Acceleration Time –to-Ejection Time Ratio in Fetal Pulmonary Artery Predicts the Development of Neonatal Respiratory Distress Syndrome

Thesis

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List of Abbreviations

AT/ET : Acceleration-to-Ejection Time Ratio

CPAP : Continuous positive airway pressure

FGR : Fetal growth restriction

FLM : Fetal lung maturity

FLV : Fetal lung volume

HMD : Hyaline membrane disease

L/S : Lecithin/sphingomyelin

MCA : Middle Cerebral Artery

PaO_2/FiO_2 : Arterial to inspired oxygen

PEEP : Positive end-expiratory pressure

PG : Phosphatidylglycerol

PSV : Peak systolic velocities

RDS : Respiratory distress syndrome

RI : Resistive index

S/D : Systole/diastole

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Introduction

The pulmonary system is the last fetal organ system required for extrauterine life to become functionally mature, and respiratory distress syndrome (RDS), related to pulmonary surfactant deficiency, remains a major cause of neonatal morbidity and mortality **(Kamath et al., 2011).**

Respiratory distress syndrome (RDS) remains a major cause of neonatal morbidity and mortality, and the incidence and severity of RDS are inversely proportional to gestational age at birth **(Sun et al., 2013).** Respiratory distress syndrome, also known as hyaline membrane disease, occurs almost exclusively in premature infants. The incidence and severity of respiratory distress syndrome are related inversely to the gestational age of the newborn infant **(Arun et al., 2017).**

Assessment of fetal lung maturity is therefore one of the most important goals of obstetrical management.. Several antenatal tests have been developed in an effort to predict the likelihood of fetal lung maturity. Although commonly used in obstetric practice, these tests such as the lecithin/sphingomyelin (L/S) ratio, phosphatidylglycerol test, fluorescence polarization test, foam stability test (or shake test), and lamellar body count11–14 do not have a reliable predictive value especially in later gestation and are invasive requiring amniocentesis **(Sun et al, 2013).**

It was reported that the frequency of fetal lung maturity testing had decreased in the USA between 1998

and 2008, often because of concerns about amniocentesis **(Grenache et al., 2010).**

Determination of fetal lung maturity traditionally has relied on amniocentesis and the measurement of component proteins and lipid in the amniotic fluid. However, amniocentesis is an invasive procedure recommended for specific indications and these tests have high sensitivity but only moderate specificity **(Spong et al., 2011).**

Nevertheless, amniotic fluid can be obtained only by performing amniocentesis, an invasive procedure that poses potential risks to the pregnancy; there is a small risk that an amniocentesis could cause a preterm labour (less than 1%, or approximately 1 in 200 to 1 in 400). Injury to the baby or mother, infection, and preterm labor are other potential complications that can occur, but are extremely rare **(Traci, 2017).**

In contrast, ultrasound examination is noninvasive and widely available for pregnant women. For all these reasons, development of a noninvasive sonographic test for the prediction of RDS would be helpful and more acceptable to patients than the current invasive methods **(Sun et al., 2013).**

A non-invasive test to assess fetal lung maturity would be a more acceptable option for pregnant women. Fetal lung maturity has been indirectly assessed by ultrasonic evaluation of gross morphology **(Gerard et al., 2008)** and the use of Doppler blood flow waveforms

(Piazze et al., 2003). However, as yet, there is no reliable non-invasive test to predict fetal lung maturity before delivery **(Moshiri et al., 2013).**

For these reasons, noninvasive methods using ultrasound to assess fetal lung maturity have long been sought for, but efforts to date (such as measurements of lung volumes, gestation age, epiphysis centers, placental grading, and estimated fetal weight) have been unsuccessful in clinical practice **(Yong et al., 2014).**

As the lungs develop throughout gestation, so does the pulmonary vasculature, where both the absolute number of pulmonary arteries rises and the total amount of smooth muscular tissue increases, and the pulmonary arterial vascular resistance decreases slightly, leading to a gradual increase in pulmonary blood flow **(Laudy et al., 2000 & Yong et al., 2014).**

Doppler velocimetry provides a simple and noninvasive method to assess the fetal pulmonary circulation. Several investigators have used Doppler velocimetry to measure fetal pulmonary blood flow in the left (or right) pulmonary artery and their peripheral branches, but the rate of satisfactory Doppler recordings is moderate (77–84%), and the results are vastly disparate **(Laudy et al., 2000 & Yong et al., 2014).**

Measurement of fetal lung volume (FLV) and pulmonary artery pressure could potentially be used to predict neonatal RDS **(Laban et al., 2015).**

Blood flow velocity waveforms in foetal pulmonary vessels vary according to the site at which measurements are taken: at the right or left pulmonary artery, after they emerge from the pulmonary trunk and enter the pulmonary hilum, or in peripheral vessels. Foetal pulmonary circulation using the Doppler method allows a better understanding of the haemodynamics of pulmonary circulation, thereby facilitating the detection of changes in pulmonary vascular resistance in foetuses at risk of inadequate lung development **(Herren et al., 2016).**

Aim of the Study

The aim of the study is to evaluate whether Acceleration Time-to-Ejection Time Ratio in Fetal Pulmonary Artery Predicts the Development of Neonatal Respiratory Distress Syndrome**.**

Research question:

In pregnant women at term may Doppler waveforms of Acceleration Time-to-Ejection Time Ratio in Fetal Pulmonary Artery predict neonatal respiratory distress syndrome?

Research hypothesis:

Acceleration Time-to-Ejection Time Ratio in Fetal Pulmonary Artery in pregnant women may accurately predict neonatal respiratory distress syndrome.