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ORIGINAL ARTICLE

Minimizing the Impact of Time Lag Variability on Accuracy Evaluation of Continuous Glucose Monitoring Systems

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Abstract

Background:

Despite all commercially available continuous glucose monitoring (CGM) systems being designed to operate in the extracellular interstitial fluid, and even though there is a well-recognized time lag between the interstitial and the venous compartments, the accuracy of the CGM device readings is still evaluated against the glucose concentration in venous blood (VB) samples, thus resulting in a perceived decrease in accuracy. This article explains how different time lag compensation methods (no compensation, compensation with a fixed delay, compensation with a variable delay based on an intercompartmental diffusional model) have an impact on how CGM accuracy is evaluated.

Methods:

The data set used consisted of 210 CGM/blood glucose data pairs from 18 diabetes subjects (15 type 1 and 3 type 2) selected from a data base collected during two independent clinical trials. All CGM measurements were performed using the GlucoMen®Day CGM system (A. Menarini Diagnostics, Italy), and the reference VB glucose measurements by means of a standard laboratory instrument. For each applied time lag compensation method, the CGM accuracy evaluation was performed as recommended by the POCT05-A consensus guideline.

Results:

The perceived accuracy of the CGM device significantly improved when applying both the fixed or the variable delay compensation method. However, it is worth noting how the variable delay method, which relies on a closer description of the intercompartmental diffusion processes, provided the best perception of the clinical accuracy of the device.

Conclusions:

When assessing the accuracy of a CGM system, a crucial step in data analysis is to account for time lag, which enables minimization of the apparent decline in system accuracy.

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Abbreviations: (BG) blood glucose, (CGM) continuous glucose monitoring, (GMD) GlucoMen Day, (GPB) glucose peak broadening, (IFG) interstitial fluid glucose, (ISF) interstitial fluid, (MAE) mean absolute error, (MARD) mean absolute rate deviation, (MARE) mean absolute relative error, (MedAE) median of the absolute error, (MedARD) median absolute rate deviation, (MedARE) median absolute relative error, (VB) venous blood

Keywords: continuous, GlucoMen Day, glucose, lag, monitoring, time

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