.¹⁹ Because the performance of an OGTT is time consuming and laborious, the ADA has recently recommended moving away from an OGTT to using the FPG as a diagnostic procedure. The 2-hour OGTT value is still considered a valid diagnostic criterion, but the use of OGTT is not recommended on a routine basis.²⁰

In conclusion, new diagnostic criteria cause an evident change in the frequency of diabetes mellitus and prediabetic conditions as shown in many large series.²¹ Our results have suggested that the new criteria are more sensitive and useful in diagnosing diabetes, especially prediabetic conditions, and also can be applied more easily. This study included patients who needed the evaluation of their glucose metabolism and further studies are needed to evaluate the change of the frequency in similar populations.

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