Articles

Short communication

Reduced prevalence of diabetes according to 1997 American Diabetes Association criteria

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Abstract

Aims/hypothesis. We examined the prevalence of diabetes and investigated the characteristics of subjects diagnosed by the American Diabetes Association and the World Health Organization criteria.

Methods. A total of 1235 Japanese-Americans living in Hawaii and Los Angeles was studied. Of the subjects 114 were classified as previously diagnosed as having diabetes. A 75-g glucose tolerance test was given to the rest of the subjects.

Results. When abnormal glucose tolerance was diagnosed by the American Diabetes Association criteria, it was possible to identify only 40 % of diabetic subjects who had not been previously diagnosed compared with the current World Health Organization criteria based on a glucose tolerance test. In addition, the subjects identified by the American Diabetes Association criteria had higher glucose concentrations

and had less insulin secretory capacity and they were in need of intensive treatment for diabetes. On the other hand, the subjects not diagnosed by the American Diabetes Association criteria alone were those whose glucose tolerance would be more likely to improve with lifestyle modification.

Conclusion/interpretation. It might be better to use the fasting plasma glucose criterion advocated by the American Diabetes Association in combination with a glucose tolerance test after taking a detailed medical history. To reduce the number of subjects requiring the glucose tolerance test, priority should be given to subjects with impaired fasting glucose ($6.1 \leq$ fasting plasma glucose < 7.0 mmol/l). [Diabetologia (1999) 42: 1168–1170]

Keywords Diabetes mellitus, criteria, fasting plasma glucose, glucose tolerance test, prevalence.

In 1997, the American Diabetes Association (ADA) proposed a new set of diagnostic criteria for diabetes mellitus [1]. The main modification in identifying diabetes compared with the World Health Organization (WHO) criteria [2] is an emphasis on fasting plasma glucose. The ADA has recommended that the fasting plasma glucose (FPG) concentration used to diag-

nose diabetes should be lowered from 7.8 mmol/l to 7.0 mmol/l. It has also indicated that a glucose tolerance test (GTT) is not recommended for routine clinical use to diagnose diabetes. The prevalence of diabetes is, however, usually estimated by the WHO criteria using the GTT and could be amended if the new ADA criteria is adopted. In our study, we compared the prevalence of diabetes and tried to ascertain the characteristics of subjects diagnosed other than by the ADA criteria alone.

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Abbreviations: FPG, Fasting plasma glucose; GTT, glucose tolerance test; NFG, normal fasting glucose.

Subjects and methods

The subjects were men and women aged more than 40 years from the Japanese-American community, who were enrolled

Fig. 1. Classification of glucose tolerance using the diagnostic criteria proposed by ADA. Excluded from this figure were 114 subjects with a history of diabetes

Fig. 2a, b. Comparison of glucose (a) and insulin (b) concentrations during 75-g OGTT in diabetic subjects diagnosed (○; $n = 39$) and not diagnosed (■; $n = 55$) using the ADA criteria. * $p < 0.05$, ** $p < 0.01$ after adjustment for age, sex and BMI

in the 1992 and 1993 medical surveys carried out in Hawaii and Los Angeles, California, USA. The surveys have already been described in detail elsewhere [3]. The study cohort consisted of 531 men and 704 women, whose mean age was 64.8 years. A total of 114 subjects who were previously diagnosed as having diabetes or were taking antidiabetic agents were classified as "previously diagnosed diabetes" [4].

A 75-g GTT was carried out after fasting blood samples were obtained early in the morning. Serum was separated after sampling and was brought back to Japan while frozen at -80°C . The serum insulin concentration was measured using RIA by a double antibody method. Results were expressed as the means $\pm$ standard error and statistical analysis was done using Student's t test and analysis of covariance. Because insulin values did not show a normal distribution, the data were analysed after logarithmic transformation. This study was approved by the ethics committee of Hiroshima University and the Council of the Hiroshima Kenjin-Kai Association in Hawaii and Los Angeles.

Results

Figure 1 shows the classification of glucose tolerance using the ADA criteria after excluding subjects with previously diagnosed diabetes. Of the 1121 subjects, 92 were diagnosed as having diabetes using the WHO criteria. Adopting only the fasting plasma glucose concentration (≥ 7.0 mmol/l) as the criterion for diabetes, 39 subjects were diagnosed. Only 2 subjects were additionally diagnosed as having diabetes, whereas 1036 subjects had normal fasting glucose and 46 had impaired fasting glucose, with 55 not being diagnosed as having diabetes using the ADA criteria alone. According to the findings shown above, the prevalence of diabetes using the ADA or the WHO criteria was calculated. From a total of 1235 subjects, 114 had previously diagnosed diabetes, which was 9.2% of the total study cohort. Using the WHO criteria based on a GTT, 92 additional subjects were diagnosed as having diabetes and the total prevalence was 16.7%. Using the ADA criteria, only 39 additional subjects were diagnosed and the total prevalence decreased to 12.4%. Among 55 subjects who were not diagnosed using the ADA criteria alone, 23 showed impaired fasting glucose (IFG; $\text{FPG} \geq 6.1$ mmol/l and < 7.0 mmol/l) and 32 showed normal fasting glucose (NFG; $\text{FPG} \geq 6.1$ mmol/l). It should be noted that half of the subjects showed diabetes with the GTT among IFG subjects.

