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RESEARCH ARTICLE

A Simple Method of Assessing Fetal Lung Maturity by Lamellar Body Concentration in Amniotic Fluid

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ABSTRACT

Objective: To find out whether amniotic fluid lamellar body concentrations (LBC) can predict neonatal respiratory distress syndrome (RDS)

Materials and methods: Amniotic fluid was obtained at the time of cesarean section was sent to the laboratory for lamellar body concentrations in amniotic fluid. The lamellar body concentrations were analyzed and correlated with the incidence of RDS.

Results: The incidence of RDS at different gestational age with an LBC cut off of 41,500 was studied. Among 220 patients studied, Respiratory distress was seen in 53 (24.09%) of patients. There is a significant correlation between decreasing lamellar body count in preterms and incidence of RDS. LBC count has a sensitivity of 92.7 %, the specificity of 90 %, a positive-predictive value of 73% and a negative-predictive value of 98% in predicting respiratory distress syndrome.

Conclusion: LBC count in the current study is a cheap, easy and reliable method of assessing fetal lung maturity.

Keywords: Fetal lung maturity, Lamellar body count, Respiratory distress syndrome.

Abbreviations: RDS: Respiratory distress syndrome; LBC: Lamellar body count; FLM: Fetal lung maturity.

Ethics approval: Ethical committee clearance was obtained on 15/9/2011 before the start of the study from Manipal University ethical committee and Kasturba Hospital, Manipal under reference number IEC248/2011.

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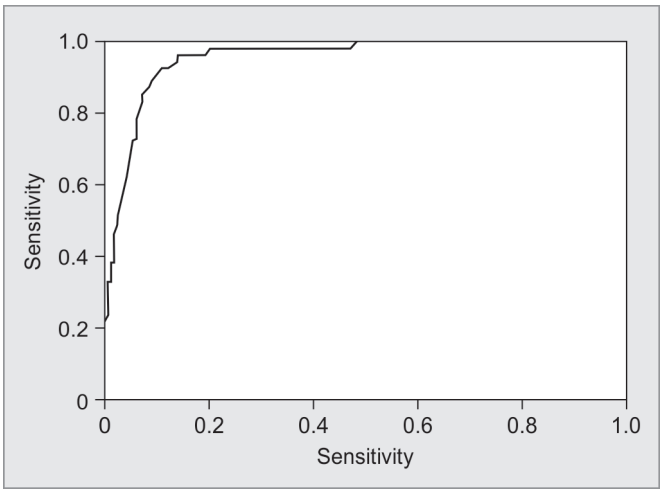
INTRODUCTION

Respiratory distress syndrome (RDS) also known as hyaline membrane disease is the most common cause of respiratory failure in the neonate.[1] The risk of RDS rises in prematurity due to decreased production of surfactant. Lamellar bodies (LB) are storage form of surfactant within type II pneumocytes and are actively secreted into the alveolar space and hence into the amniotic fluid. They are secreted from 28 weeks of gestation. The concentration of lamellar bodies increases as the gestational age increases.[2] Respiratory distress syndrome is a major cause of morbidity and mortality in preterm neonates. With the advent of modern newborn care now, many pregnancies are terminated before the term in many situations. These conditions warrant an assessment of lung maturity in the fetus as RDS is a major cause of morbidity in preterm neonates. There are various tests to assess fetal lung maturity (FLM).[3] The most widely accepted approach for assessing FLM has been the lecithin-to-sphingomyelin (L/S) ratio and the quantification of phosphatidylglycerol (PG) in amniotic fluid. Measurement of phospholipids, lecithin/sphingomyelin ratio (L/S) is expensive. The analysis is labor intensive, making them unavailable in many clinical settings in developing the world. There are other alternative laboratory tests like fluorescent polarization, microviscosity, tap test, shake test, foam stability index, absorbance at 650 nm. These tests though simple to perform do not predict RDS in newborn accurately. New promising test in prediction of RDS in the newborn is a lamellar body count. Several studies have shown that the lamellar body count (LBC) is an accurate predictor of Fetal lung maturity. We made an attempt to correlate lamellar body count and fetal lung maturity. Lamellar bodies are similar in size to that of the platelets and can be easily counted in platelet counting chamber of auto analyzers. In the current study, the lamellar body count was taken from amniotic fluid during cesarean section. Incidence of RDS in newborn babies was studied and an attempt was made to correlate LBC and fetal lung maturity. The objective of this study was to find out whether amniotic fluid lamellar body concentrations have potential in predicting neonatal RDS. The lamellar body count is a simple test which can be performed easily and is helpful in determining fetal lung maturity in areas where resources are limited.

