Original Research Article

Cross-sectional study to compare the biochemical parameters in low normal versus high normal plasma glucose levels in euglycemic individuals

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ABSTRACT

Background: Since a long time ago, the experts have realized that determination of cut-off point for diagnosing diabetes will be revised over time with the lower blood glucose level as the more sensitive diagnosis for detecting the occurring complication and biochemical changes.

Methods: This cross sectional study was carried out in the department of medicine, M.G.M. Medical College and M.Y. Hospital Indore from July, 2016 to August, 2017 in 200 individuals and patients having euglycemic status attending General Medicine OPD.

Results: In the low and high normal group 2 (2.0%) and 8 (8.0%) were having abnormal total cholesterol (TC) level respectively. The mean total cholesterol in the low normal group was 117.16±26.94mg/dl and it was 154.74±28.38mg/dl in the high normal group. The difference was found to be statistically significant (p value 0.000). In the low and high normal group, 4 (4.0%) and 17 (17.0%) were having abnormal triglyceride (TG) levels respectively. The mean TG levels in the low and high normal group were 96.93±22.64mg/dl and 110.55±32.37mg/dl respectively. The difference was found to be statistically significant (p value 0.001). In the low and high normal group, 6 (6.0%) and 14 (14.0%) patient was having abnormal uric acid levels respectively. The mean uric acid levels in the low and high normal group was 4.88±1.10mg/dl and 5.31±1.31mg/dl respectively. The difference was found to be statistically significant (p value 0.013).

Conclusions: Higher levels of Cholesterol and Triglycerides were found more commonly in high normal euglycemic group compared to low normal euglycemic group. Mean cholesterol and mean triglyceride levels were higher in high normal euglycemic group.

Keywords: Cholesterol, Diabetes, Euglycemia, Triglyceride, Uric acid

INTRODUCTION

It has been known that the diagnosis of diabetes should be made early to prevent cardiovascular and other metabolic complications. So far, determination of blood glucose levels has been used to diagnose diabetes. As a matter of fact, some diabetic patients had already had chronic complication at the first time of diagnosis. It shows why the glucose-centric definition for diagnosing diabetes that has been used so far could not be applied to the sole diagnosis criteria for a group of patients with such "syndrome". Blood glucose examination and the cut-off point for diagnosing diabetes have become

controversial debates for a long time. Blood glucose examination and the cut-off point for diagnosing diabetes have become controversial debates for a long time.

In 1979, the National Diabetes Data Group (NDDG) made diagnostic criteria for diabetes, which subsequently have been used for over 2 decades. At that time, the Committee used the cut-off point of blood glucose level based on distribution and it was not associated with the correlation between blood glucose level and chronic complication. Diagnosis of diabetes was established when fasting plasma glucose level (FPG) >140 mg/dl; 2-hour post-prandial blood glucose or 2-hours PPG >200 mg/dl.[1-5]

Classification of diabetes mellitus reviewed the principles of diagnosis for diabetes. The Committee used the new approach for diagnosing diabetes by correlating the blood glucose level with the distribution of long-term complications. The Committee considered three epidemiological studies, i.e. the population study in Egypt (n=1018), US National Health and Nutrition Examination Survey (NHANES) survey (n=2821), PIMA Indians study with HbA1c as diagnostic criteria (n=960).[6,7] Those three studies used retinopathy complication as the dependent variable for determining the cut-off point of blood glucose level. By applying such approach, the criteria of diabetes has been changed particularly from FPG >140mg/dl into >126mg/dl. The cut-off point may reveal more linearity association between FPG and PPG.

In addition to establishing diagnosis criteria for diabetes, the Committee also introduced the terms "impaired fasting glucose" (IFG) and "impaired glucose tolerance" (IGT) to differentiate metabolic conditions between the normal groups and diabetics; with the criteria of 110-125mg/dl and 140-199mg/dl, respectively. Consequently, WHO adapted such approach and suggested individual with IFG should have oral glucose tolerance test (OGTT) to avoid the false-negative result and recommended OGTT as the gold standard for diagnosing diabetes.

