Comparison of The World Health Organization (WHO) Two-Step Strategy and OGTT for Diabetes Mellitus Screening

John MF. Adam, Nirmala P. Tarigan

ABSTRACT

The new diagnostic criteria recommended by the American Diabetes Association (ADA) will only detect diabetic patients with fasting hyperglycemia, and leave patients with isolated post-challenge hyperglycemia (IPCH) and impaired glucose tolerance (IGT) unidentified. The WHO recommends that all those with abnormal fasting glucose should undergo the oral glucose tolerance test (OGTT) to exclude the diagnosis of diabetes (two-step strategy). This two-step strategy will leave out subjects with normal fasting glucose (< 109 mg/dl). The aim of this study is to compare the WHO two-step strategy and the gold standard OGTT for all subjects.

We re-analyzed the results of 907 high-risk patients who have been screened for diabetes mellitus and impaired glucose tolerance. All subjects were screened with an OGTT containing a 75-gram glucose load after fasting for 12 hours. The results were classified into three categories: the ADA criteria, the two-step strategy, and the OGTT.

Using the ADA criteria, these 907 subjects can be classified as having normal fasting glucose (fasting plasma glucose - FPG < 109 mg/dl) in 715 subjects (78.9%), abnormal fasting glucose (FPG 110 – 125 mg/dl) in 107 subjects (11.8%), and diabetes mellitus (FPG > 126 mg/dl) in 85 subjects (9.4%). The WHO two-step strategy performed in 107 IFG subjects identified another 30 diabetic patients (FPG < 109 mg/dl and 2 hour post load ≥ 200 mg/dl = IPCH) or 3.3%, and 49 patients with IGT, or 5.4% from all subjects. If the OGTT was performed on the 715 normal fasting glucose, it could identify another 40 diabetic patients or 4.4%, and another 178 IGT patients, or 19.6% of all subjects. This means that without OGTT to all subjects, 40 diabetic patients or 25.8% of all diabetic patients and 178 patients or 78.4% from all IGT subjects would have remained unidentified.

From this study we can conclude that applying the WHO two-step strategy in subjects with IFG would fail to detect 25.8% of diabetic patients and 78.4% of IGT subjects. It is recommended that the old strategy of screening – the gold standard OGTT – should be used instead of the two-step strategy, at least in high-risk groups.

Keywords: Two-step strategy, high-risk group, OGTT

INTRODUCTION

Diabetes mellitus is a metabolism disorder characterized by chronic hyperglycemia due to abnormal insulin secretion, insulin dysfunction or a combination of both.1,2 Chronic hyperglycemia could result in dysfunction, damage, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels. Type 2 diabetes mellitus patients have a higher risk of developing stroke, coronary heart disease, peripheral blood vessel disorder compared to those without diabetes mellitus.1,2 The results of the Diabetes Control and Complication Trial (DCCT)3 in 1996 in the United States and the United Kingdom Prospective Diabetes Study (UKPDS)4 in England, have proven that strict glycemic control can prevent the incidence and delay the aggravation of microvascular and macrovascular diseases. In that sense, it is very important to detect asymptomatic diabetes mellitus patients as early as possible so that treatment can be started promptly.5

Screening for early detection of asymptomatic patients in the clinic is recommended among people from the high-risk group.6 The problem lies in deciding which diagnostic criteria for diabetes mellitus that should be used. As we know, there are 2 diagnostic criteria for diabetes mellitus that are now, which are American Diabetes Association (ADA) 19972 criteria, which only relies on a fasting plasma glucose of ≥ 126 mg/dl, and the 1999 WHO criteria that uses the oral glucose tolerance test (OGTT).1

Diabetes and Lipid Centre, Dr.Wahidin Sudirohusodo Hospital, Sub-Division of Endocrinology and Metabolism, Department of Internal Medicine, Faculty of Medicine Hasanuddin University, Makassar
According to the 1999 WHO criteria, if only fasting plasma glucose was tested, it is suggested that those who do not meet the diagnosis of diabetes mellitus, or those with abnormal fasting plasma glucose (110 - ≤ 125 mg/dl) undergo the oral glucose tolerance test (OGTT). The question that arises is whether high risk patients with normal fasting plasma glucose (≤ 109 mg/dl) should undergo the OGTT. This study was aimed to compare the difference between the two-step screening process, in which step one consists of checking fasting plasma glucose and OGTT among those with abnormal fasting plasma glucose, compared to the one-step screening process, in which OGTT alone is performed on all subjects.

