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The "cardiometabolic index" as a new marker determined by adiposity and blood lipids for discrimination of patients with type 2 diabetes mellitus

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Abstract:

*__background:__Diabetes is a well-established independent risk factor for cardiovascular diseases (CVD). Compared with non-diabetic individuals, diabetic patients have 2 to 4 times increased risk for stroke and death from heart disease.
*__aim:__ - Studying the relationship between cardiometabolic index and severity of diabetes.
*__patients&methods__: Cross sectional stydy, was carried out in the Clinical Pathology Department, Faculty of medicine, Sohag university hospital, on 200 patients known to have type 2 diabetes mellitus the outpatient diabetic clinic, in addition to 100 healthy individuals with the mean age as it was 53 years in all groups.
*__results__: In our study group 2 (diabetic obese) showed the worst values for both lipid profile and HbA1c, followed by group 1 (diabetic non obese) and group 3 (controls) showed the best figures. Also BMI was much higher among group 2 (diabetic obese) compared to both groups 1 and 3.
*__conclusion__:Dyslipidemia increases the risk of CVD in type-2 diabetic patients.

Introduction:

The prevalence of type 2 DM is undergoing a rapid progression ***(Harati et al., 2009)***. Diabetic patients are more likely to have dyslipidemia such as high triglyceridemia, low HDL cholestrolemia, and atherogenic small dense LDL ***(Mooradian et al., 2009 and Dunn et al., 2010)***.

Diabetes mellitus is associated with a considerably increased risk of premature atherosclerotic cardiovascular disease. Intensive glycemic control has essentially failed to significantly improve cardiovascular outcomes in clinical trials. Dyslipidemia is common in diabetes and there is strong evidence that cholesterol lowering improves cardiovascular outcomes, even in patients with apparently unremarkable lipid profiles(***Jonathan D.Schofield, Yifen Liu, Prasanna Rao-Balakrishna, Rayaz et al.2016***).

Adiposity, defined by higher cardiometabolic index (CMI), lipid accumulation product (LAP), and body adiposity index (BAI), has conferred increased metabolic risk. (***Haoyu Wang , Yintao Chen et al 2018***).

The ratio of triglycerides to HDL-C (TG/HDL-C ratio) has been proposed to be a good discriminator for cardiovascular risk , also (TG/HDL-C) has been shown to be associated with insulin resistance ***(McLaughlin et al.,***

2005) and metabolic syndrome ***(Cordero et al., 2008)***.

Waist to height ratio (WHtR) has been shown to be a better discriminator of coronary heart disease and cardiovascular risk factors than waist circumference and body mass index(BMI) ***(Lee et al., 2008; Gruson et al., 2010 and Ashwell et al., 2012)***.

Now there is cardiometabolic index (CMI), calculated as the product of TG/HDL-C ratio and WHtR which are good predictors of coronary heart disease and a central component of metabolic syndrome ***(Alberti et al., 2005)***.

Objectives:

- Studying the relationship between cardiometabolic index and severity of diabetes.

Patients and methods :

This study conducted on two groups:

1- Control group: 100 persons completely healthy.
2- Diabetic group: 200 diabetic patients will be divided into:

a) 100 obese.
b) 100 non- obese.

All subjects (patients and controls) will be subjected to:

1- Complete history taking and general examination.
2- Calculation of body mass index (BMI).
3- The following parameters are done in this study:

A) Routine investigations:

- Complete blood count (CBC).
- Erythrocytic Sedimentation Rate (ESR).
- Urine analysis.
- Liver function tests: serum bilirubin (total, direct and indirect), aspartate aminotransferase (AST), alanine aminotransferase (ALT), Albumin and alkaline phosphatase (ALP).
- Renal function tests: blood urea and serum creatinine.

B) Specific investigations:

- Lipid profile(cholesterol,triglycerides,high density lipoprotein(HDL)and low density lipoprotein(LDL).
- Calculation of triglycerides/high density lipoprotein (TG/HDL) ratio.
- Glycated hemoglobin (HbA1c).
- Calculation of waist to height ratio.

