

## Quantitative parametric fetal lung ultrasound for staging gestational age: towards non-invasive assessment of fetal lung maturity

Gert Weijers<sup>1</sup>, Freke A. Wilmink<sup>2</sup>, Frans P.H.A. vandenBussche<sup>2</sup>, and Chris L. de Korte<sup>1</sup>

<sup>1</sup>Medical Ultrasound Imaging Center (MUSIC), department of Radiology and Nuclear Medicine, Radboud University Medical Center, Nijmegen, The Netherlands

<sup>2</sup>Obstetrics & Gynaecology, Radboud University Medical Center, Nijmegen, The Netherlands

### Background, Motivation and Objective

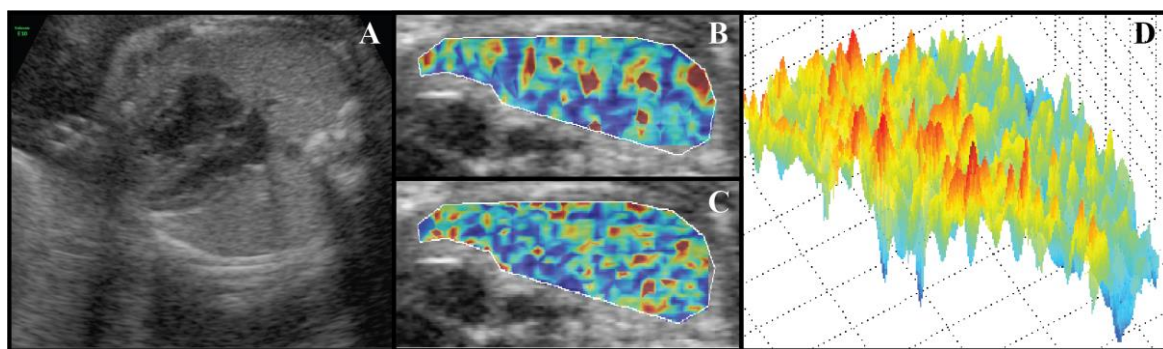
*Neonatal Respiratory Morbidity (NRM) is highly associated with fetal lung in-maturity and associated with late premature ( $34^{+0}$ - $36^{+6}$ ) or early term ( $37^{+0}$ - $38^{+6}$ ) delivery of the newborn. The risk at NRM and the maternal capacity and risks must be balanced while making a decision concerning an elective delivery. Currently, lung maturity is hard to assess, and not feasible using non-invasive tools. Therefore, a noninvasive diagnostic tool is highly warrant to support this decision making.*

### Statement of Contribution/Methods

*Computer Aided UltraSound (CAUS) data of the fetal lung, using fixed and calibrated imaging presets were acquired using three Voluson ultrasound machines (GE Healthcare, 1x E8 and 2x E10, using RM6C transducer bandwidth: 1-7MHz). The calibrations were performed using a tissue mimicking phantom (TMP) and included: determination of optimal zoom-setting for adequate speckle sampling; beam-profile correction; relative expression of all CAUS parameters to the TMP used. Three ultrasound B-mode images of the fetal thorax (four chamber view) of 45 fetuses from singleton pregnant women were acquired (gestational age range: 20-39 weeks). The CAUS software<sup>1</sup> was further developed to estimate the mean echo level, residual attenuation coefficient (RAC), and 2D parametric texture images of the axial (AX) and lateral (LAT) speckle size [mm] (Fig.1), and axial and lateral amplitudes (max [dB]). From the parametric images descriptive statistics and entropy values were calculated. All parameters were correlated to gestational age (GA) in order to search for parameters able to predict GA.*

### Results/Discussion

*Highly significant correlations for all texture entropy parameters (AX;  $AX_{max}$ ; LAT;  $LAT_{max}$ :  $R = 0.56^{**}$ ;  $0.66^{**}$ ;  $0.62^{**}$ ;  $0.51^{**}$  respectively) with GA were found. Also the RAC ( $R = -0.38^{**}$ ) and the lung area ( $R = 0.75^{**}$ ) correlated well with GA. Further research including, addition of NRM scores of the newborns and multiparametric logistics regression analysis, have to be conducted to assess the potential for lung ripeness staging, and to determine the cut-off values for predictive values estimates.*



**Fig. 1. Quantitative and parametric feature extraction using ultrasound B-mode images of the fetal lungs A. fetal lung (four chamber view) B-mode image, B. CAUS post-processed image with interactive drawn proximal lung contour and parametric axial speckle size overlay, C. parametric lateral speckle size overlay, D. speckle surface plot, representing the texture amplitude and size variations**

<sup>1</sup> Weijers, G., G. Wanten, J. M. Thijssen, M. van der Graaf and C. L. de Korte (2016). "Quantitative Ultrasound for Staging of Hepatic Steatosis in Patients on Home Parenteral Nutrition Validated with Magnetic Resonance Spectroscopy: A Feasibility Study." *Ultrasound Med Biol* **42**(3): 637-644.