Evaluation of Prediabetes in High Risk Population of Kashmir Valley

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Abstract

Background: To evaluate pre diabetes and diabetes in patients with clinical risk factors and or symptoms who have been previously undiagnosed.

Methods: A cross-sectional cohort study of 783 patients, carried at a tertiary health care centre using diagnostic tools of oral glucose challenge test (GCT), overnight fat standard oral glucose tolerance test (OGTT) and HbA1C estimation and criteria of standard guidelines applied for diagnosis of individual at risk of prediabetes and diabetes.

Results: Among the studied subjects, 588 (75.1%) were hypertensive, 67 (8.6%) had history of vascular disease, 84 (10.7%) had dyslipidemia and 78 (10%) carried family history of diabetes. On GCT, 266 (34%) subjects had levels of plasma glucose more than cut off of 140 mg/dl. A high sensitivity (92.59%), specificity (84.56%) was seen among diabetes, while as it was 75.58% and 84.56% among the subjects with pre-diabetes, and HbA1c > 5.5% was observed in 298 (38.1%) patients. The diabetics had mean BMI of 27.75 kg/m2 compared to 26.04 kg/m2 in pre-diabetics and mean age for diabetic and pre-diabetics was 52.68 and 51.7 years, respectively.

Conclusion: GCT screening would be an accurate, convenient and relatively in expensive way to detect pre-diabetes and previously unrecognized diabetes. Large scale surveys are suggested for better outcome.

Keywords: Diabetes; Pre-Diabetes; Oral Glucose Tolerance Test; Glycosylated Hemoglobin

Introduction

Diabetes mellitus (DM) is a metabolic disorder with heterogeneous etiologies of disturbances of carbohydrate, fat and protein metabolism due to defect of insulin secretion, action or both. The International Diabetes Estimate for the global prevalence of impaired glucose tolerance (IGT) is projected to increase from 6.9% of 2013 to 8% by 2035. Almost 30% of Americans have either impaired glucose plasma glucose (IFG) and over 40% of those aged 20 years or older have IGT, IFG or type 2 diabetes mellitus [1]. Several cohort studies

have demonstrated a gradient of increasing mortality risk from normoglycemia to IFG to IGT and finally to diabetes [2,3]. Both IFG and IGT are asymptomatic, intermediate states of abnormal glucose regulation that proceed to overt type 2 diabetes [4]. A meta-analysis of prospective studies conducted in different populations estimated an annualized relative risk of 4.7 to 12% from IGT and/or IFG to type 2 diabetes mellitus, with annual absolute risks between 5% and 10% [5]. A number of large studies have been carried out internationally with aim to identify effective interventions to delay or prevent development of type 2 DM in individuals at high risk of developing the disease [6].

Aim of the Study

Our aim of the present study was to evaluate DM and pre-diabetes with recommended tools in patients with clinical risk factors and/ or symptoms in subjects who were previously undiagnosed.

Materials and Methods

This was a cross-sectional cohort study conducted from March 2013 to October 2014 in the Postgraduate Department of Medicine, Government Medical College, Srinagar - a tertiary care center of Jammu and Kashmir, India.

Study population and setting

The study population was drawn primarily from the patients visiting the department with one or more of the clinical risk factors: (i) BMI greater than 23 kg/m^2, (ii) family history of diabetes (especially first degree relatives); (iii) history of vascular disease (coronary artery disease, stroke, peripheral arterial disease); (iv) history of hypertension; (v) previous history of IGF and (vii) clinical conditions associated with insulin resistance (e.g. acanthosis nigricans) and/or one or more of the symptoms including polydypsia, polyuria, and unexplained weight loss. The study population included subjects with age of 18 years and above belonging to both sexes.

Those known to have diabetes, or taking corticosteroids, or carrying pregnancy, were excluded from the study.

Sample collection

The selected subjects were subjected to oral glucose challenge test (GCT) in which 50g glucose was given orally at any time of day without prior fast, and glucose levels were measured one hour later. The sample were transported to the clinical laboratory immediately to avoid the risk of false results. The study included estimation of plasma glucose and glycosylated hemoglobin (HbA1c). The samples were drawn from antecubital veins and the estimation of plasma glucose was done using automatic biochemistry analyze (Abbott C 4000). On second visit of every selected subject, oral glucose tolerance test (OGTT) was carried by estimation of plasma glucose after intake of 75g of glucose at 0 and 2 hours, and patients were categorized as normal, pre-diabetes and diabetics according to the guidelines of the American Diabetes Association [7]. The subjects were classified at increased risk for diabetes on the basis of IFG of 100 - 125 mg/ dL or IGT at 2h of 140 - 199 mg/dL.