SUBJECTS AND METHODS

The study data comes from 2 years of research, from January 2001 to December 2002. The study subjects are those with high risk of diabetes mellitus. All subjects are patients from the Internal Medicine clinics of teaching hospitals and private clinics who come for routine check up, as well as those who sought treatment for another ailment. OGTT was performed in all subjects with a glucose load of 75 gram after a night’s fasting of 10-12 hours. Patients are considered to be in the high risk category are those with an age of ≥ 45 years or below 45 years old with a predisposing factor such as a) a family history of diabetes mellitus b) obesity, with a Body Mass Index (BMI) of ≥ 25 kg/m² c) history of glucose intolerance or impaired fasting plasma glucose (IGT), d) hypertension (a blood pressure of ≥ 140/90 mmHg), e) women with history of gestational diabetes mellitus or history of delivering a ≥ 4000 gram baby.

From the data available, the benefit of the two-step screening was observed, starting with fasting plasma glucose test and continued with OGTT to those with impaired fasting plasma glucose (fasting plasma glucose110 -< 125 mg/dl). The result was then compared with the result when OGTT was performed alone to those considered normal with fasting plasma glucose of ≤109 mg/dl (Figure 1). Age and body mass index (BMI) were also compared between patients with impaired fasting plasma glucose and diabetes mellitus and normal subjects. Statistical study was performed using the student test, and was considered significant if p <0.05.

RESULTS

The Number of Subjects WHO were Examined

During the period of the study, 907 subjects with high risk of diabetes mellitus were evaluated. They consisted of 424 males and 483 females. There were 203 (22.4%) elderly patients ≥ 60 years, and 704 subjects (77.6%) less than 59 years of age. There were quite a number of younger subjects (below 39 years of age), making up 172 subjects (19.0%) (Table 1).

Table 1. The Number of Patients Examined

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Sex</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>≤ 39</td>
<td>84</td>
<td>6</td>
</tr>
<tr>
<td>40 – 49</td>
<td>143</td>
<td>27</td>
</tr>
<tr>
<td>50 – 59</td>
<td>111</td>
<td>30</td>
</tr>
<tr>
<td>60 – 69</td>
<td>64</td>
<td>9</td>
</tr>
<tr>
<td>70 – 79</td>
<td>21</td>
<td>5</td>
</tr>
<tr>
<td>≥ 80</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>424</td>
<td>77</td>
</tr>
</tbody>
</table>

The Results of Fasting Plasma Glucose Assessment and Two-step Screening

From the results of the fasting plasma glucose test, 715 (78.8%) patients were found to be normal, 107 (11.8%) to have impaired fasting plasma glucose, and 85 (9.4%) met the criteria for diabetes mellitus. According to the two-step screening strategy proposed by WHO 1999, which states that “if resources allow, it is recommended that all those with IFG have an OGTT to exclude the diagnosis of diabetes – WHO 1999”,1 then those with IFG (107 subjects) must then proceed with 2-hour OGTT. From that number, normal glucose tolerance was
found among 28 subjects, impaired glucose tolerance (IGT) in 49 subjects, and diabetes mellitus in 30 subjects. Thus, if we performed the two-step screening, the number of diabetes mellitus patients who were identified would be 115 (the first step yielding 85 patients and the second step 30 patients) (Figure 2). The number of diabetes mellitus patients identified using the two-step screening would reveal a prevalence of diabetes mellitus of 3.3%, and IGT of 5.4%.

The Results Of OGTT in Subjects with Normal Fasting Plasma Glucose

As many as 715 subjects had normal fasting plasma glucose, who based on the two-step screening, would not have undergone the 2-hour OGTT. The results of the OGTT were as follows: normal glucose tolerance in 797 subjects, IGT in 178 subjects, and diabetes mellitus patients in 40 subjects. Thus, these results show that those with high risk of diabetes mellitus, albeit with normal fasting plasma glucose (≤ 109 mg/dl), making up about 25.8% of all diabetes mellitus patients, would not be detected. In addition, a large number of IGT patients (78.4% of all IFG in this study), who would be in the high-risk group of developing diabetes mellitus or even coronary heart disease, would have remained undetected (Figure 3).

