Background and aim of the study

Fetal well being assessment is very important through pregnancy care. Therefore, methods higher specific on this evaluation are desired, as capacity to obtain early any possible fetal illness without invasive. One method that shows reasonable casuistic is the Short Term Variaton (STV) [1] from cardiotographic (CTG) records. Cardiotography uses ultrasound technology to extract the fetal heart activity and has limited time resolution. A technique which achieves excellent time resolution collectively without invasion is the Fetal MagnetoCardioGraphy (fMCG). Main works has been published exploring linear and non-linear parameters on fMCG and CTG. Our objective is look for correlations between the main parameters in both linear and non-linear analysis.

Methods

AS STV has good casuistics in CTG analysis, other methods that have show potential detectability and more potential screening between health and illness fetus are the non-linear entropies analysis. In this work we analyze the parameters: STV[1, 2], LTI and deltaSTV[2], standard deviation of RR[3, 4] from RR traces obtained by automatic localization on fMCG records, which are separated from the mother signal using FastICA[5] as Approximated Entropy (ApE) and Sample Entropy (SE) [2,3]. Were analysed 40 records of 5 minutes each, from 14 pregnant women from 21 to 38 week (mean 28 weeks). The records were obtained in 55 channel SQUID system (ATB Argos 200) in Chieti, Italy and 74 Channel SQUID system (Magnes, BTI) in Madison, USA. The Pearson correlation coefficients were obtained for each pair

STV, which is a beat-to-beat measurement of HRV, was estimated on one minute

\[ STV = \frac{1}{16} \sum_{i=1}^{16} T_i (i+1) - T_i(i) \]

where \( T_i \) is the RR time interval in ms calculated every 3.75s (60s/16).

Correlation among SampEn, ApEn and STV was calculated using the Pearson correlation coefficient.

LTI, is interquatile range (1/4-3/4) of the \( l \) distribution below, over 3 min.

\[ l_j = \sqrt{T_j(i) + T_j(i+1)} \]

and

\[ \Delta T = \frac{\sum |\max(T(i)) - \min(T(i))|}{m} \]

where \( m \) is the number of minute considered.

Before extract the parameters the RR vector interval was submited to an RR value correction algorithm, which eliminates the improbable RR values above 200 bpm and below 80 bpm as values changes above 25bpm [6].

Results

The parameters with the Pearson correlations coefficients are explicitated in table 1, with very strong (*), strong (¥) and medium correlation (#). As could be wait some similar parameters has high correlation, as ApE and SE, mRR and mHR, which suggest there is not significant different information into these parameters. sdRR and deltaSTV(r=0.90) has similar information even that has not significant correlation between STV and RR, from which they derivate. The non-linear parameters ApE and SE did not show high correlation with neither linear parameter, only medium correlation with parameter associated to variation of variability indices as deltaSTV, mLTI and sdRR. Suggesting that entropy carrier information about the variability of variation indices.

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Discussions and Conclusions

As STV have show good casuistic results, high correlation with low STV values and fetal death and metabolic acidemia at delivery [1] this is an important parameter. Non-linear parameters as approximated entropy have shown good correlations too, as they are not correlated they does not analyses the same information that STV.

Further investigation may be done to assess the effectiveness of those estimators in risk pregnancies.

References


Perinatal Biomagnetism - 1st International Workshop on the clinical usefulness of Biomagnetism in Perinatal Medicine – Chieti University, Italy – 4 April 2009