Amniotic Fluid Lamellar Body Counts and the Prediction of Fetal Lung Maturity

Thesis
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By
Hosam Abdalla Abd El- Fadeel
M.B.B.Ch.

Supervised by
Prof. Dr.
Mounir Mohammed Fawzy El- Hao
Professor of Obstetrics & Gynaecology
Faculty of Medicine Ain-Shams University

Dr.
Alaa El Din Abdel-Aziz El-Gendy
Lecturer of Obstetrics & Gynaecology
Faculty of Medicine Ain-Shams University

Faculty of Medicine
Ain - Shams University

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بسم الله الرحمن الرحيم

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سورة البقرة

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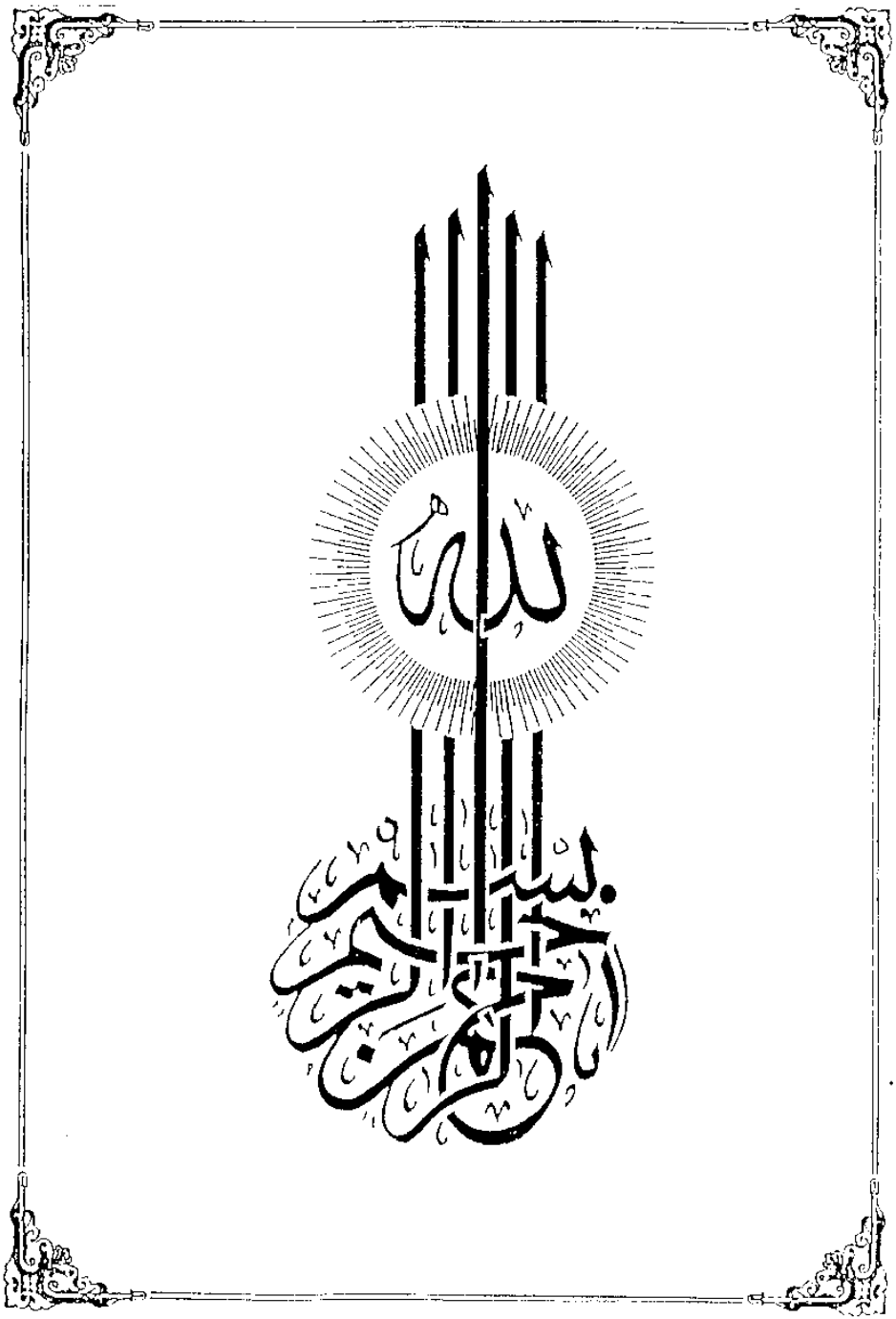

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Abstract

OBJECTIVE: Amniotic fluid lamellar body concentration was quantified and compared with shake test to predict fetal lung maturity in normal, pre-eclamptic, and diabetic pregnancies.

STUDY DESIGN: Amniotic fluid was obtaind from 40 patients during third trimester, in labour, and quantified on a Coulter counter set for particle size used for platelets (2-20fl). The lamellar body concentration cutoff was compared with the shake test as a predictor of fetal lung maturity. Outcomes of 42 neonates were used to evaluate the test; 4 neonates developed repsiratory distress syndrome. Lamellar body counts were used to compare normal, pre-eclamptic, and diabetic pregnancies.

RESULTS: The lamellar body concentration cutoff that gives the best prediction of respiratory distress syndrome was 20,000 particles/µl. In 40 patients delivered within 12 hours the lamellar body concentration correctly predicted four cases of repiratory distress syndrome (100% sensitivity and specificity).