The metabolic syndrome is a cluster of the most dangerous heart attack risk factors: diabetes and raised fasting plasma glucose, abdominal obesity, high cholesterol and high blood pressure.[8,9] It is estimated that around 20-25 percent of the world's adult population have the metabolic syndrome and they are twice as likely to die from and three times as likely to have a heart attack or stroke compared with people without the syndrome. In addition, people with metabolic syndrome have a fivefold greater risk of developing type 2 diabetes.[10]

Since a long time ago, the experts have realized that determination of cut-off point for diagnosing diabetes will be revised over time with the lower blood glucose level as the more sensitive diagnosis for detecting the occurring complication.

METHODS

This cross sectional study was carried out in the department of medicine, MGM Medical College and MY Hospital Indore from July 2016 to August 2017. We included 200 individuals and patients having euglycemic status attending General Medicine OPD, Endocrine OPD and Medicine Wards.

We arbitrarily divided fasting euglycemia into low normal below <85mg/dl and high normal ranging from 86-100mg/dl and post prandial euglycemia into low normal ranging from <120mg/dl and high normal ranging from 121-140mg/dl. All patients or legally acceptable representative provided written inform consent for participation. The research protocol and informed consent form was approved by scientific review committee.

Inclusion criteria

- All consenting individuals found to be euglycemic.
- Age group: adult population of 18 - 60 years.

Exclusion criteria

- Known case of diabetes.
- Patients not giving consent.
- Patients on drugs causing hypoglycemia (e.g. Beta-blockers, Haloperidol, Quinidine, MAO inhibitors etc.).
- Patients on drugs causing hyperglycemia (e.g. Corticosteroids, Fluoroquinolones, thiazide and thiazide like drugs etc.).

Patients included in the study were subjected to full history including family history for Diabetes and Hypertension. Then patient is examined clinically and hemodynamically. Blood samples were withdrawn and investigations planned (Complete Hemogram, Renal Function Test, Lipid Profile, and Uric Acid) were done and if patient/ individual is found to be euglycemic, he/she is included in the study after his/her consent.

Statistical methods

Data were prospectively collected and coded prior to analysis using the professional statistical Package for Social Science (SPSS) software. The description of data was in the form of mean (±) SD for quantitative data and frequency and proportion for qualitative data. Unpaired 't' test (t) applied was used for comparison between two groups regarding normally distributed (parametric) quantitative data. Results were considered significant if p <0.05.

RESULTS

This cross sectional study was carried out in the department of medicine, M.G.M. Medical College and M.Y. Hospital Indore from July 2016 to August 2017.

We included 200 individuals and patients having euglycemic status. Our results are as follows:

Table 1 shows distribution of patients according to total cholesterol level in both the groups. In the low normal group, 98 (98.0%) patients were having normal total cholesterol level and only 2 (2.0%) were having abnormal total cholesterol level. In the high normal group, 92 (92.0%) patients were having normal total cholesterol level and only 8 (8.0%) were having abnormal total cholesterol level. The mean total cholesterol in the low normal group was 117.16±26.94mg/dl and it was 154.74±28.38mg/dl in the high normal group. The difference was found to be statistically significant (p value 0.000), showing a higher total cholesterol level in the high normal group.

Table 1: Distribution of patients according to total cholesterol level.

Total cholesterol level	Low normal group FBS≤85 PPBS≤120		High normal group FBS>85 PPBS>120	
	No.	Percentage	No.	Percentage
Normal (≤ 200 mg/dL)	98	98.0	92	92.0
Abnormal (>200 mg/dL)	2	2.0	8	8.0
Total	100	100.0	100	100.0
Mean±SD	117.16±26.94		154.74±28.38	
't' value	-9.605, df=198			
p value	0.000*			

Unpaired 't' test applied. p value = 0.000, Significant

Table 2: Distribution of patients according to triglyceride level.

Triglyceride level	Low normal group FBS≤85 PPBS≤120		High normal group FBS>85 PPBS>120	
	No.	Percentage	No.	Percentage
Normal (≤ 150 mg/dL)	96	96.0	83	83.0
Abnormal (>150 mg/dL)	4	4.0	17	17.0
Total	100	100.0	100	100.0
Mean±SD	96.93±22.64		110.55±32.37	
't' value	-3.448, df=198			
p value	0.001*			

Unpaired 't' test applied. p value = 0.001, Significant

Table 2 shows the distribution of patients according to triglyceride levels in both the groups. In the low normal group, 96(96.0%) patients were having normal triglyceride levels and 4(4.0%) were having abnormal triglyceride levels. In the high normal group, 83 (83.0%) patients were having normal triglyceride levels and 17

(17.0%) were having abnormal triglyceride levels. The mean triglyceride level in the low normal group was 96.93±22.64mg/dl and in the high normal group it was 110.55±32.37mg/dl. The difference was found to be statistically significant (p value 0.001), showing a higher triglyceride levels in the high normal group in comparison of low normal group.

