Original Article

Single Flexible Postprandial Plasma Glucose Test as a New Screening Modality for Diabetes Mellitus

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ABSTRACT

Background: The study was aimed at assessing the adequacy of single flexible postprandial plasma glucose (FPPPG) test with time of sampling between 30-120 min after breakfast/snack/meal as a screening test for diabetes mellitus and IGT.

Study Design: cross sectional study

Place and Duration of study: Study was carried out in the Department of Chemical Pathology and Endocrinology at Armed Forces Institute of Pathology, Rawalpindi from January to November 1995.

Patients and methods: Eighty eight consecutive patients referred to AFIP for oral glucose tolerance test were included. The ages of patients ranged from 30 - 65 y. In the first step, on day 1 oral glucose tolerance test and in the second step, on day 2 flexible time based postprandial plasma glucose (FPPPG) 30-120 min after breakfast/snack/meal were performed. 12 patients did not turn up on day 2 for FPPPG test. In this study we performed FPPPG test on 76 patients as a screening test, with a cutoff point of 7. 0 mmol / l

Results: The study revealed that all 22 diabetic patients (100%) had levels above the limit whereas, 15 (83.3%) out of 19 patients of IGT had levels above cutoff level. On the other hand out of 35 healthy subjects only 2 (5.71%) had values above the limit.

Conclusion: This study proposes a new screening test (FPPPG) for diabetes mellitus and IGT, which has a sensitivity of (100 %), specificity of (66.7 %) and positive predictive value of (55 %)

Key words: diabetes mellitus (DM), flexible post prandial plasma glucose (PPPG), world health organization WHO, oral glucose tolerance test (OGTT), impaired glucose tolerance (IGT), international diabetic federation (IDF), positive predictive value (PPV+), negative predictive value (NPV-)

INTRODUCTION

Diabetes mellitus is a syndrome of chronic hyperglycemia due to insulin resistance, deficiency or both[1]. In 2000, an estimated 171 million people worldwide had diabetes and numbers are projected to double by 2030[2,3]. WHO ranks Pakistan 7th in the world on diabetes prevalence list. According to International Diabetes Federation, 6.9 million people are affected by diabetes in Pakistan with the estimate that this number will grow to 11.5 million by 2025 unless measures are taken to control the disease[4]. One of the problems with diabetes is that it remains undiagnosed or under diagnosed until complications developed especially in developing countries where health screening facilities are less likely. About one third of people with diabetes do not know they have it, and the average lag between onset and diagnosis is seven years[5]. Diabetes is usually irreversible and although patients can have reasonably normal life style, its complications result in reduced life expectancy and major health cost. .The increasing prevalence of obesity and sedentary life styles are the major underlying causes of Type 2 diabetes to become one of the fastest growing public health problems worlds wide, imposing a high financial burden on health care cost[6,7]. The W H O definition for labeling diabetes is single raised glucose reading with symptoms, otherwise raised glucose values on two occasions of either, fasting plasma glucose $\geq$ 7.0 mmol/l (126 mg/dl) or with a glucose tolerance test, two hours after the oral dose a plasma glucose $\geq$ 11.1 mmol/l (200 mg/dl).[8-10]The process of diagnosing diabetes mellitus can not be regarded as a exact science. It has evolved over many years and even now continues to change as our knowledge and the perception of the condition alter. A difference of opinion still exists regarding the screening tests for early detection of diabetes mellitus. Blood glucose estimation is now a preferred screening procedure in a person clinically suspected of having diabetes mellitus. Diabetes screening is recommended for many people at various stages of life, and for those with any of several risk factors. The screening test varies according to circumstances and local policy, and may be a random blood glucose test, a fasting blood glucose

test, a blood glucose test two hours after 75 g of glucose, or an even more formal glucose tolerance test. Many healthcare providers recommend universal screening for adults at age 40 or 50, and often periodically thereafter. Earlier screening is typically recommended for those with risk factors such as obesity, family history of diabetes, history of gestational diabetes and with high-risk ethnicity. Interest has arisen in preventing diabetes due to research on the benefits of treating patients before overt diabetes. Pakistan is a third world country with budget restraints due to which budget allocation for health sector is very limited. Above all our 70% of the population is illiterate. Keeping in view of these facts we intend to evaluate a single postprandial plasma glucose test with time of sampling between 30-120 minutes after breakfast/meal/snack as a screening test for diabetes.

