

TSF12-2012-000002

Abstract for an Invited Paper
for the TSF12 Meeting of
the American Physical Society

Theory and experiment in biomedical science¹

ROLAND ALLEN, Department of Physics and Astronomy, Texas A&M University

A physicist might regard a person as a collection of electrons and quarks, and a biologist might regard her as an assemblage of biochemical molecules. But according to some speakers at a recent Welch conference [1] biology is a branch of physics. Then biomedical research is a branch of applied physics. Even if one adopts a more modest perspective, it is still true that physics can contribute strongly to biomedical research. An example on the experimental side is the recent studies of G protein-coupled receptors (targeted by more than 50 percent of therapeutic drugs) using synchrotron radiation and nuclear magnetic resonance. On the theory side, one might classify models as microscopic (e.g., simulations of molecules, ions, or electrons), mesoscopic (e.g., simulations of pathways within a cell), or macroscopic (e.g., calculations of processes involving the whole body). We have recently introduced a new macroscopic method for estimating the biochemical response to pharmaceuticals, surgeries, or other medical interventions, and applied it in a simple model of the response to bariatric surgeries [2]. An amazing effect is that the most widely used bariatric surgery (Roux-en-Y-gastric bypass) usually leads to remission of type 2 diabetes in days, long before there is any significant weight loss (with further beneficial effects in the subsequent months and years). Our results confirm that this effect can be largely explained by the enhanced post-meal excretion of glucagon-like peptide 1 (GLP-1), an incretin that increases insulin secretion from the pancreas, but also suggest that other mechanisms are likely to be involved, possibly including an additional insulin-independent pathway for glucose transport into cells.

[1] Physical Biology, from Atoms to Medicine, edited by Ahmed H. Zewail (Imperial College Press, London, 2008).

[2] Roland E. Allen, Tyler D. Hughes, Jia Lerd Ng, Roberto D. Ortiz, Michel Abou Ghantous, Othmane Bouhali, Abdelilah Arredouani, “Biochemical response and the effects of bariatric surgeries on type 2 diabetes” (submitted).

¹Supported by the Qatar Foundation through the Qatar Biomedical Research Institute and Texas A&M Qatar.