Insulin resistance detection using spectral analysis of arterial plethysmography versus Euglycemic Hyperinsulinemic Clamp

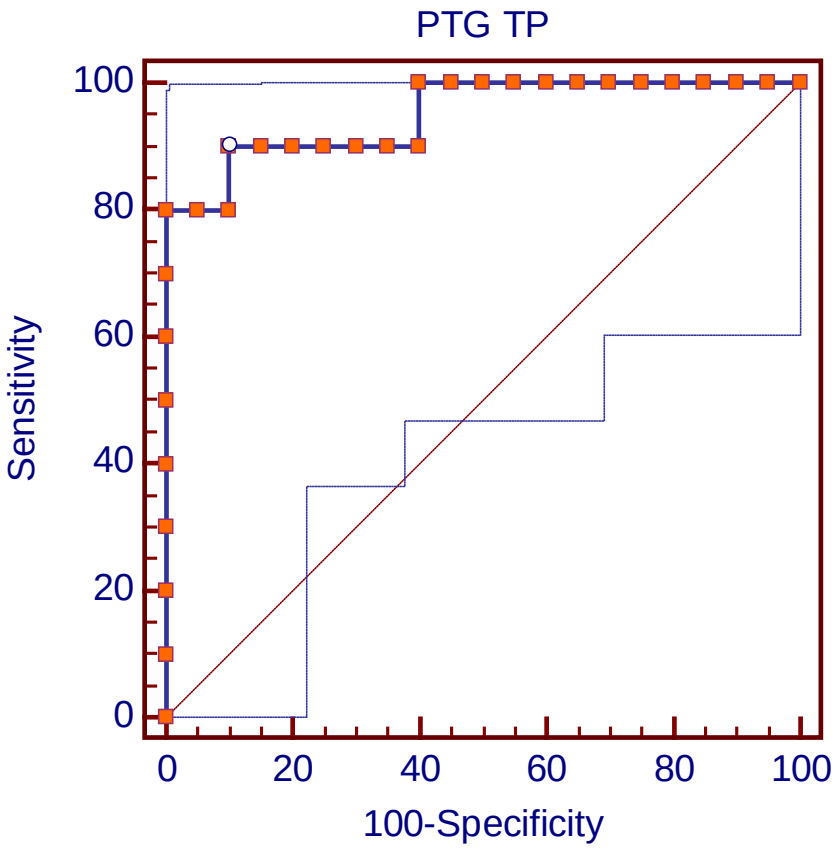
Background: Insulin resistance is a condition in which the body produces insulin but does not use it properly and usually this condition has no symptoms. Moreover, insulin resistance is a strong a risk factor of type 2 diabetes and cardiovascular diseases. Insulin resistance carried a greater risk for developing cardiovascular disease than smoking or age or total / HDLcholesterol ratio. Because insulin resistance can be reversed, the early detection is a requirement to reduce the pandemic diabetes diseases and its complications such as retinopathy, nephropathy, hypertension and cardiovascular diseases.

Material and method:
Thirty patients (23 women) of mean age 32 (range 22-55) years, who were candidates for euglycemic clamp were included in the study, and underwent euglycemic hyperinsulinemic clamp tests and examination with the TM-Oxi system. The TM-Oxi system is using 2 technologies (blood pressure device and oximeter) and the software performs signal processing analysis of the oximeter data (photoelectrical plethysmography and rate variability analysis) in time domain and spectral analysis. Also, The TM-Oxi system had the capacity to receive the data from patient at home using a the TM-Oxi Kit and HIPAA server
We investigated the cross-sectional association between insulin sensitivity (*M/I*, assessed using euglycemic hyperinsulinemic clamp) and the spectral analysis of the total records of the photoelectrical plethysmograph (PTG).
Statistical analysis was performed to correlate M/I ratio and PTG Total Power (PTG TP) using the Spearman's coefficient of rank correlation and Brand Altman Plot. Receiver-operating characteristic curves were also constructed to determine the specificity and sensitivity of PTG TP in detecting a M/I ratio value < 4.5.

Results:
The Spearman's coefficient of rank correlation (rho) was -0.624 (P. 0.001). PTG TP had a sensitivity of 90 % and specificity of 90% (cutoff # 370ms2) to detect M/I ratio value < 4.5 (P.0.0001).

Conclusion: The PTG TP has a good predictive correlation with M/I ratio, and high specificity and sensitivity to detect M/I ratio value < 4.5.
Therefore, PTG TP provided by the TM-Oxi system represents a novel parameter of screening and follow ups for insulin resistance on a large scale. This parameter is independent factor of risk of age and BMI of the patients. Such a tool, which is easy to administer, non-invasive, cost-effective, and could be used at home with telemedicine feature and results analyzed by practitioner would be of great benefit for control the pandemic diabetes diseases and its complications. A new study is ongoing to confirm the results with 100 patients.

Keywords: Insulin resistance, TM-Oxi system, euglycemic hyperinsulinemic clamp PTG TP, Telemedicine, large scale screening and follow ups.



