Diagnostic accuracy of the American Diabetes Association criteria in the diagnosis of glucose intolerance among high-risk Omani subjects

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Background: Type 2 diabetes mellitus is highly prevalent in the rapidly growing Omani population. The American Diabetes Association (ADA) has recommended new criteria for Type 2 diabetes, but the new criteria have been challenged as inadequate. We measured the sensitivity and specificity of the ADA criteria compared with World Health Organization (WHO) criteria for the diagnosis of abnormal glucose intolerance in Omani subjects.

Methods: Subjects not known to have diabetes were recruited from the Lipid and Endocrine Clinics at Sultan Qaboos University Hospital between 1999 and 2001. Fasting and 2-hour post-75g oral glucose tolerance test (OGTT) glucose levels were measured according to WHO criteria.

Results: 176 subjects were recruited for the study. WHO and the ADA criteria were in agreement for 104 out of 115 normal glucose tolerance (NGT), 4 out of 38 impaired glucose tolerance (IGT), and 14 out of 23 diabetic tolerance glucose (DGT) corresponding to a sensitivity of 90%, 10%, and 61% for NGT, IGT, and DGT, respectively. Compared with WHO criteria, the ADA criteria had 30% sensitivity and 90% specificity overall. Comparing fasting glucose cutoff values for the diagnosis of IGT, a cut-off of 5.9 mmol/L yielded the best diagnostic sensitivity and specificity compared to the 6.1 mmol/L recommended by the ADA criteria as determined by the receiver-operating characteristics (ROC), with an area under the curve of 0.677 vs. 0.387, respectively.

Conclusion: The ADA criteria had poor sensitivity in the detection of impaired glucose tolerance in high-risk Omani subjects compared with WHO criteria.

Key words: Type 2 diabetes mellitus, glucose intolerance, sensitivity and specificity, Oman

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Type 2 diabetes mellitus is one of the fastest growing syndromes worldwide, with a high prevalence in some countries, especially in Asia.[1] In Oman, the prevalence of type 2 diabetes and impaired glucose tolerance (IGT) is 10% and 13%, respectively, and the prevalence rises with age.[2] Recently, it was reported that the prevalence of diabetes in Oman has increased over the past decade, reaching 16.1% of the population aged 30 to 64 years old.[3]

Several protocols have been published for the diagnosis of patients with abnormal glucose tolerance, but the 75-g oral glucose tolerance test (OGTT) remains the gold standard. In 1997, the American Diabetes Association (ADA) Expert Committee recommended two changes in the diagnostic criteria for diabetes.[4] First, the committee suggested using only fasting glucose without OGTT to diagnose diabetes. Second, the Committee created three new categories based on fasting glucose levels. The new diagnostic criteria were proposed to remedy criticisms of the original 1985 World Health Organization (WHO) criteria, which relied on both fasting glucose level and additional glucose measurements during a 2-hour 75-g OGTT. It was thought that using the fasting glucose alone would simplify the screening process to a single, more reproducible laboratory test without the need to perform a cumbersome OGTT. A fasting glucose cutoff of 7.0 mmol/L was chosen to correspond more closely to individuals with a 2-hour plasma glucose of 11.1 mmol/L. Following the publication of the ADA criteria, a provisional report by the WHO consultation endorsed the new diabetic fasting plasma glucose threshold of 7.0 mmol/L. However the WHO continues to recommend using the OGTT in screening for diabetics. Several recent studies have challenged the new ADA criteria and questioned the exclusive use of the fasting glucose criterion for diabetics.[5] Our endocrine unit at Sultan Qaboos University Hospital had adapted the new ADA criteria. In this report, we assessed the performance of the ADA fasting glucose criteria compared to WHO criteria in Omani subjects at high risk for diabetes.

Methods

Participants not previously diagnosed with diabetes mellitus were recruited from the Lipid and Endocrine Clinics at Sultan Qaboos University Hospital between the years 1999 and 2001. OGTT was considered in those subjects who were symptomatic (osmotic symptoms), with a strong positive family history of diabetes in one of their first-degree

Table 1. The BMI and distribution of the 176 subjects by glucose tolerance and fasting glucose.

