Cardiovascular Diabetology

Original investigation

Predictive models of insulin resistance derived from simple morphometric and biochemical indices related to obesity and the metabolic syndrome in baboons

Alberto O Chavez[1], Amalia Gastaldelli[2], Rodolfo Guardado-Mendoza[1], Juan C Lopez-Alvarenga[3], M Michelle Leland[4], M Elizabeth Tejero[3], GianPio Sorice[1], Francesca Casiraghi[1], Alberto Davalli[5], Raúl A Bastarrachea[3], Anthony G Comuzzie[3], Ralph A DeFronzo[1] and Franco Folli*[1,3,6]

Address: [1]Department of Medicine, Diabetes Division, University of Texas Health Science Center at San Antonio, San Antonio, TX, USA, [2]Fondazione G. Monasterio and Institute of Clinical Physiology-CNR, Pisa, Italy, [3]Genetics Department, Southwest Foundation for Biomedical Research, San Antonio, TX, USA, [4]Lab Animal Resources. University of Texas Health Science Center at San Antonio, San Antonio, TX, USA, [5]Istituto Scientifico San Raffaele, Milan, Italy and [6]Department of Pharmacology, University of Texas Health Science Center at San Antonio, San Antonio, TX, USA

Email: Alberto O Chavez - chavezvelazq@uthscsa.edu; Amalia Gastaldelli - amalia@ifc.cnr.it; Rodolfo Guardado-Mendoza - guardadomenr@uthscsa.edu; Juan C Lopez-Alvarenga - jalvaren@sfbrgenetic.org; M Michelle Leland - lelandm@uthscsa.edu; M Elizabeth Tejero - ltejero@sfbrgenetics.org; GianPio Sorice - sorice@uthscsa.edu; Francesca Casiraghi - casiraghi@uthscsa.edu; Alberto Davalli - alberto.davalli@hsr.it; Raúl A Bastarrachea - raulbs@sfbrgenetics.org; Anthony G Comuzzie - tony@sfbrgenetics.org; Ralph A DeFronzo - albarado@uthscsa.edu; Franco Folli* - folli@uthscsa.edu

* Corresponding author

Abstract

Background: Non-human primates are valuable models for the study of insulin resistance and human obesity. In baboons, insulin sensitivity levels can be evaluated directly with the euglycemic clamp and is highly predicted by adiposity, metabolic markers of obesity and impaired glucose metabolism (i.e. percent body fat by DXA and HbA_{1c}). However, a simple method to screen and identify obese insulin resistant baboons for inclusion in interventional studies is not available.

Methods: We studied a population of twenty baboons with the euglycemic clamp technique to characterize a population of obese nondiabetic, insulin resistant baboons, and used a multivariate linear regression analysis (adjusted for gender) to test different predictive models of insulin sensitivity (insulin-stimulated glucose uptake = Rd) using abdominal circumference and fasting plasma insulin. Alternatively, we tested in a separate baboon population (n = 159), a simpler model based on body weight and fasting plasma glucose to predict the whole-body insulin sensitivity (Rd/SSPI) derived from the clamp.

Results: In the first model, abdominal circumference explained 59% of total insulin mediated glucose uptake (Rd). A second model, which included fasting plasma insulin (log transformed) and abdominal circumference, explained 64% of Rd. Finally, the model using body weight and fasting plasma glucose explained 51% of Rd/SSPI. Interestingly, we found that percent body fat was directly correlated with the adipocyte insulin resistance index (r = 0.755, p < 0.0001).

Conclusion: In baboons, simple morphometric measurements of adiposity/obesity, (i.e. abdominal circumference), plus baseline markers of glucose/lipid metabolism, (i.e. fasting plasma glucose and insulin) provide a feasible method to screen and identify overweight/obese insulin resistant baboons for inclusion in interventional studies aimed to study human obesity, insulin resistance and type 2 diabetes mellitus.