Variable	PTG_TP PTG TP
Classification variable	diagnostic diagnostic

Sample size	30
Positive group : diagnostic = 1	10
Negative group : diagnostic = 0	20

Disease prevalence (%)	33.3

Area under the ROC curve (AUC)

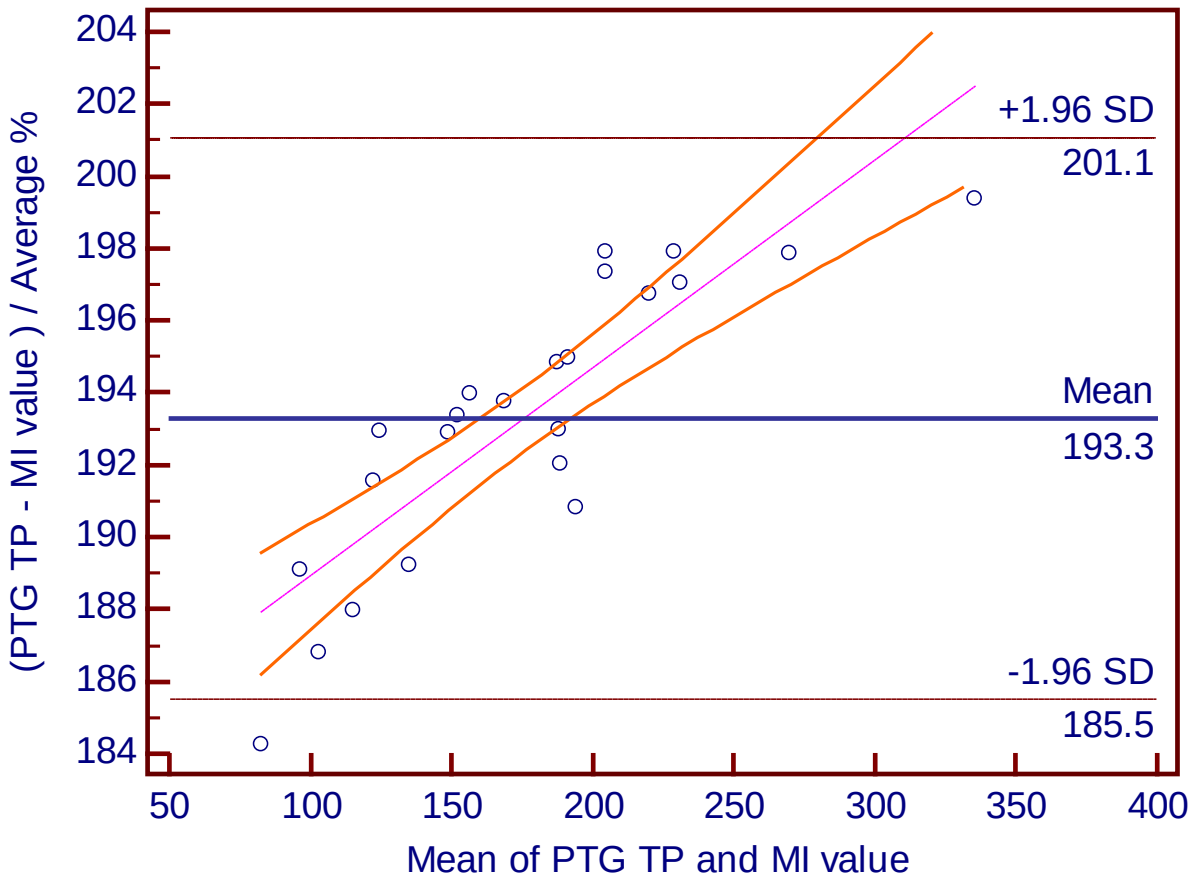
Area under the ROC curve (AUC)	0.950
Standard Error[a]	0.0426
95% Confidence interval[b]	0.803 to 0.996
z statistic	10.555
Significance level P (Area=0.5)	<0.0001

[a] Hanley & McNeil, 1982
[b] Binomial exact

Summary Table

Estimated specificity at fixed sensitivity			
Sensitivity	Specificity	95% CI[a]	Criterion
80.00	100.00	30.00 to 100.00	>379.67
90.00	90.00	35.00 to 100.00	>370
95.00	60.00	20.00 to 85.00	>302.385
97.50	60.00	20.00 to 85.00	>300.7225
Estimated sensitivity at fixed specificity			
Specificity	Sensitivity	95% CI[a]	Criterion
80.00	90.00	40.84 to 100.00	>369.68
90.00	90.00	50.00 to 100.00	>370
95.00	80.00	31.50 to 90.00	>377.88
97.50	80.00	31.50 to 90.00	>378.775

[a] BC_a bootstrap interval (1000 iterations).


204
202
200
198
196
194
192
190
188
186
184
(PTG TP - MI value) / Average %
+1.96 SD
201.1
Mean
193.3
-1.96 SD
185.5
50
100
150
200
250
300
350
400
Mean of PTG TP and MI value