Results of the study:

§ This study was carried on 200 cases with type 2 diabetes mellitus 113 males, 87 females , their ages ranged from 33 to 75 years were collected from the outpatient diabetic clinic of sohag university hospital. Statistical package for social sciences (IBM-SPSS), version 24 IBM- Chicago, USA (May 2016) was used for statistical data analysis.

§ Data expressed as mean, standard deviation (SD), number and percentage. Mean and standard deviation were used as descriptive value for quantitative data, while number and percentage were used to describe qualitative data.

§ Student t test was used to compare the means between two groups, and one-way analysis of variance (ANOVA) test with post HOC tests were used to compare means of more than two groups.

§ Pearson Chi square was used to compare percentages of qualitative data.

§ ROC curve analysis was used to predict the value of CMI to differentiate diabetic or obese or both patients from non diabetics, or non obese ones.

§ For all these tests, the level of significance (P-value) can be explained as:

- No significance P > 0.05

§ Table 1. Lipid profile and HbA1c comparison among the three groups

	Diabetic, non obese	Diabetic, obese	Controls	P value*
TG (mg/dl)	192.07±51.00	218.86±55.63	102.27±18.36	**<0.001**
Cholesterol (mg/dl)	198.26±28.40	209.36±31.27	132.22±31.90	**<0.001**
HDLC (mg/dl)	47.17±7.11	42.52±6.87	51.88±8.52	**<0.001**
LDL (mg/dl)	108.37±20.14	120.30±17.06	84.11±10.17	**<0.001**
VLDL (mg/dl)	37.55±8.58	42.52±7.57	25.77±4.19	**<0.001**
HbA1c	8.24±1.24	9.17±1.45	5.24±0.61	**<0.001**

§ * one way ANOVA was used to compare means of the three groups

§ This table shows that group 2 (diabetic obese) showed the worst values for both lipid profile and HbA1c, followed by group 1 (diabetic non obese) and group 3 (controls) showed the best figures. The differences were all highly significant using one way ANOVA.

§

§ **Table2. Weight, height, waist circumference and BMI among the three groups**

Group	Weight (kg)	Height (cm)	Waist circumference (cm)	BMI
Group 1 (diabetic, non obese)	76.04±7.51	169.90±6.41	78.19±15.73	26.33±2.04
Group 2 (diabetic, obese)	94.40±10.04	167.12±6.41	101.98±7.81	33.79±2.95
Group 3 (controls)	71.85±7.47	166.79±7.18	77.30±7.29	25.76±1.01
P value				
1 vs 2	**<0.001**	**0.002**	**<0.001**	**<0.001**
1 vs 3	**<0.001**	**0.001**	0.608	**0.012**
2 vs 3	**<0.001**	0.732	**<0.001**	**<0.001**
All groups	**<0.001**	**0.002**	**<0.001**	**<0.001**

§ This table shows that BMI was much higher among group 2 compared to both groups 1 and 3, and also, it was significantly higher among group 1 compared to group 3.

Table 3. TG/HDL; waist/height and CMI comparison among the three groups

Group	TH/HDL	Waist/height	CMI
Group 1 (diabetic, non obese)	4.26±1.66	0.46±0.10	1.98±0.91
Group 2 (diabetic, obese)	5.35±1.86	0.61±0.04	3.29±1.23
Group 3 (controls)	2.03±0.51	0.46±0.04	0.94±0.24
P value			
1 vs 2	**<0.001**	**<0.001**	**<0.001**
1 vs 3	**<0.001**	0.840	**<0.001**
2 vs 3	**<0.001**	**<0.001**	**<0.001**
All groups	**<0.001**	**<0.001**	**<0.001**

Discussion:

Diabetes is a well-established independent risk factor for cardiovascular diseases (CVD). Compared with non-diabetic individuals, diabetic patients have 2 to 4 times increased risk for stroke and death from heart disease. Hyperglycemia cannot entirely account for the high cardiovascular risk in diabetic patients. In fact, aggressive glycemic control does not necessarily lead to a substantial reduction in cardiovascular events or mortality. In recent decades, strategies for managing vascular complications associated with diabetes have moved away from a "glucocentric" approach to address additional risk factors that contribute to the development and progression of atherosclerosis ***(Lorenzo et al. 2013)***.

