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SYMPOSIUM

Prediction Capability of Optical Coherence Tomography for Blood Glucose Concentration Monitoring

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Abstract

Background:
Optical coherence tomography (OCT) has been shown to be a promising optical approach to noninvasive monitoring of blood glucose concentration because of its capability of probing optical properties at different depths in tissue with high resolution. This article investigates the capability of OCT to predict changes in blood glucose concentration.

Methods:
We varied blood glucose concentration in the physiological range in three sets of experiments. In the first set, we investigated large variations of blood glucose concentration (≈400 mg/dl) and used 2100 OCT A scans for signal averaging. In the second set, we varied blood glucose concentration by approximately 200 mg/dl and used 8400 A scans for signal averaging. In the third set, we improved OCT blood glucose monitoring by increasing and controlling skin temperature under the OCT probe. In this set of experiments we increased the glucose concentration by approximately 300 mg/dl and used 4200 A scans for averaging.

Results:
The predicted glucose concentrations in the first two sets were lower than actual glucose concentration by 10–20% (the mean shift), while the heating and temperature control in the third set of experiments reduced the mean shift down to 1.5%. Therefore, the mean shift was reduced substantially by tissue heating and temperature control. However, it did not depend on the number of A scans to be averaged. In contrast, the uncertainty in OCT prediction of glucose concentration (the standard deviation) did not depend on heating and temperature control, but was reduced substantially from 56 to 24 mg/dl by increasing the number of A scans from 2100 to 8400, respectively.

Conclusion:
These results suggest that the accuracy of OCT-based glucose monitoring is approaching that of standard invasive and minimally invasive techniques.

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Abbreviations: optical coherence tomography (OCT)

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