PATIENTS AND METHODS

The study was carried out in the Department of Chemical Pathology and Endocrinology at Armed Force Institute of Pathology Rawalpindi, in a year 1995. Initially eighty eight consecutive patients were included in the study, referred to AFIP for Oral Glucose Tolerance Test. The ages of patients ranged from 30 - 65 years. Oral glucose tolerance test was performed on all 88 subjects following WHO protocol as a first step. In second step on day 2 they were called for flexible time based postprandial plasma glucose (FPPPG) test. Out of 88 patients twelve did not turn up on day 2. FPPPG test was then performed on seventy six patients, 30-120 minutes after taking food. Blood glucose estimation was performed by glucose oxidase kit method. The test characteristics of FPPPG method for screening were assessed. The sensitivity, specificity and predictive values of the screening test for diabetes was studied at levels 7.0 mmol/l up to 11.1 mmol/l , at increments of 0.1 mmol/l .The data was processed by the computer program Special Package for Social Sciences (SPSS-10).

RESULTS

As per OGTT, out of 76 patients 22 had blood glucose level above7.0 mmol/l, 19 patients felled in IGT group, whereas 35 were found healthy. The sensitivity, specificity and predictive values of the screening test at different cut-off values were calculated and cut-off value for FPPPG was set at7.0 mmol/l. At this cut-off value for FPPPG all 22 diabetics, 15 out of 19 from IGT group and 2 out of 35 healthy subjects had values above the cut-off limit. Altogether 39 patients were picked up through FPPPG test, 22(100%) from diabetic group, 15 (83.3%) from IGT group and 2 (5.71%) from normal groups (Fig. 1).

Results showed that at cut-off value of7 mmol/l, FPPPG test for detecting diabetes had a sensitivity of 100% and specificity of 66.7% with the predictive value of 55%. FPPPG test in IGT group showed the sensitivity, specificity and positive predictive values as 79%, 91.4% and 83.3% respectively at same cut-off value.

The selected cut-off value i.e.7.0 mmol/l was found to be the most appropriate for its efficiency and performance for screening population. A detailed summary of workup for cut-off limits having relevant sensitivity, specificity and predictive values are shown in Table No. 1 & 2.

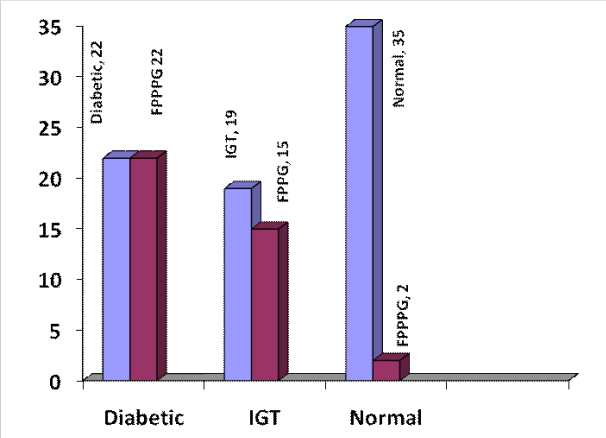
Table No.1: Summary of workup for cut-off values of FPPPG test for the detection of diabetes

FPPPG test mmol/l	Sensitivity (%)	Specificity (%)	PPV+ (%)	NPV- (%)
7.0	100	66.7	55	100
7.2	100	70.3	57.9	100
7.5	100	72.2	59.5	100
7.6	100	74	61	100
7.7	95.5	74	60	97.6
7.8	95.5	76	62	97.6
8.0	91	70.4	65.5	95.0
8.5	86.4	81.5	65.5	93.6
9.0	82	83.3	66.7	92.0
9.5	68	90.7	75.0	87.5
10.0	68.2	92.6	79.0	87.7
10.3	68.2	96.3	88.3	88.13
10.5	63.6	100	100	87.0
11.1	63.6	100	100	87.0