A very common metabolic abnormality associated with diabetes is dyslipidemia, which is characterized by a spectrum of quantitative and qualitative changes in lipids and lipoproteins. A common pattern of lipid abnormalities, known as diabetic dyslipidemia, includes hypertriglyceridemia, reduced high-density lipoprotein (HDL)-cholesterol concentration and a shift towards small dense lowdensity lipoprotein (LDL) ***(Arca et al. 2012)***.

Dyslipidemia increases the risk of CVD in type-2 diabetic patients. Hypertriglyceridemia, low HDL and elevated small dense LDL concentrations are all associated with CVD, but their relative contribution to the development of atherosclerotic vascular disease is still unclear. A causal relationship between LDL and atherosclerosis is well established, but not for HDL ***(Shah et al. 2013)***.

The main objective of this trial is to investigate relationships between plasma lipid levels and diabetes prevalence in patients attending to our out-patient clinic because we are interested in the relationship between diabetes and dyslipidemia, cardiometabolic syndrome.

This study included three groups (diabetic, non diabetics, and controls). There was no significant difference between the three groups regarding the mean age as it was 53 years in all groups, also in study of ***Kumar et al. (2016)*** mean age of their patients was 50.3 years with range 25-85 years.

In diabetic patients, several researches have evidently established that complications are mainly due to chronic hyperglycemia that exerts its adverse to health effects through numerous mechanisms: dyslipidemia, platelet activation, and altered endothelial metabolism ***(Ozder. 2014)***.

In our study group 2 (diabetic obese) showed the worst values for both **lipid profile and HbA1c**, followed by group 1 (diabetic non obese) and group 3 (controls) showed the best figures. **Also BMI** was much higher among group 2 (diabetic obese) compared to both groups 1 and 3.

Similar to observations in other population, our study demonstrated that **TG&HDL** was much higher among group 2 (diabetic obese) compared to both groups 1 and 3, and also waist/height, CMI, were significantly higher among group 1 compared to group 3, this was in agreement with study of ***Jain et al. (2016)*** as they shown that TG, TC, LDL-C, and VLDL-C, the lipid profile was higher significantly in diabetes than and HDL-C was significantly lower in diabetics than control groups.

In study of ***Abdel-Aal et al. (2008)*** they reported higher mean serum levels of LDL, cholesterol, total cholesterol, and triglycerides were noted in patients with diabetes, which are well known risk factors for cardiovascular diseases among diabetic patients. Higher level of LDL (34.9%) and hypercholesterolemia (34.6%) were the most frequent and found almost in similar proportion in all diabetic patients. The third prevalent dyslipidemia was hypertriglyceridemia affecting 29.8% of their studied subjects. Their findings of hypercholesterolemia and hypertriglyceridemia were almost half way between two studies from Ethiopia ***(Seyoum et al. 2003, Siraj et al. 2006)***, in which hypercholesterolemia was found the most prevalent with 18.5 to 47.5% of all studied diabetic patients; while hypertriglyceridemia was the second prevalent with 14.2 to 41.8% of all study participants. In addition, their results had some similarity with study from Botswana ***(Addisu. 2006)*** but by far lower than study finding from the UK ***(Lawrence et al. 2001)***.

In the Heart Protection Study, 5963 patients were included, in diabetic subgroup 40 mg/day simvastatin was administered for 5 years. At the end of the trial results pointed out decrease of MI frequency by 37 %, and cardio-vascular mortality by 20 %. On the other hand, in patients with high risk, lowering LDL-C levels by a ratio of 20-30 % lead to a decrease of cardiovascular risk by 30 % ***(Collins et al. 2003)***.

Conclusion:

Diabetes is a well-established independent risk factor for cardiovascular diseases (CVD). Compared with non-diabetic individuals, diabetic patients have 2 to 4 times increased risk for stroke and death from heart disease.

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