

Original Article

Comparison of insulin resistance by indirect methods - HOMA, QUICKI and McAuley - with fasting insulin in patients with type 2 diabetes in Galle, Sri Lanka: A pilot study

Authors

Lukshmy M. Hettihewa

Department of Pharmacology, Faculty of Medicine, Molecular Science and Biomedical Unit, University of Ruhuna, Sri Lanka

Shalika Palangasinghe

Department of Pharmacology, Faculty of Medicine, University of Ruhuna, Sri Lanka

Sudheera S. Jayasinghe

Department of Pharmacology, Faculty of Medicine, University of Ruhuna, Sri Lanka

Sudari W. Gunasekara

Department of Pharmacology, Faculty of Medicine, University of Ruhuna, Sri Lanka

Thilak P. Weerarathna

Department of Medicine, Faculty of Medicine, University of Ruhuna, Sri Lanka

Address For Correspondence

Dr. L.M. Hettihewa

Molecular Science and Biomedical Unit,
Department of Pharmacology,
Faculty of Medicine,
University of Ruhuna, Sri Lanka.

E-mail: lukshmy@yahoo.com

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Materials and Methods:

Forty two recently diagnosed Type 2 diabetic patients were included in the study from clinics of public and private hospitals. Inclusion criteria of our study were fasting plasma glucose >7 mmol/L (126 mg/dl) in one occasion if the patient is symptomatic, or in two occasions if the patient is asymptomatic. Clinical history was obtained from all patients including age, sex, drugs, smoking, alcohol consumption, level of physical exercise, previous history of diabetes, coronary heart disease and peripheral vascular disease. Family history of diabetes was also ascertained. Following exclusion criteria were used in this study: hypothyroidism, liver, kidney or heart failure and neoplasm. Informed written consent was taken from the selected patients. After 12 hours of overnight fast, each participant's weight, height and blood pressure were measured and recorded. Blood samples were collected into the in dry tubes with EDTA. Plasma was separated immediately by centrifugation at 4000 rpm for a period of 10 minutes. Fasting blood glucose was assessed by absorbance method (Diagnostic- Merck). Fasting insulin was assessed by ELISA (Diagnostic-Automation). Fasting triglyceride levels were measured enzymatically by colorimetric test (LABKIT). Four indirect methods used for the assessment of IR were calculated using the equations mentioned below.

$$\text{McAuley (McA)} = \exp [2.63 - 0.28 \ln (\text{insulin in mU/L}) - 0.31 \ln (\text{triglycerides in mmol/L})]$$
$$\text{HOMA} = \text{insulin (mU/m)} \times [\text{glucose (mmol/L)}/22.5]$$
$$\text{QUICKI} = 1/(\log \text{insulin} + \log \text{glycemia in mg/dL})$$

Patients were considered as insulin resistant when $\text{McA} \leq 5.8$, $\text{HOMA} \geq 2.6$ and $\text{QUICKI} \leq 0.33$.^{7,8} Fasting insulin was considered to assess IR and FI level $\geq 12\text{mU/l}$ was considered as insulin resistant among both non-diabetic and diabetic ($<15\text{mU/l}$) populations.⁷⁻⁹

Statistical analysis: For the descriptive statistics after having checked the normality of the variables using the Kolmogorov-Smirnov test, the usual central and dispersion methods were used: average, SD, and 95% CI. The statistical significance of differences between the means were evaluated using the paired Student's T-test in the case of normal distribution of data sets, and using the Kolmogorov-Smirnov test when at least in one of the data sets the normal distribution was excluded. The sensitivity and specificity of insulin resistance indexes were estimated as true-positive results/(true-positive results + false-negative results) and true-negative results/(true-negative results + false-positive results), respectively. Sensitivity showed the ability to detect insulin resistance by doing fasting insulin alone when patients are really insulin resistant by the gold standard method. Specificity detected the ability to as insulin sensitive when the patients are really insulin sensitive by the gold standard. Cohen's kappa was used to check the validity of FI as a diagnostic test to determine the IR. Correlation between two variables was studied with the Spearman rank-order. All statistical analyses were performed using Microcal origin 4.1 and Microsoft Excel whenever applicable.

having IR by FI test. 13% of patients who were detected by HOMA and QUICKI were not detected by FI. This can be explained by limitations that were found out with HOMA and QUICKI with other researchers. One limitation is that HOMA is calculated from fasting glucose and fasting insulin and thereby reflects only hepatic insulin sensitivity.¹⁰ Results of the Miyazaki's group facilitate these findings by studying the composite insulin resistance, which includes both hepatic and peripheral resistance for the assessment of insulin sensitivity in diabetic patients.¹² Therefore, considering all the factors we hereby suggest that FI is sensitive and also specific as McA in assessment of IR in diabetic population. Our results are in agreement with results obtained by Louise S.C⁹ et al showing that significant negative correlation between HOMA-IR and sensitivity (S) ($r = -0.89$, $r = -0.90$, and $r = -0.81$, $P < 0.01$) and a significant positive correlation between QUICKI and S ($r = 0.89$, $r = 0.90$, and $r = 0.81$, $P < 0.01$) at each time point. They suggested that HOMA-IR, QUICKI and fasting insulin correlate strongly with S assessed by the FSIVGTT (frequently sampled intravenous glucose tolerance test) in obese children and adolescents.⁹

In addition, the correlations of FI with McA, HOMA and QUICKI are significant ($p < 0.01$). We also found that FI test had significant sensitivity and specificity when compared to McA, HOMA & QUICKI indices. This observation suggests that assessment of IR by FI gives parallel results to the assessment of IR by other methods. Validity of FI was further analyzed by Cohen's kappa test and had a satisfactory agreement ($k = 0.7$). All together, suggest that FI can be used as an easy test to detect IR also in diabetic population. We also would like to draw your attention on our minor failures, in our study plan. Because our study sample is small, our results might not predict values in population based research in diabetes. Therefore, we would like to draw an attention on population based studies for assessment of sensitivity and specificity of this FI test prior to the recommendation for clinical practice.

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