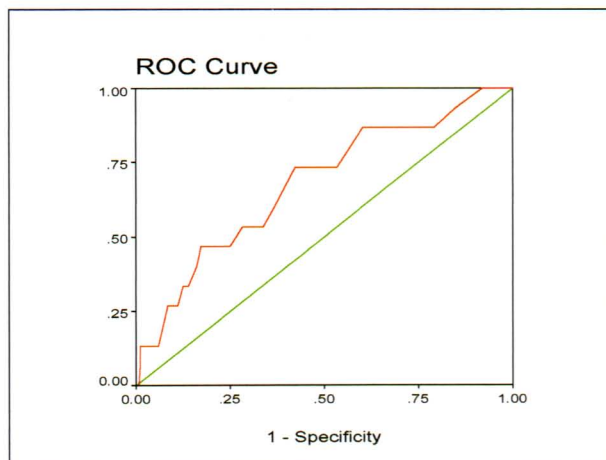|		WHO Criteria			
		NGT	IGT	DGT	Total
ADA Criteria	NFG	104	33	3	140
	IFG	10	4	6	20
	DFG	1	1	14	16
	Total	115	38	23	176
Total	BMI	29.8 (1.3)	31.2 (1.2)	30.3 (0.9)	P value NS

Figure 1. ROC curve, comparing fasting glucose cut-off values for the diagnosis of IGT (WHO criteria);.(A) Fasting glucose 6.1 mmol/L (ADA criteria) with an area under the curve = 0.387 and (B) Fasting glucose of 5.9 mmol/L with an area under the curve = 0.677.

relatives or a pattern of dyslipidemia suggestive of metabolic syndrome (syndrome X or insulin resistance syndrome, i.e., low HDL cholesterol with high triglycerides and without an acute medical problem). Body mass index (BMI, calculated as weight (kg) divided by height (m2), was used as a measure of adiposity.

Following a 10-hour over-night fast, a blood sample was taken for measurement of glucose. OGTT was carried out according to the WHO criteria[6]: subjects were classified by 2-hour post 75-g anhydrous glucose load as having diabetic glucose tolerance (DGT)(11.1 mmol/L), impaired glucose tolerance (IGT) (7.8 to 11.0 mmol/L), or a normal glucose tolerance (NGT)(7.8 mmol/L). ADA criteria study subjects were labeled as having normal fasting glucose (NFG) (<6.1 mmol/L), impaired fasting glucose (IFG (6.1-7.0 mmol/L), or diabetic fasting glucose (DFG) (7.0 mmol/L).

Glucose determination was performed using the timed endpoint enzymatic method on a Synchron CX system (Beckman, Brea, CA, USA). Within-run and between-run precision was 2 and 3%, respectively. Sensitivity, specificity, and likelihood ratio were estimated using formulae proposed by Jones and Payne.[7] Evaluation of the diagnostic performance of different fasting glucose cut-off values was carried out by construction of receiver-operating characteristic (ROC) curves, using WHO criteria as a dichotomous variable.

Results

A total of 176 OGTTs were carried out during 1999 to 2001. WHO and the ADA criteria were in agreement for 104 out of 115 NGT, 4 out of 38 IGT, and 14 out of 23 DGT (Table 1). The corresponding percentages for sensitivity of the ADA and WHO criteria were 90%, 10%, and 61% for NGT, IGT, and DGT, respectively. Pooling all subjects, the ADA compared with WHO had 30% sensitivity and 90% specificity with a likelihood negative and positive ratio of 1.28 and 3.0, respectively. The optimal diagnostic cut-off value of fasting glucose for IGT (according to WHO criteria) with the highest sensitivity and specificity as determined from ROC curve was 5.9 mmol/L compared with 6.1 mmol/L (ADA criteria), with areas under the curve of 0.677 vs. 0.387, respectively (Figure 1). The IGT group had a higher average BMI (31.2±1.2, mean±SD) compared with the other two groups (29.8±1.3 for NGT and 30.3±0.9 for DGT), but the difference did not reach statistical significance.

Discussion

This study shows that the ADA criteria had poor sensitivity in the detection of Omani subjects with IGT compared with the WHO criteria. Our data shows that 90% and 39% of subjects with IGT and DGT, respectively, were missed by the ADA criteria. These findings agree with those reported among different populations.[8,9,10,11,12,13] Furthermore, ethnic variations were reported by Harris and colleagues[8] where the new ADA criteria had failed to identify substantial numbers of subjects with impaired glucose tolerance, particularly among South Asians compared with whites and patients of African ethnic descent[8]. Similar findings were also reported by Rodriguez et al[13] where the ADA criteria had a sensitivity of 17% for Japanese–American subjects with impaired glucose tolerance.[13]

Since diabetes is highly prevalent in Oman, we recommend that OGTT be used as a screening test for such a high-risk group rather than fasting glucose. However, fasting glucose criteria may have a place in the diagnosis of diabetes in the clinical setting, in which simplicity and specificity are very important.

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