OGTT Results in All Subjects

The results of the OGTT in all subjects revealed diabetes mellitus patients in 155 subjects and IGT in 227 patients. If only the two-step screening was performed, 40 diabetes mellitus patients would have remained undetected, as well as 178 patients with IGT. In other words, if OGTT is not performed in those with normal fasting plasma glucose, then one in four diabetes mellitus patients would remain undetected and one in eight IGT subject would have remained undiagnosed (Figure 4).

The Risk Factors in 40 Diabetes Mellitus Patients with Normal Fasting Plasma Glucose

Among the high-risk subjects with normal fasting plasma glucose, 40 were found to have diabetes mellitus, in a conditioned known as Isolated Post-Challenge Hyperglycemia (IPCH), and 178 were found to have IGT.
The comparison of mean age and BMI of those with IGT and diabetes mellitus and those with normal glucose tolerance revealed an older age and higher BMI in those with IGT and diabetes mellitus. In those with IGT and diabetes mellitus, the mean age was 50.6 years and the mean BMI was 26.1 kg/m², and those with normal fasting plasma glucose had a mean age of 48.4 years and a mean BMI of 24.7 kg/m², and the difference is statistically significant (p<0.05).

DISCUSSION

Glycemic control in diabetic patients can prevent or at least delay the incidence of chronic diabetes mellitus complications. Therefore, experts agree that early detection of type 2 diabetes mellitus is a necessity. The American Diabetes Association suggests that for early detection diabetes mellitus, diabetes mellitus screening should be targeted to those with high risk of diabetes mellitus. The question is which diagnostic criteria should be used, whether it is sufficient to merely test fasting plasma glucose (ADA criteria 1977) or is it necessary to perform the OGTT (according to WHO). The Diabetes Epidemiology Collaborative Analysis of Diagnostic Criteria in Europe (DECODE) proved that those with IPCH possess the same risk of coronary heart disease as those with known diabetes mellitus. Therefore, screening of fasting plasma glucose alone would not detect those with IPCH, particularly among elderly patients.

Researchers in Asia have also reported that the ADA criteria, which is based on fasting plasma glucose alone, is less sensitive for diabetes mellitus screening compared to the WHO criteria (Choi KM, Kho GTC). A study in Makasar by Ursia et al reported a prevalence of diabetes mellitus of 15.5% using the 1985 WHO criteria, and only 11.7% using the ADA criteria. A large-scale study in Asia by the Diabetes Epidemiology Collaborative Analysis of Diagnostic Criteria in Asia (DECODA) proved that for Asians, the criteria of diagnosing diabetes mellitus by means of fasting plasma glucose alone (ADA criteria) is not adequately sensitive to identify diabetes mellitus patients, and it is suggested that OGTT should be performed. For that reason, the WHO 1999 suggests that OGTT should still be performed, or at least maintain the two-step screening used.

The results of this study, it is clear that when only two step screening was performed, particularly among those with high risk of diabetes mellitus, 25.8% of all the diabetes mellitus patients would not have been identified compared to when OGTT was used. The same findings was found by the DECODA which reported that using the two-step screening strategy, 24.4% of diabetes mellitus patients would not be diagnosed. One of the benefits of using OGTT is it can detect those with IGT and IPCH, who were found in large numbers in this study.

Significant risk factors for cardiovascular disease include age and obesity. In elderly and obese subjects, the incidence of insulin resistant is higher. In these groups, glucose tolerance test is more sensitive compared to fasting plasma glucose testing alone. In this study, subjects with IGT and IPCH in the group with normal fasting plasma glucose were found to be of older age or have a higher BMI compared to the rest of those with normal fasting plasma glucose. This shows that although they show normal fasting plasma glucose, obese and older patients should undergo the OGTT.

CONCLUSION

From this study, it can be concluded that in those with high risk of diabetes mellitus, 25.8% of diabetes mellitus patients and the majority of IGT patients would have been overlooked when only the two-step screening was performed. Therefore, it is suggested that OGTT is performed. In those with IGT and IPCH, body mass index (BMI) and old age are significant factors that determine the development of IGT and diabetes mellitus.
ACKNOWLEDGEMENT

The researcher would like to thank Dr. Robert Setiadji MScSp.FK for processing the data for statistical analysis and Ms. Desy Sahertian who have assisted in putting this paper together.

REFERENCES