Table No. 2: Summary of workup for cut-off values of FPPPG test for the detection of IGT

FPPPG test mmol/l	Sensitivity (%)	Specificity (%)	PPV+ (%)	NPV- (%)
F6.5	78.9	86.7	62.5	86.7
6.6	78.9	83.0	71.4	87.9
6.7	78.9	85.7	75.0	88.2
6.8	78.9	88.9	83.3	88.9
7.0	79.0	91.4	83.3	88.9
7.1	79.0	94.3	88.0	89.2
7.2	79.0	97.1	93.0	89.5
7.3	74.0	97.1	93.0	87.2
7.4	74.0	97.1	93.0	87.2
7.5	74.0	97.1	93.0	87.2
7.6	68.4	97.1	93.0	85.0
7.7	68.4	97.1	93.0	85.0
7.8	63.2	97.1	93.0	83.0

Figure 1: Comparison of OGTT with FPPPG Test



DISCUSSION

In most of the prevalence studies oral glucose tolerance test is used as reference method[11]. In our study we used flexible postprandial plasma glucose (FPPPG) test as a screening test, with a cutoff point of7.0 mmol/l that has a sensitivity of 100 %, Specificity of 66.7 % with positive predictive value of 55 % for flexible postprandial plasma glucose (FPPPG) test. The result is comparable with other references in different populations having high prevalence of diabetes mellitus. In the Botnia[11] Study, the post load plasma glucose concentration measured at one hour with a cut off point of 155 mg/dl was a strong predictor of future risk for type 2 diabetes mellitus. While Rolka et al[12] evaluate the performance of recommended screening tests for undiagnosed diabetes and found a random capillary blood glucose test for diagnosis of diabetes mellitus with sensitivity of 75% at cut off value 6.7 mmol/l or more and specificity of 88 % that had low sensitivity as compared to our study but the specificity was better. In another study by Harris et al [13] the fasting plasma glucose level of > 7.0 mmol/l diagnoses current diabetes with sensitivity of about 50% and specificity of more than 95%. Compare with our study the sensitivity is low whereas specificity is on higher side. Pradhan et al[14] suggests HbA1C values as predictive of subsequent clinical diabetes in US female health professionals with cut of value of 6% or more having sensitivity of 16.7% and specificity of 98.9 %.In this study sensitivity is very low but specificity is very high. Several studies support Random Capillary Blood Glucose as screening test at cut-off value of 6-7 mmol/l, with high sensitivity and specificity and can be used as diagnostic test for diabetes mellitus[15-17]. By adjusting postprandial period and age, RCBG test had improved performance. Review of data[18], shows that the best test is the oral glucose tolerance test, but it is the most expensive, inconvenient and has weak reproducibility. Fasting plasma glucose would fail to notice people with IGT. Standardized estimation of glycated hemoglobin does not require fasting, reflects long term glycemia and with infrequent chance of errors makes it the best compromise. It may be that more people would be tested and diagnosed if the more convenient test was used, rather than the oral glucose tolerance test. Specific screening standards should be established that prompt further testing and closer follow-up for diagnosis of diabetes mellitus, including fasting Plasma Glucose of 100 mg/dl or more, random Plasma Glucose of 130 mg/dl or more, and HbA1Cgreater than 6.0% [5,18].

FPPPG screening test in our study has very high sensitivity for detection of the diabetes as compared to other studies and its low cost and convenience advocates it as a better screening method for detection of undiagnosed type 2 diabetes mellitus in developing countries like Pakistan, a third world country with budget restrains. A flexible postprandial plasma glucose test with time of sampling between 30-120 min after breakfast/snack/meal as a screening test is advocated.

CONCLUSION

This study proposes and recommends flexible postprandial plasma glucose (FPPPG) as new screening test for diabetes mellitus and IGT, with a cutoff point of7.0 mmol/l has sensitivity of (100 %), specificity of (66.7 %) and positive predictive value of (55 %). It is easy to perform, cheap and convenient for general population to comply.

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