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Research Article

Non-Invasive Studies on Fetal Lung Immaturity by Ultrasound Gray Level Histogram Width

Maeda K[1]* and Matsui Serizawa M[2]

[1]*Honorary Professor OBGY, Tottori University Medical School, Japan*

[2]*Department of Obstetrics and Gynecology, Hamamatsu Medical Center, Japan*

***Corresponding author:** Maeda K, Honorary Professor OBGY, Tottori University Medical School, Yonago, Japan

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Abstract

Fetal lung immaturity was diagnosed by the analysis of amniotic fluid, while to avoid invasive nature of amniocentesis, ultrasound B-mode imaging gray level histogram width is applied to detect fetal lung immaturity, of which advantage is its non-invasive nature, accordingly, repeated application is able using ultrasound techniques.

Keywords: Fetus; Neonatal Respiratory Distress; Amniotic Fluid; Ultrasound B-Mode; Steroid Therapy of Fetal Lung Immaturity; Repeated Tests of Maturity

Introduction

As amniotic fluid examination was afraid of sharp needle of amniocentesis, it changed to non-invasive ultrasound technique.

Methods

It is the measurement of gray level of every pixel of ultrasound B-mode images, where all pixel intensity is shown by the histogram of B-mode image, [1] of which origin is pixel gray level intensity of 1x1cm area of images (region of interest, ROI), of which representative function is selected by the ultrasound B-mode user.

Fetal lung image

Fetal lung image is visualized beside fetal heart on the ultrasound B-mode of pregnant woman. [2] One by one cm region of interest (ROI) [3] is placed on fetal lung and press "histogram" button, then fetal lung pixel histogram is illustrated as Figure 1, where the length A divided by B (%) is GLHW Figure 1. Automatic GLHW is "%W" in the histogram of Aloka B-mode ultrasound devices.

Fetal lung GLHW calculation, standardization, and fetal lung maturity

Fetal lung GLHW was low in young fetus, while fetal liver GLHW was almost constant, thus fetal lung GLHW was standardized when it is divided by fetal liver GLHW [4,5]. where fetal lung immaturity was decided when the ratio of fetal lung and liver GLHW multiplied by gestational weeks was less than 29, while fetal lung is mature if fetal lung and liver GLHW ratio multiplied by gestational weeks was 29 or more. Fetal lung/liver GLHW ratio multiplied by gestational weeks' sensitivity to predict neonatal Respiratory Distress Syndrome (RDS) was as high as 96% and sensitivity was 72% in ROC curve analysis [4,5], namely, the sensitivity to predict neonatal RDS was 96% and specificity was 72% [5]. Since immature fetal lung causes neonatal Respiratory Distress Syndrome (RDS), it is important that the sensitivity of the GLHW to predict neonatal RDS was 96% and specificity 72%, which were the highest in various indices including amniotic fluid tests to predict fetal lung immaturity and neonatal RDS, namely, it was the goal to detect immature fetal lung and predict neonatal RDS, suggesting neonatal lung treatment with artificial surfactant after birth. The 96% high sensitivity and 72% specificity in ROC curve are important information to neonatal treatment since immature fetal lung causes neonatal Respiratory Distress Syndrome (RDS), as the sensitivity and specificity of GLHW to predict neonatal RDS was 96% and specificity was 72%, which were the highest among various indices to predict fetal lung immaturity and neonatal RDS, namely, fetal lung immaturity study arrived at the goal to detect almost all immature lung and neonatal RDS using GLHW.

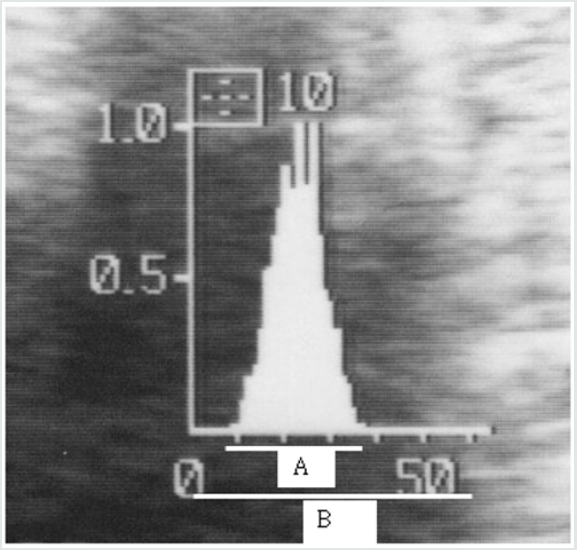

Figure 1: Calculation of GLHW on the histogram of fetal lung in the study of fetal lung immaturity.

Conclusion

As the technique to detect fetal lung immaturity was totally non-invasive, GLHW can be studied repeatedly in preterm pregnancy, and also estimate the effect of steroid to promote fetal lung maturity repeatedly. It will be possible to discuss whether artificial surfactant would be repeated or not with the results of GLHW analysis of fetal lung. The GLHW tissue characterization enabled the diagnoses of gynecologic tumor malignancy, fetal brain periventricular echo density, meconium stained amniotic fluid predicting fetal asphyxia and amniotic aspiration syndrome, and possible diagnosis of adult liver diseases [3,5]. General application of ultrasonic tissue characterization is possible using the histogram of common ultrasound B-mode imaging devices in GLHW technique. Non-invasive nature of GLHW tissue characterization in the diagnosis of fetal lung immaturity will further promote the perinatal medicine. Further application of GLHW in tissue characterization will promote various pathologic diagnosis including adult studies in the future.

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