Table 3: Distribution of patients according to uric acid level.

Uric acid level	Low normal group FBS≤85 PPBS≤120		High normal group FBS>85 PPBS>120	
	No.	Percentage	No.	Percentage
Normal (3.4-7.0 mg/dL)	94	94.0	86	86.0
Abnormal (>7.0 mg/dL)	6	6.0	14	14.0
Total	100	100.0	100	100.0
Mean±SD	4.88±1.10		5.31±1.31	
't' value	-2.497, df=198			
p value	0.013*			

Unpaired 't' test applied. p value = 0.013, Significant

Table 3 shows the distribution of patients according to uric acid level in both the groups. In the low normal group, 6(6.0%) patient was having abnormal uric acid level, and 94(94.0%) were having normal uric acid level. In the high normal group, 14(14.0%) patient was having abnormal uric acid level, and 86(86.0%) were having normal uric acid level. The mean uric acid level in the low normal group was 4.88±1.10mg/dl and in the high normal group it was 5.31±1.31mg/d. The difference was found to be statistically significant (p value 0.013), showing a higher abnormal uric acid level in the high normal group in comparison to the low normal group.

DISCUSSION

This cross sectional study was carried out in the department of medicine, M.G.M. Medical College and M.Y. Hospital Indore from July 2016 to August 2017. We included 200 individuals and patients having euglycemic status. The p value was found to be significant in high normal Euglycemic group in Triglyceride, Cholesterol, and Uric acid. Our study showed that Triglyceride, Cholesterol, and Uric acid were on higher side in high normal euglycemic individuals suggesting that the individuals in high normal euglycemic group are at risk of developing diabetes and metabolic complications, cardiovascular complications in future. On the basis of these findings we can advise interventions like – Health education, life style modification, weight reduction and restrictions and modifications in Dietary Habits to prevent complications of metabolic syndrome. In addition, future screening for diabetes and other complications can be advised.

According to Gastroenterology society of Australia Fatty liver is associated with Obesity (20% obese patients have fatty liver), high blood TC and TG are also associated with Diabetes Mellitus. In our study also high normal euglycemic individuals are more commonly associated with fatty liver when compared with low normal euglycemic individuals. Indian Journal Endocrinology and Metabolism performed a study - Prevalence of dyslipidemia in adult Indian diabetic patients: A cross sectional study (SOLID) according to this study Diabetes mellitus is one of the most common chronic diseases globally and continues to increase in numbers.[11] It is among the top five causes of mortality. Diabetes is considered a coronary heart disease (CHD)- risk equivalent and it is frequently associated with various other cardiovascular (CV) risk factors.[12] It is well-established that dyslipidemia is a major risk factor for macrovascular complications in patients with type-2 diabetes mellitus (T2DM) and affects 10%-73% of this population.

Approximately, 80% of deaths in patients with diabetes are attributable to cardiovascular disease. In our study also high normal euglycemic individuals are more commonly associated higher levels of Cholesterol and Triglycerides when compared with low normal euglycemic individuals. According to Global Diabetes Community obesity is believed to account for 80-85% of the risk of developing type 2 Diabetes Mellitus, while recent research suggests that obese people are up to 80 times more likely to develop type 2 Diabetes Mellitus than those with a BMI of less than 22.

Studies suggest that abdominal fat causes fat cells to release 'pro-inflammatory' chemicals, which can make the body less sensitive to the insulin it produces by disrupting the function of insulin responsive cells and their ability to respond to insulin. This is known as insulin resistance - the hallmark of type 2 diabetes. Having excess abdominal fat (i.e. a large waistline) is known as central or abdominal obesity, a particularly high-risk form of obesity. 85 In our study also BMI and Waist-Hip ratio was found to be on higher side in high normal euglycemic individuals when compared with low normal euglycemic individuals.

CONCLUSION

Higher levels of cholesterol and triglycerides were found more commonly in high normal euglycemic group compared to low normal euglycemic group. Mean cholesterol and mean triglyceride levels were higher in high normal euglycemic group.

Ethical approval: The study was approved by the Institutional Ethics Committee

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