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ORIGINAL ARTICLE

Susceptibility of Interstitial Continuous Glucose Monitor Performance to Sleeping Position

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Abstract

Background:

Developing a round-the-clock artificial pancreas requires accurate and stable continuous glucose monitoring. The most widely used continuous glucose monitors (CGMs) are percutaneous, with the sensor residing in the interstitial space. Inaccuracies in percutaneous CGM readings during periods of lying on the devices (e.g., in various sleeping positions) have been anecdotally reported but not systematically studied.

Methods:

In order to assess the impact of sleep and sleep position on CGM performance, we conducted a study in human subjects in which we measured the variability of interstitial CGM data at night as a function of sleeping position. Commercially available sensors were placed for 4 days in the abdominal subcutaneous tissue in healthy, nondiabetic volunteers (four sensors per person, two per side). Nocturnal sleeping position was determined from video recordings and correlated to sensor data.

Results:

We observed that, although the median of the four sensor readings was typically 70–110 mg/dl during sleep, individual sensors intermittently exhibited aberrant glucose readings (>25 mg/dl away from median) and that these aberrant readings were strongly correlated with subjects lying on the sensors. We expected and observed that most of these aberrant sleep-position-related CGM readings were sudden decreases in reported glucose values, presumably due to local blood-flow decreases caused by tissue compression. Curiously, in rare cases, the aberrant CGM readings were elevated values.

Conclusions:

These findings highlight limitations in our understanding of interstitial fluid physiology in the subcutaneous space and have significant implications for the utilization of sensors in the construction of an artificial pancreas.

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Abbreviations: (CGM) continuous glucose monitor, (NH) nocturnal hypoglycemia, (T1DM) type 1 diabetes mellitus

Keywords: blood flow, continuous glucose monitor, night time hypoglycemia, nocturnal hypoglycemia, pressure, sleep

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