To investigate the differences between subjects diagnosed using the ADA and the WHO criteria, we compared the clinical characteristics of the 39 subjects diagnosed using the ADA criteria (group 1) with those of the 55 subjects not diagnosed by the ADA criteria alone (group 2). Age and waist: hip circumference ratio were not statistically significantly different between the two groups, but body mass index (27.2 ± 0.5 vs 25.4 ± 0.4 kg/m 2 , $p < 0.05$), fasting serum glucose (8.4 ± 0.2 vs 5.8 ± 0.1 mmol/l, $p < 0.01$) and insulin (118.5 ± 10.9 vs 82.5 ± 9.1 pmol/l, $p < 0.01$) were significantly higher in group 1. Figure 2 shows the serum glucose and insulin profiles during the GTT in groups 1 and 2. Plasma glucose was significantly higher in group 1 at fasting, 1-h and 2-h and plasma insulin was significantly lower in group 1 at 1-h and 2-h of the GTT after adjustment for age, sex and BMI. These findings indicate that subjects in group 1 had more severe hyperglycaemia and a lower capacity for insulin secretion in response to an oral glucose load compared with those in group 2.

Discussion

The new criteria advocated by the ADA are expected to standardize the evaluation of abnormal glucose tolerance and facilitate epidemiological studies by allowing the prevalence of diabetes to be determined

without using a GTT. If only the fasting plasma glucose is used, more cases of diabetes will naturally be detected if a value of 7.0 mmol/l, rather than 7.8 mmol/l, is adopted as the diagnostic criterion [5].

The findings of a previous study [6] and the present findings show, however, that the prevalence of diabetes obtained without using a GTT is appreciably lower than that estimated using the current WHO criteria. It has been reported that approximately half of all diabetic subjects can be detected only by medical history [7]. Because the ADA criteria are based on fasting plasma glucose, people with an FPG less than 7.0 mmol/l and a 2-h glucose concentration of 11.1 mmol/l or more are not diagnosed. In the present study, 92 subjects were diagnosed as having diabetes based on the WHO criteria using the GTT, after excluding 114 previously diagnosed patients. Of these 92 subjects, 37 were also diagnosed as having diabetes using the ADA criteria and another two subjects were additionally diagnosed. There were 55 subjects who were not diagnosed as having diabetes because their FPG values were less than 7.0 mmol/l. Assessment using the ADA criteria therefore detected only 40% of diabetic subjects who had not been diagnosed previously.

Furthermore, subjects diagnosed as having diabetes using the ADA criteria had higher blood glucose concentrations and a lower insulin secretory response. In other words, these were patients who required immediate treatment for diabetes. Subjects who were not detected using the ADA criteria alone still had intact insulin secretory capacity and their glucose tolerance was considered to improve through the active implementation of a diet and exercise regimen [8]. From the view of preventing diabetic complications, it is necessary to use a combination of several examinations rather than relying solely on the fasting glucose concentration.

It has been reported that people with a 2-h glucose concentration of 11.1 mmol/l or more have a high probability of being detected if HbA_{1c} and FPG are used in combination [9]. In the study of 2877 subjects, 238 subjects had an FPG of 7.0 mmol/l or more for whom it was considered appropriate to make a diagnosis of diabetes based on the ADA criteria without a doing a GTT. Only 500 subjects with an FPG more than 5.6 mmol/l and less than 7.0 mmol/l and HbA_{1c} of 5.5% or more required the GTT and the authors estimated that the GTT was not required in almost 80% of the total subjects.

Based on our study, we would like to propose the following as a new strategy for the diagnosis of diabetes. A detailed medical history should be taken to determine the presence of previously diagnosed diabetes (step 1). Approximately half of all diabetic people can be detected at this point. Then, FPG is measured and those with a value of 7.0 mmol/l or more are diagnosed as having diabetes without further examination (step 2). A GTT is carried out in subjects with IFG to identify

the diabetic subjects whose FPG is less than 7.0 mmol/l (step 3). According to the findings of our study, the GTT is required for only 4 to 5% of subjects at this point. As about one third of diabetic people have NFG, it is, however, desirable to identify diabetes among as many NFG subjects as possible. In our study, when a cutoff value of FPG more 5.6 mmol/l was applied, the GTT was needed for another 74 subjects. Thus, it is necessary to do the GTT for about 10% of total subjects (step 4). If the number of patients undergoing the GTT needs to be reduced further, subjects who are obese, have a family history of diabetes [10] or exhibit higher HbA_{1c} values should be selected.

Treatment of diabetes requires great social expenditure, because of the associated vascular complications. The number of patients with diabetes is growing, so more efficient methods of identifying diabetes are required. It should be emphasized that diabetes needs to be identified not only among people diagnosed on the basis of an FPG of 7.0 mmol/l or more as specified in the new ADA criteria but also among those having lower FPG values, with special emphasis on IFG subjects.

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