Lamellar body counts correlates linearly with gestational age ($r= 0.37$). Lamellar body counts compared to normal were significantly higher in pre-eclamptic pregnancies ($t = 4.76$, $P<0.001$). Whereas it were significantly lower in diabetic pregnancies ($t= 2.03$, $P < 0.05$).

CONCLUSION: This study confirms that lamellar body counting is a reliable and practical assay for assessing fetal lung maturity in normal, diabetic, and pre-eclamptic pregnancies.

Key Words: Amniotic fluid fetal pulmonary maturity testing, lamellar body concentration, automated lamellar body counting by Coulter counter.

Introduction

Introduction

The neonatal respiratory distress syndrome (RDS) is a condition characterized by failure of pulmonary gas exchange following birth with progressive atelectasis. It occurs in infants that lack adequate amounts of pulmonary surfactant at birth. Respiratory distress syndrome, and its complications, is the most common cause of death in the neonatal period as it accounts for 20% of all neonatal mortality and for 50-70% of death in premature infants ***(Perelman et al., 1981 ;Kjos, 1994).***

Iatrogenic prematurity and the respiratory distress syndrome are the leading factors responsible for fetal morbidity and mortality associated with elective delivery. So fetal lung maturity should be established before elective caesarean section or induction of labour for a patient with an imprecise clinical estimate of gestational age. Tests predicting maturity of the fetal lung are also important in managing pregnant patients with pre-eclampsia, erythroblastosis fetalis or placenta previa because premature birth is useful in each of these conditions. So that the obstetrician must decide when the risk of RDS is low enough to warrant therapeutic premature delivary of the infant ***(Ashwood et al., 1986).***

Among the available tests used for predicting fetal lung maturity the most widely accepted standerd remains the lecithin / sphingomyelin (L/S) ratio and phosphatidylglycerol using thin - layer chromatography. The sensitivity and specificity of the L/S ratio is 83% and 98%, respectively, indicating that this test is an excellent predictor of pulmonary maturity.The complexity and the need for special equipment limit the application of these tests to larger, more sophisticated laboratories ***(Fakhoury et al., 1994).***

Pulmonary surfactant is synthesized in the alveolar type II

granular pneumocytes and "packaged" as lamellar bodies that are 1-5 μm in diameter. These surfactant storage granules contain phospholipids, cholesterol, and several surfactant - specific proteins. Lamellar bodies first appear in the cytoplasm of fetal pneumocytes between 20-24 weeks' gestation. The lamellar bodies become more numerous and are continuously secreted into the fetal alveoli. Fetal breathing movements and a net exudation of fluid carry these lamellar bodies into the amniotic fluid. Thus counting these particles would be useful in predicting fetal lung maturity ***(Ashwood et al., 1993).***

Surfactant containing lamellar bodies is secreted by type Π pneumocytes. Thus lamellar body counts are a potential direct assay to determine fetal pulmonary maturity. They are easy to quantify and requir no special instrumentation. Lamellar body counts > 30,000 particles/μl have been associated with fetal pulmonary maturity ***(Lemuel et al., 1990; Fakhoury et al., 1994).***

The advantage of a lamellar body count over L/S ratio and phosphatidylglycerol is the simplicity of the measurement as the method used for quantifcation is easily performed in any hospital that has a clinical laboratory and Coulter counter 660 or any automated particle counter for automated platelet quantitation. So laboratory method for lamellar body counting is much simpler, faster, with low cost and more readily accessible than those for L/S ratio and phosphatidylglycerol ***(Fakhoury et al., 1994).***

Aim of the Work

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The purpose of this study is to quantify amniotic fluid lamellar body counts during the second and third trimester of pregnancy to assess the ability of lamellar body concentration to predict neonatal respiratory distress syndrome (RDS) in normal pregnancy, hypertensive, and diabetic pregnancies.

Review of Literature

Anatomical development of the lung

Knowledge of the normal development, structure and function of the lung is clinically important for recognizing and understanding disease pattern and providing effective therapy *(Smart, 1992)*.

STAGES OF ANATOMICAL DEVELOPMENT

The anatomical development of the human fetal lung progresses through four main stages; the embryonic, pseudoglandular, canalicular and the terminal sac stage *(Koff, 1988)*.

I - The embryonic stage (first 5 weeks of gestation)

The earliest formation of the lung begins at approximately 26 days of gestation. An outpouching of the foregut, the lung bud, develops from the endoderm. The lung bud divides, continues to grow and becomes enveloped within the mesoderm. As it develops into the right and left mainstem bronchi, the lung bud carries mesoderm with it that adapts to the shape of the bronchial tree and differentiates into muscle, connective tissue, cartilage and supporting structures. The lung buds are generally asymmetrical inclining to the right and are made up of two lobes; a large right and smaller left lobe, separated by a shallow sulcus. By the end of this stage, the trachea, main and subsidiary bronchi are well developed *(Koff, 1988)*.

II - The pseudoglandular stage (6 - 16 weeks)

During this stage asymmetric dichotomous branching of the bronchial tree occurs and gradually progresses from about 4 to 25 generations at 16 week of gestation. The lung at this point resembles a gland and gives the stage its name. By the end of this stage, the prenatal formation of new bronchi is nearly complete *(Koff, 1988)*.