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Fractal properties of blood glucose fluctuations

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Blood glucose concentrations are the end result of a complex interplay between multiple intrinsic and extrinsicfactors. These factors are governed by multiple regulatory systems and feedback loops. The introduction of continuous glucose monitoring sensors (CGMS) gave us the opportunity to get a closer look at the dynamics of blood glucose fluctuations and the regulatory processes that control it. Since CGMS's record the data in equally spaced discrete intervals, the continuous data can be regarded as a time series and analyzed as such. Many limitations imposed by the traditional analysis techniques can thus be overcome, and new insights on the dynamics of the regulatory systems of blood glucose fluctuations can be gained. The aim of our study was to analyze the dynamics of blood glucose concentrations during prolonged time periods using nonlinear chaos-based analysis techniques. The results of our analyses revealed that the dynamics of glucose concentrations in diabetic patients is far from a stochastic-random process and follows a fractal pattern. Self-similarity, power-law behaviour and phase space reconstruction reveal repetitive pattern and imply that self-regulatory processes are operative not only in healthy individuals but also in diabetic patients. De-trended fluctuation analysis shows that glucose fluctuations have selfsimilar properties that extend in multiple time scales. These findings open an angle for further investigations and understanding of the dynamics of regulatory processes and feedback loops in health and disease.

Biography

Weissman is a senior obstetrician in the delivery ward of the Rambam Medical Center. He graduated from the Sackler School of Medicine at Tel Aviv University. His main areas of interest are obstetrics, perinatology and ultrasound. He has authored over 60 publications in peer-reviewed medical journals related to these areas of interest. Additionally, Weissman studied at the Technion's Faculty of Biomedical Engineering, specializing in laboratory methods in biomedicine and signal analysis. Weissman heads the High-risk Pregnancy Clinic at Lin Medical Center, and also manages the Diabetes in Pregnancy Clinic. He is actively involved in studies in the areas of the physiology of women, parturients, fetuses and neonates. He is also an instructor for students, nurses and doctors completing their doctoral or master's thesis.

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