Brief report

TyG index performs better than HOMA in a Brazilian population: A hyperglycemic clamp validated study

Ana Carolina Junqueira Vasques*, Fernanda Satake Novaes, Maria da Saúde de Oliveira, José Roberto Matos Souza, Ademar Yamanaka, José Carlos Pareja, Marcos Antonio Tambascia, Mário José Abdalla Saad, Bruno Geloneze

Laboratory of Investigation on Metabolism and Diabetes (LIMED), Department of Internal Medicine, School of Medicine, State University of Campinas, Campinas, Brazil

A R T I C L E   I N F O

Article history:
Received 14 December 2010
Received in revised form 14 March 2011
Accepted 19 May 2011
Published on line 12 June 2011

Keywords:
Insulin resistance
Hyperglycemic clamp
Adiposity
Diabetes mellitus

A B S T R A C T

The TyG index was evaluated as a surrogate method for estimation of insulin resistance (IR). TyG index correlated with adiposity, metabolic and atherosclerosis markers related to IR and presented a moderate degree of agreement with hyperglycemic clamp. TyG index represents an accessible tool for assessment of IR in clinical practice.

© 2011 Elsevier Ireland Ltd. Open access under the Elsevier OA license.

1. Introduction

The assessment of insulin resistance (IR) is of interest because of its key role in type 2 diabetes mellitus and metabolic syndrome. The homeostatic model assessment (HOMA) is a validated and widely used method to measure IR from fasting glucose and insulin in epidemiological studies and has also been used in clinical practice [1]. However, laboratory determinations of plasma insulin are yet not available and standardized in all services.

Recently, the TyG index, a product from the fasting levels of triglycerides and glucose, presented promising results as surrogate marker for the assessment of IR in Mexican patients [2,3]. The spectrum of triglyceride and also IR levels is variable according to ethnicity. So, validation is necessary to allow the application of new indexes in different populations.

Given the continuing need for methods with accessibility and with good discriminating power for the assessment of IR, we evaluate the potential of using TyG index to assess IR in a sample of Brazilian subjects, an admixture population, as well TyG index correlation with adiposity, metabolic and subclinical atherosclerosis markers related to IR.

2. Patients and methods

A cross-sectional study was conducted with 82 patients (84% female). This study was approved by the Ethics Committee of
the School of Medical Sciences of State University of Campinas, Brazil.

Patients underwent an anthropometrical and a body composition (bioelectrical impedance) assessment. Ultrasonography was applied to measure intra-abdominal visceral and subcutaneous adipose tissue [4] and carotid intima-media thickness [5]. The transthoracic echocardiogram measured epicardial adipose tissue thickness on right ventricle [6]. Fasting plasma glucose, insulin, triglycerides, total cholesterol and fractions, adiponectin and C-reactive protein (CRP) were determined. HOMA2-IR [1] and TyG indexes [2,3] were calculated. The 3-h hyperglycemic clamp test (180 mg/dl) was the reference method for IR [7]. The mean glucose infusion rate (GIR,FMD) of the last clamp hour was adjusted for free fat mass and represented the IR level of each subject [8].

Statistical analysis comprised Spearman’s correlation test, inter-rater agreement weighted k test, and ROC analysis.

3. Results

A total of 82 subjects aged 22–81 (47.3 ± 14.6) years participated in this study. According to the ADA criteria, 33% were type 2 diabetic and 66% had normal glucose tolerance. In the BMI assessment, 29.3% were normal weight, 25.6% overweight and 45.1% obese.

As demonstrated in Table 1, the TyG index was significant correlated with several parameters of adiposity, metabolic and subclinical atherosclerosis related to IR. In general, the correlations for the TyG index were better compared with the HOMA2-IR and it is noteworthy that the correlation found for the GIR was stronger for the TyG index (Fig. 1).

Fig. 1 – Correlations between TyG index (A) and HOMA2-IR (B) with insulin resistance from the hyperglycemic clamp test.

Table 1 – Correlations between TyG index and HOMA2-IR with adiposity, metabolic and subclinical atherosclerosis markers.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>TyG index</th>
<th>HOMA2-IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiposity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body mass index</td>
<td>0.47**</td>
<td>0.51***</td>
</tr>
<tr>
<td>Waist circumference</td>
<td>0.52**</td>
<td>0.52**</td>
</tr>
<tr>
<td>Sagittal abdominal diameter</td>
<td>0.59**</td>
<td>0.59***</td>
</tr>
<tr>
<td>Subcutaneous adipose tissue</td>
<td>0.14</td>
<td>0.11</td>
</tr>
<tr>
<td>Visceral adipose tissue</td>
<td>0.65**</td>
<td>0.49**</td>
</tr>
<tr>
<td>Epicardial adipose tissue</td>
<td>0.36**</td>
<td>0.31</td>
</tr>
<tr>
<td>Metabolic profile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fasting insulin</td>
<td>0.54**</td>
<td>0.98***</td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>0.33**</td>
<td>-0.03</td>
</tr>
<tr>
<td>LDL cholesterol</td>
<td>0.35**</td>
<td>-0.01</td>
</tr>
<tr>
<td>HDL cholesterol</td>
<td>-0.55**</td>
<td>-0.39**</td>
</tr>
<tr>
<td>C reactive protein</td>
<td>0.35**</td>
<td>0.26**</td>
</tr>
<tr>
<td>Adiponectin</td>
<td>-0.59**</td>
<td>-0.43**</td>
</tr>
<tr>
<td>Subclinical atherosclerosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intima media thickness</td>
<td>0.35**</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Spearman coefficient of correlation.

* p < 0.05.

** p < 0.01.

*** p < 0.001.

Fig. 2 – Receiver operating characteristic (ROC) scatter plot for TyG index in the identification of insulin resistance.
The kappa test computed a moderate degree of agreement between TyG index and the reference parameter (GIRTM) obtained from the hyperglycemic clamp test (weighted k coefficient of agreement = 0.431; \( p < 0.001 \)).

In the ROC analysis, the TyG showed a slightly better performance in comparison with the HOMA2-IR in identifying patients with IR (Fig. 2).

4. Discussion

The present study evaluated the performance of the TyG index in the assessment of IR in a sample of Brazilian subjects in a wide range of adiposity and glucose tolerance. This index has the advantage of being applicable into clinical practice since both triglyceride and glucose concentrations are inexpensive and routinely measured.

Although the coefficient of agreement and the area under the curve identified in the present study were not so elevated as demonstrated in Mexican study already published [2,3], the TyG index presented a slightly better performance in comparison with the HOMA2-IR index. Furthermore, TyG index was correlated with fat distribution and fat depots, metabolic parameters and markers of subclinical atherosclerosis related to IR. Hence, TyG index was significantly correlated to a first line measurement of IR, i.e. hyperglycemic clamp.

5. Conclusions

The TyG index represents a useful and accessible tool for assessment of IR in our Brazilian population.

Acknowledgements

We thank the FAPESP for their financial support.

Conflict of interest

There are no conflicts of interest.

REFERENCES