Continuous Glucose Monitoring in the Perioperative Period

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Summary
The performance of two glucose sensing technologies was evaluated in a diabetic surgical patient. The interstitial fluid sensors had a higher correlation (R=0.906) than the vascular sensor (R=0.761).

Background
Continuous glucose monitoring has the potential to improve glycemic control in hospitalized patients with diabetes or stress hyperglycemia. Real-time glucose information will allow aggressive titration of insulin and glucose to achieve and maintain euglycemia, decrease staff workload, and alleviate the fear of hypoglycemia.

Materials and Methods
The performance of a modified Guardian RT System (SC sensor) and Vascular Glucose Monitoring System (IV sensor) was evaluated over 60 hours in the perioperative period. Six SC sensors and one IV sensor were inserted in a surgical patient with type 2 diabetes. Each SC sensor was inserted into the subcutaneous tissue and provided a measurement of the interstitial fluid glucose concentration every minute. The IV sensor was inserted through a central venous catheter and provided a measurement of the blood glucose concentration every minute.

All sensors were inserted preoperatively using aseptic technique. Three SC sensors were inserted through the skin in the upper right chest wall region (sensors 1-3). An additional three SC sensors were inserted in the right upper arm (sensors 4-6). The IV sensor was inserted through a right internal jugular vein central venous catheter so that the distal tip floated freely at the junction of the superior vena cava and right atrium. The patient experienced minimal discomfort during sensor insertions. Reference blood samples were obtained from a radial artery catheter every 20 minutes and assayed for the concentration of glucose using an OMNI 9 Blood Gas Analyzer (Roche Diagnostics).

Analysis was performed on a continuous 40-hour block of data that began 7 hours and 43 minutes after the sensors were inserted, starting in the post operative period. The Pearson correlation coefficient (R) between the reference and sensor measurements was calculated. Paired values were obtained by matching the closest sensor measurement in time with its corresponding reference measurement. The sensor data was not calibrated to reference measurements. The IV sensor data was based on an in-vitro calibration curve.

Results
The sensitivity of SC sensors drifted significantly in the first few hours after subcutaneous insertion (run-in time) whereas the IV sensor did not require a run-in period. In Figure 1, the reference glucose measurements are plotted with the output signals from SC sensors (upper panel) and the IV sensor (lower panel). R was 0.906 ± 0.014 (mean ± SD) for the SC sensors and 0.761 for the IV sensor.

Conclusions
The SC sensor measurements produced better correlation with reference arterial blood glucose measurements than those from the IV sensor. Whereas the SC sensor measures the hydrogen peroxide end-product of the glucose oxidase reaction, the IV sensor measures the amount of oxygen consumed by the reaction and is susceptible to sudden changes in a patient's oxygen levels. The performance of the IV sensor would improve with real-time recalibrations.

Acknowledgements
Research was funded by the Department of the Army and Medtronic Diabetes.