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ORIGINAL ARTICLE

Hypoglycemia-Associated Electroencephalogram and Electrocardiogram Changes Appear Simultaneously

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Abstract

Background:

Tight glycemic control in type 1 diabetes mellitus (T1DM) may be accomplished only if severe hypoglycemia can be prevented. Biosensor alarms based on the body's reactions to hypoglycemia have been suggested. In the present study, we analyzed three lead electrocardiogram (ECG) and single-channel electroencephalogram (EEG) in T1DM patients during hypoglycemia.

Materials and Methods:

Electrocardiogram and EEG recordings during insulin-induced hypoglycemia in nine patients were used to assess the presence of ECG changes by heart rate, and estimates of QT interval (QTc) and time from top of T wave to end of T wave corrected for heartbeat interval and EEG changes by extraction of the power of the signal in the delta, theta, and alpha bands. These six features were assessed continuously to determine the time between changes and severe hypoglycemia.

Results:

QT interval changes and EEG theta power changes were detected in six and eight out of nine subjects, respectively. Rate of false positive calculations was one out of nine subjects for QTc and none for EEG theta power. Detection time medians (i.e., time from significant changes to termination of experiments) was 13 and 8 min for the EEG theta power and QTc feature, respectively, with no significant difference ($p = .25$).

Conclusions:

Severe hypoglycemia is preceded by changes in both ECG and EEG features in most cases. Electroencephalogram theta power may be superior with respect to timing, sensitivity, and specificity of severe hypoglycemia detection. A multiparameter algorithm that combines data from different biosensors might be considered.

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Abbreviations: (ECG) electrocardiogram, (EEG) electroencephalogram, (HR) heart rate, (QTc) QT interval, (T1DM) type 1 diabetes, (TpTec) time from top of T wave to end of T wave

Keywords: biosensor, diabetes, electrocardiogram, electroencephalogram, human, hypoglycemia

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