Alteration of Glucidic Metabolism in Relation with Visceral Adiposity Index

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Obesity is has become a major problem worldwide. Since 1975, the prevalence of obesity nearly trippled, and nowadays we are facing an obesity epidemic. Obesity is a major risk factor for many diseases such as cardiovascular ones (mainly heart disease and stroke) -being the leading cause of death worldwide, musculoskeletal disorders or type 2 diabetes mellitus (DM).

Key words: visceral adiposity index, diabetes mellitus, obesity, prediabetes, glycated hemoglobin

Obesity is a major risk factor for insulin resistance and type 2 diabetes mellitus (DM). It is well known the association between abdominal obesity (visceral fat), DM and cardiovascular risk [1]. Insulin resistance, mediated by obesity, correlates with accumulation of macrophages and triggering the inflammatory process. Worldwide, metabolic disorders have been worrying over the past few years. We are seeing what is called an obesity epidemic along with the diabetes epidemic (DM) [2].

Recently, it is insisted that in medical practice we should consider cardiovascular risk and metabolic risk as one single notion, that of cardiometabolic risk. The argument is the involvement of common risk factors in its pathogenesis, namely the genetic predisposition on which *pro-risk* environmental factors occur [3]. These factors lead to visceral obesity, visceral adipose tissue that behaves as a true *endocrine organ* that secrets adipokines and vasoactive substances, that are associated with a major risk of atherogenesis, the development of cardiovascular diseases, metabolic diseases, including DM with all complications associated with its evolution. For these reasons, to develop cardiovascular risk prevention and to implement therapeutic strategies, it is imperative to develop global risk assessment systems.

To evaluate the cardiometabolic risk associated with visceral obesity, it was attempted to identify a useful indicator in clinical practice [4]. Thus, Amato et al. [5], in a study of a European Caucasian population, validated a visceral obesity index defined as the Visceral Adiposity Index (VAI). VAI could become an easy-to-use tool in everyday practice that highlights cardiometabolic risk. The VAI formula considers gender (Males/Females), anthropometric measurements (abdominal circumference, body mass index), biochemical tests (triglycerides, HDL cholesterol).

Experimental part

The aim of the study

This study aims to identify the utility of the visceral adiposity index (VAI) in estimating the glucose metabolic dysfunction expressed by the presence of DM.

Material and methods

The study was conducted over 3 years (2011-2014) and included patients with diabetes mellitus, prediabetes and subjects without diabetes or prediabetes. The study, an epidemiologically, transversally, noninterventionally type, was conducted by analyzing 300 subjects divided into three subgroups, as follows: Subgroup 1 included 100 prediabetic patients; Subgroup 2 included 100 patients with type 2 diabetes and subgroup 3 (control) of 100 individuals randomly recruited without diabetes or prediabetes. In these patients, the following anamnestic data were recorded: age, sex, personal history of diabetes mellitus. Clinically, the following anthropometric data were evaluated: weight, height, body mass index, waist circumference. Venous blood was harvested from which the following tests were performed: blood glucose, HbA1c, HDL-cholesterol, triglycerides. The oral glucose tolerance test (OGTT) was performed in all patients included in the prediabetes subgroup, who had either impared fasting

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glucose (IFG) or impared glucose tolerance (IGT) and all patients without DM or prediabetes.

Visceral adiposity index (VAI) was calculated, according to gender, according by the following formulas:

$$\text{Males: VAI} = \left(\frac{\text{WC}}{39.68 + (1.88 \times \text{BMI})}\right) \times \left(\frac{\text{TG}}{1.03}\right) \times \left(\frac{1.31}{\text{HDL}}\right)$$

$$\text{Females: VAI} = \left(\frac{\text{WC}}{36.58 + (1.89 \times \text{BMI})}\right) \times \left(\frac{\text{TG}}{0.81}\right) \times \left(\frac{1.52}{\text{HDL}}\right)$$

where: VAI = visceral adiposity index, WC = waist circumference, BMI = body mass index, TG = triglyceride, HDL = HDL-Cholesterol

The obtained data was recorded as a Microsoft Excel spreadsheet and analyzed for each of the three subgroups using Microsoft Excel (Microsoft Corp., Redmond, WA, USA) together with XLSTAT 2014 for Microsoft Excel (Addinsoft SARL, Paris, France) and IBM SPSS Statistics 17.0 (IBM Corporation, Armonk, NY, USA) in order to analyze the relationships between clinical and paraclinical data of patients. For statistical analysis, the SPSS (Statistical Package for Social Sciences) version 17.0 for Windows was used.

Results and discussions

Each batch comprised patients equally divided by age and gender. The decades of age in which the patients of each group were assigned as table 1 shows.

Table 1

DECADES OF AGE AND SEX DISTRIBUTION OF THE THREE GROUPS

Decades	No. Men	No. Female
20 - 39 years	1 (2%)	1 (2%)
40 – 59 years	17 (34%)	17 (34%)
60 – 79 years	32 (64%)	32 (64%)
TOTAL	50 (100%)	50 (100%)

The glycated hemoglobin mean in the control subgroup was 5.43% ± 0.38, in the prediabet subgroup was 5.86% ± 0.19 and in the subgroup of diabetic patients was 7.14% ± 1,.57, reflecting good metabolic control of diabetic patients (table 2).

By calculating VAI, we obtained an average of 4.99 for prediabetic patients, greater than 6.22 for patients with DM and the smallest mean of 4.88 being found in the control subgroup, statistically significant difference between subgroups (p = 0.039) (table 3).

