Pattern-segmented heart rate variability analysis during fetal maturation

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Introduction

Monitoring fetal heart rate (fHR) and variability (fHRV) covers an important role in assessing the health of a fetus. However, most of the analysis methods have been used to get quantitative measures of the average behavior over entire time series according to established standards.

The traditional assessment of fetal well-being is based on the visual inspection by a trained gynecologist and the FIGO guidelines for cardiotocogram (CTG) classification. The fHR signal is analyzed with respect to four aspects, namely baseline, variability, decelerations and accelerations. These aspects influence the calculated fHRV parameters and are often not considered. Aim of this study was the examination of different pattern-segmented linear and nonlinear fHRV parameters under consideration of the fetal behavioral states using fetal magnetocardiographic recordings. We want to see to what extent the statistical properties of these parameters allow a more precise estimation of the fetal maturation age compared to the established standard fHRV analysis.

Methods

First, the floating baseline of the fHR is estimated and the accelerations and decelerations are detected. After this, each fHRV parameter is calculated for the four types of pattern-segmented beat to beat intervals of 1) the original fHR, 2) the fHR decelerations excluded, 3) the fHR accelerations and decelerations excluded, 4) the baseline corrected fHR.

Dependency of these types of parameters on gestational age and there comparison were evaluated using regression analysis. We analyzed more than 500 fetal magnetocardiographic recordings, each one lasting 30 minutes, of normal fetuses from 20 weeks of gestation onward.

Results/Conclusion

Several fHRV parameters of the four different pattern-segmented beat to beat intervals show substantially different dependencies on maturation age. These results may allow a more accurate assessment of the complex sympathetic and parasympathetic modulations, and consequently, provide an extended foundation for the early sensitive identification of maturation disorders of the fetus.