Evaluation of fetal lung with quantitative texture analysis before and after maternal corticosteroid treatment

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Objective

To evaluate the quantitative texture analyses of pulmonary ultrasound images before and after antenatal betamethasone administration for lung maturation, using image processing techniques. We hypothesized that corticosteroid treatment will lead to textural changes in foetal lungs detected by advanced image analysis techniques.

Methods

Prenatal ultrasound images recorded before and after maternal betamethasone treatment in pregnancies with a diagnosis of threatened preterm delivery (n=20) at our unit were reviewed, and transverse thorax sections with both foetal lungs clearly visible were retrieved. Afterwards, image processing techniques including invariant moments (IM), grey level co-occurrence matrix (GLCM), and wavelet analysis (WA) using MATLAB R2014a software were used to extract the features from a region of interest (ROI) of 64x64 pixels. The computed features (n=7, n=8, and n=144 for IM, GLCM and WA, respectively) were compared using Wilcoxon signed-rank test.

Results

There were significant differences ($p < 0.05$) across 4 and 21 of the computed features using IM and WA, respectively. A mathematical model with first-order polynomial curve fitting technique was constructed to predict the effect of corticosteroid therapy.

Conclusion

Antenatal betamethasone administration for foetal lung maturation leads to quantitative textural changes in foetal lung ultrasound images. These changes can be predicted using a mathematical prediction method.