Statistical analysis

The analysis was conducted by experience statistician using statistical package for social sciences (SPSS, Ver. 20). Continuous data were expressed as mean ± SD and categorical data as percentages. Chi-square test was used wherever necessary and p value of less than 0.05 was considered statistically significant.

Results

The total cohort comprised of 783 patients, majority of 329 (58%) were males, in the age group of 28 to 73 with a mean ± SD of 51.89 ± 11.16 years. Most of the patients (48.1%) belonged to the age group of 40 to 60 years. 53% of patients belonged to the rural

community. 588 (75.1%) were hypertensives and 67 (8.6%) were having historical evidence of vascular disease (myocardial infarction, stroke or peripheral vascular disease). 78 (10%) patients were having family history of diabetes among first degree relatives, and 84 (10.7%) patients were having biochemical evidence of dyslipidemia. 11 (1.4%) patients were found to have conditions associated with insulin resistance, like acanthosis nigricans. The mean BMI of the cohort was 25.21 ± 3.19 kg/m². HbA1c ranged from 5.0 to 7.2% with a mean of 5.42 ± 0.35%, and value of more than 5.5% was seen among 298 (38.1%) patients. among 783 patients, 517 (66%) had glucose challenge test (GCT) of ≤140 mg/dl. When the standard oral glucose tolerance test (OGTT) after the overnight fast was performed, 254 (69%) subjects were in the diabetic range, 172 (22%) were pre-diabetics and 557 (71.1%) had normal test (Figure 1 and table 1). Among the 54 diabetics, 10 (18.50%) subjects had vascular disease, while as in pre-diabetics, 17 (9.9%) had dyslipidemia (Figure 2). Among the 54 diabetic subjects, 39 (72.2%) had HbA1c greater than 5.5%, while as in pre-diabetics only 85 (49.9%) had this value. Among the 54 diabetic subjects, 50 (92.6%) had GCT plasma/hour greater than 140 mg/dL, carrying high statistical significance (Figure 3). GCT and HbA1c carried high sensitivity and specificity among diabetics compared to pre-diabetics and same was true for negative predictive value (Table 2).

OGTT	Frequency	Percent
Diabetes	54	6.9
Non-diabetes	557	71.1
Pre-diabetes	172	22.0
Total	783	100.0

Table 1

Properties	Diabetes		Prediabetes	
	GCT	HbA1c	GCT	HBA1C
Sensitivity	92.59	72.2	75.58	49.42%
Specificity	84.56%	99.1%	84.56%	99.1%
Positive Predictive Value	36.76%	88.64%	60.19%	94.44%
Negative predictive value	99.16%	97.35%	91.81%	86.38%
Diagnostic accuracy	85.27%	96.73%	82.44%	87.38%
Cohen's Kappa (unweighted)	0.457	0.77	0.552	0.5809

Table 2: Sensitivity, specificity, positive predictive value, negative predictive value of glucose challenge test in prediabetes and diabetes.
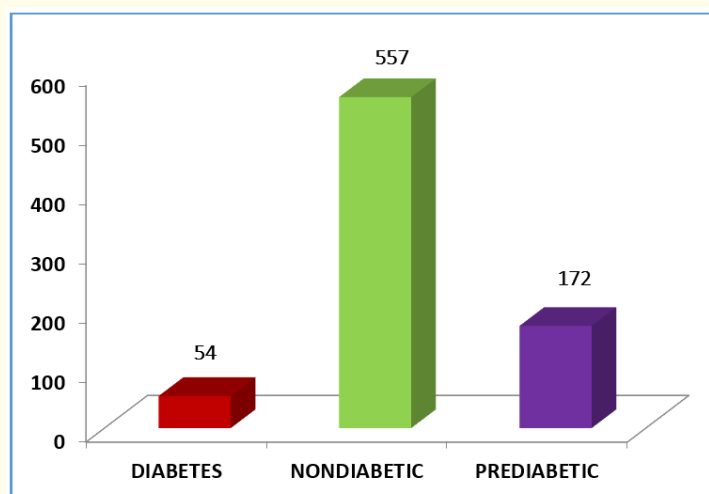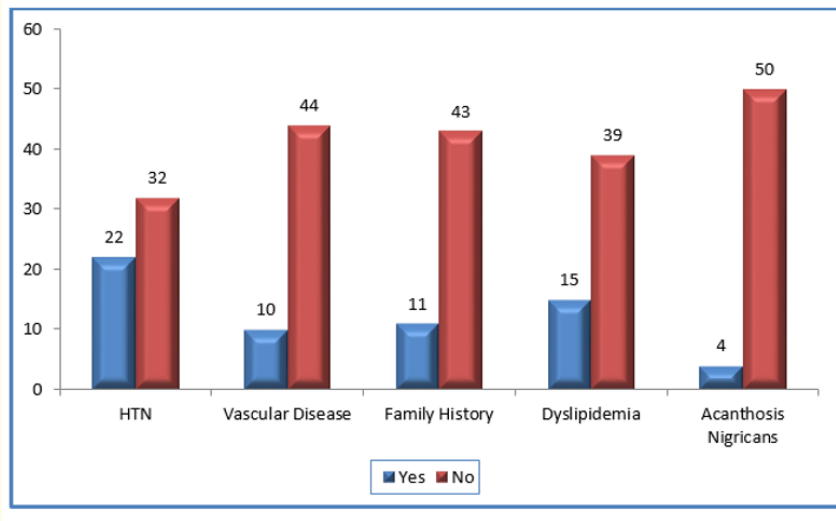