Table 2

CHARACTERIZATION OF THE 3 GROUPS ACCORDING TO THE MEAN VALUE OF GLYCATED HEMOGLOBIN

Variable	GROUP	Mean (SD)	95% CI	p
HbA1c	SUBGROUP 1	5.86 (0.19)	5.82862 – 5.90520	< **0.001**
	SUBGROUP 2	7.14 (1.57)	6.83384 – 7.46066	
	SUBGROUP 3	5.43 (0.38)	5.36402 – 5.51518	

Table 3

ASSESSMENT OF VAI IN THE 3 SUBGROUPS

Variable	GROUP	Media (SD)	95% CI	p
Visceral adiposity index (VAI)	SUBGROUP 1	4.99 (4.04)	4.182-5.805	**0.039**
	SUBGROUP 2	6.22 (4.9)	5.393-7.066	
	SUBGROUP 3	4.85 (4.13)	4.016-5.7	

We analyzed the linear correlation between the VAI value and the HbA1c value by the Pearson evaluation method and we found that no positive linear correlation of the VAI value with the HbA1c value (R = 0.025, p = 0.809) was observed at the control group level (fig. 1) , while for prediabetic groups (R = 0.199, p = 0.04) and diabetes (R = 0.202, p = 0.04) the VAI value correlated positively, statistically significant (fig. 2,3). Thus, we can assert that a higher value of VAI is predictive of a higher HbA1c value.

Obesity and, in particular, abdominal obesity is a complex and aggressive form of disease with a huge potential for cardiovascular and metabolic diseases, associating with anomalies of glucose metabolism.

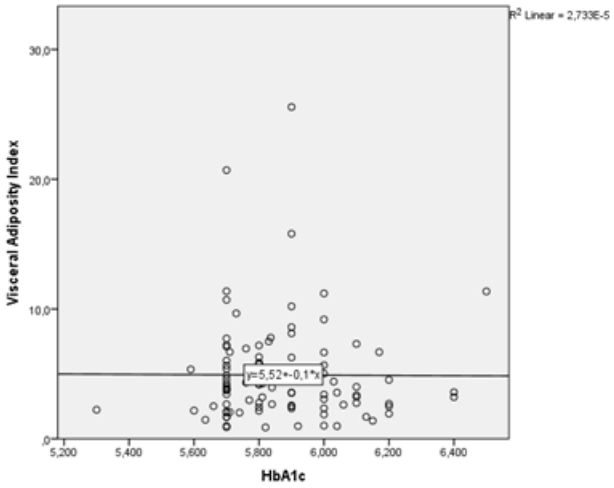

Fig. 1. Correlation of VAI with HbA1c value in control subgroup

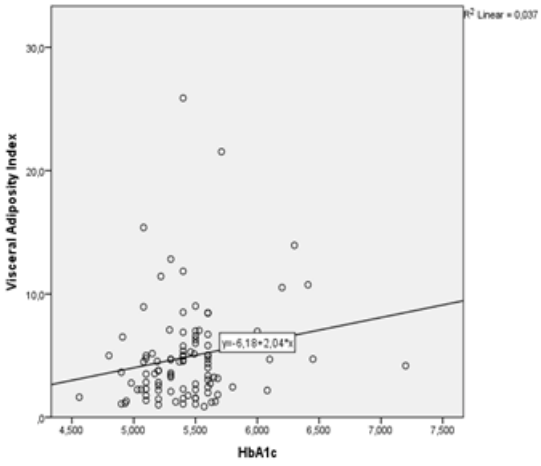

Fig 2. Correlation of VAI with HbA1c value in the prediabetic subgroup

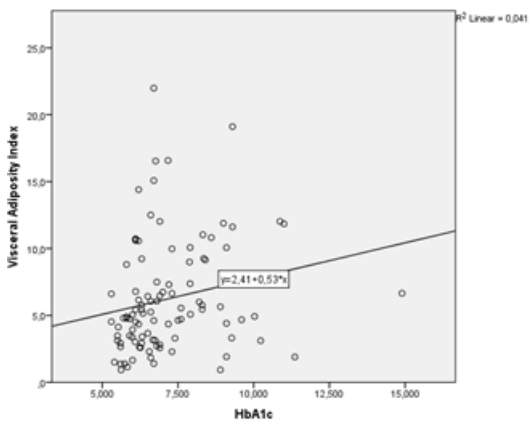

Fig 3. Correlation of VAI with HbA1c value in the diabetic subgroup

The visceral adiposity index [6] is associated with increased adipocytokine production with proinflammatory activity [7], deterioration of insulin sensitivity [8], increased risk of developing DM, atherosclerosis and a higher mortality rate [9-12]. The identification of an applicable routine method, possibly an indicator for visceral adiposity assessment, with greater sensitivity and specificity than conventional parameters (such as CT, BMI, and lipid fractions) could be useful for assessing cardiometabolic risk. The current study shows statistically significant correlations of VAI values with the HbA1c value.

Conclusions

The VAI assessment concluded that it had a higher mean value in diabetic patients followed by those with prediabetes, with the lowest mean value being found in the control subgroup, a statistically significant difference between subgroups.

The VAI value and the HbA1c value correlated positively statistically significantly in prediabetic and diabetic patients but not in control patients, so we can assert that higher VAI is predictive of a higher HbA1c. VAI can thus be interpreted as an easy and useful tool in estimating the glycemic metabolism imbalance.

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