Fetal heart rate variability analysis for detection of asphyxia can be improved by including uterine activity information

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FETAL HEART RATE VARIABILITY ANALYSIS FOR
DETECTION OF ASPHYXIA CAN BE IMPROVED BY
INCLUDING UTERINE ACTIVITY INFORMATION.

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Abstract
Fetal heart rate variability (HRV) provides information on fetal distress. However, interpretation of fetal HRV during labor is difficult due to the influence of uterine contractions on fetal HRV. The aim of this study is to investigate whether separating contractions and rest periods in HRV analysis can improve the detection of fetal asphyxia.

Keyword(s): biosignals

1. INTRODUCTION
During labor, uterine contractions can cause temporal oxygen deficiency for the fetus. When oxygen deficiency is severe and prolonged, this can result in asphyxia which is associated with neonatal morbidity and mortality. It is therefore important that clinicians can timely intervene before asphyxia develops.

Recent studies have shown that valuable information for detection of asphyxia can be obtained by analysis of fetal heart rate variability (HRV) [1]. However, most HRV features have been developed for adults. Unlike for adults, changes in the fetal cardiovascular system during labor cannot be controlled, which makes interpretation of HRV features difficult. The aim of this study is to examine whether separating contractions and rest periods can improve HRV analysis for the detection of asphyxia during labor.

2. METHODS
A case-control study was performed using 14 fetuses with asphyxia (umbilical artery pH<7.05), matched with 14 healthy fetuses (umbilical artery pH>7.20). In this study, the standard deviation (SD), high frequency power (HF), and sample entropy (SampEn) were used. For each patient, HRV features were calculated using the final 15 minutes of good quality signal before birth (with less than twenty percent loss of fetal heart rate and no loss of uterine activity trace). A comparison was made between HRV features of fetuses with and without asphyxia, when calculated over the entire 15 minutes, and separately during contractions and rest periods.

3. RESULTS
No statistically significant difference was found between the two groups for HRV features calculated from the entire 15 minutes, separately during contractions, or separately during rest periods. However, when considering the ratio between HRV features calculated during contractions and rest periods, SD and SampEn were significantly lower for the group with asphyxia, as shown in Table 1.

Table 1. HRV features: ratio between contractions and rest periods. Results are shown as median [inter-quartile range].

<table>
<thead>
<tr>
<th>HRV feature</th>
<th>without asphyxia</th>
<th>with asphyxia</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD</td>
<td>1.5 [1.1-2.0]</td>
<td>1.1 [1.0-1.3]</td>
</tr>
<tr>
<td>HF</td>
<td>3.1 [1.5-4.5]</td>
<td>2.0 [1.1-4.1]</td>
</tr>
<tr>
<td>SampEn</td>
<td>1.9 [1.6-3.2]</td>
<td>1.4 [1.0-1.8]</td>
</tr>
</tbody>
</table>

4. CONCLUSIONS
Results in our study suggest that separating contractions and rest periods improves HRV analysis for the detection of asphyxia during labor. A larger dataset is required to validate our results for clinical practice.

References