Figure 1: OGTT.
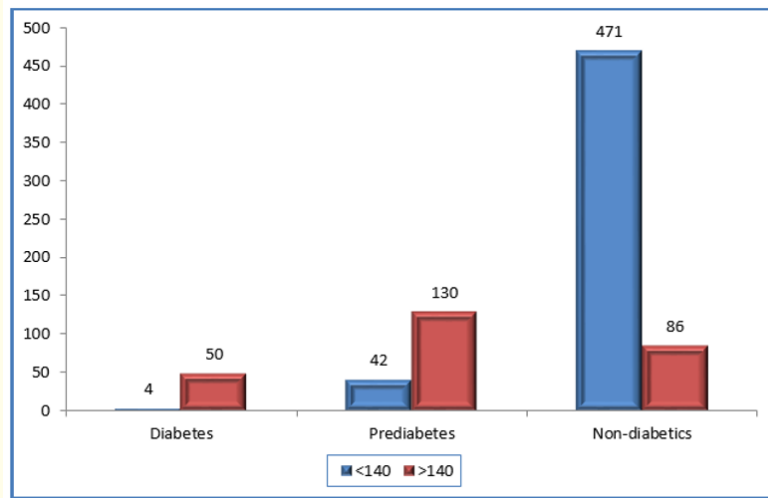
Figure 2: Diabetes and risk factors.

Figure 3: OGTT GCT.

Discussion

A good number of studies have been carried out internationally with aim to identify effective interventions to delay or prevent the occurrence of type 2 DM in individuals at risk [8-12]. Our study using HbA1c to identify pre-diabetics and diabetics at cut off of ≥ 5.5%

showed sensitivity and specificity of 72.22% and 68.75% respectively among diabetics while as it was 49.42% and 68.76% respectively amongst the pre-diabetic subjects. Similarly, previous studies from UK [13], China [14], Germany [15] were conducted relating to the performance of HbA1c. Mohan and co-workers [16] from India in 2010 examined cut points for glucose intolerance and IFG according to WHO criteria, the optimal cut point was 5.6% giving a sensitivity of 60%, specificity of 56.5% and positive predictive value of 8.0%. The authors concluded on HbA1c cut point of 5.6% would identify Asian Indians with IGT and/or IFG with 69 to 74% accuracy at optimal sensitivity and specificity. Zhou and co-authors [17] conducted a survey in Beijing to determine the performance of HbA1c as a screening tool for detecting newly diagnosed diabetes and pre-diabetes. It was claimed that optimal cut off point for pre-diabetes with HbA1c of ≥ 5.7% demonstrated sensitivity and specificity of 59.4% and 73.9% respectively. Again, Phillips and co-workers [18] in 2009 aimed to determine the risk assessment using a strategy similar to that used for gestational diabetes. Optimal GCT plasma cut off 7.8 mmol/L (140 mg/dL) provided a sensitivity of 73%, specificity of 68% and positive predictive value of 34%. Area under the curve for detecting diabetes was 0.79. The GCT plasma screening appeared to be more accurate, convenient and widely applicable. Lee and co-authors [19] conducted cross-sectional study of 254 overweight or obese (BMI ≥ 84th percentile) children aged 10 - 17 years. The test performance was assessed using receiver operating characteristics curves and calculations of area under the curves. It was observed that random glucose estimation or 1-h GCT may potentially be incorporated into clinical practice as initial screening tests for pre-diabetes and diabetes for determining which subject should undergo further definitive testing.

Conclusion

To conclude, similar other large sample studies may be conducted in future for early detection and prevention of pre-diabetes and diabetes to improve patient care.

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Volume 18 Issue 9 September 2022