MATERIALS AND METHODS

The present study was a prospective observational study conducted in the Department of Obstetrics and Gynaecology, Kasturba Hospital, Manipal, Karnataka, India. It was conducted for two years from October 2011 to September 2013. Patients undergoing cesarean section who fulfilled the criteria were included in this study. Patients with severe oligoamnios, premature rupture of membranes or blood or meconium stained amniotic fluid were excluded from the study. Both elective and emergency cases were included in the study. Only patients with excellent dating with a scan done between 7 weeks and 12 weeks were taken in this study. Cases were divided into term and preterm. Term fetus for this study was defined as the gestational age was more than 37 completed weeks until 40 weeks. Preterm fetuses were those with gestational age was between 28 weeks to less than 37 completed weeks. Ethical committee clearance was obtained on 15/9/2011 before the start of the study from Manipal University ethical committee and Kasturba Hospital, Manipal under reference number IEC248/2011.

During cesarean section after uterine incision, 5 mL of the amniotic fluid is collected and sent to hematology laboratory. Lamellar bodies which are of the same size as platelets were counted in platelet counting chamber in Coulter hematological analyzer. The specimen was not centrifuged. The lamellar body count was noted. The data was statistically analyzed. The incidence of RDS at different LBC count was analyzed. Incidence of RDS at different gestational ages with an LBC cut off of 41,500 was analyzed. Respiratory distress syndrome (RDS) was defined as (i) oxygen dependence increasing during the first 24 hours of life, (ii) exclusion of infection, and (iii) typical chest X-ray pattern with reduced air content, the reticulonodular pattern of the lung. Statistical package for social science (SPSS-16) was used for statistical compilation and analysis. For statistical analysis, Chi-square test was used when appropriate. Statistical significance was accepted at $p < 0.05$.



Graph 1: ROC curve

RESULTS

LBC of 41500 was chosen to be cut off as it had a sensitivity of 92.7 % and specificity of 90% (Graph 1).

Total of 1920 cesarean deliveries was done from October 2011–September 2013. Among them, 220 patients who fulfilled criteria were included in the study. RDS was seen in only 53 of the preterm group (Fig. 1). All the patients who underwent cesarean section in the preterm group had emergency sections. In our study, RDS was seen only in preterm fetuses. LBC count was significantly lower in preterm fetuses (Table 1). When LBC count was less than 41,500 the incidence of RDS was high. (Table 2). The lamellar body count was significantly higher in patients who received steroids antenatally (Table 3). There were 19 cases with gestational diabetes mellitus. All of them had good glycaemic control and had received steroids. All 19 patients had a lamellar body count of more than 41,500 and there was no incidence of RDS (Table 4). All patients with diabetes were delivered at term (Table 5). There were no cases with features of chorioamnionitis in the study. Our study did not show increases lamellar body count in women with the hypertensive disease in pregnancy (Table 6).

DISCUSSION

Though there are many methods to predict lung maturity in the fetus, most of them are labor intensive and expensive. We in our current study tried to evaluate the role of lamellar body count (LBC) in the prediction of RDS. LBC count can be done easily in auto analyzers as it has the same size, like that of the platelets. In our study, we enrolled a total of 220 patients who were undergoing a cesarean section. Amniotic fluid was collected after uterine incision and sent to the laboratory to calculate LBC in the automated hematological analyzer. In our study, we calculated a cut off of 41500 after constructing the ROC curve. LBC count cut off 22,000–57,000 has been suggested by various investigators.[4] We used a cut off of 41,500 for LBC and found a sensitivity of 92.7%, the specificity of 90%, positive-predictive value of 73% and negative-predictive value of 98% in predicting RDS. Ross et al.[5]

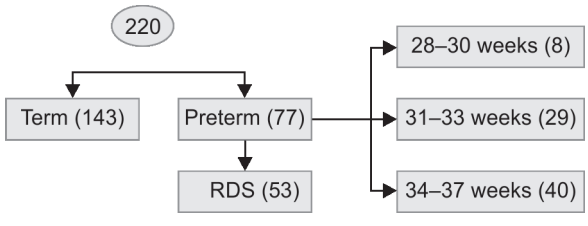


Fig. 1: Consort statement

Table 1: Relationship between gestational age and RDS (n = 220)

	RDS	
Gestational age	*Yes (n = 53) (%)*	*No (n = 167) (%)*
Preterm 28–30 weeks (8)	8 (15–9%)	0 (0%)
Preterm 31–33 weeks (29)	25 (47.1%)	4 (2.3%)
Preterm 34–37 weeks (40)	20 (37.7%)	20 (11.9%)
Term >38 weeks (143)	0 (0%)	143 (85.6%)

Table 3: Relationship between steroids given antenatally and lamellar body count (LBC)

Preterm (77)	*Average LBC count*		*p value*
	<41500 n = 53 (%)	*>41500 n = 24 (%)*	
Steroids given (64)	40(62%)	24 (38%)	0.004
Steroids not given (13)	13(100%)	0 (0%)	<0.001

Table 5: Duration of pregnancy in patients with GDM

Duration of pregnancy	*n = 19*
Term	19
Preterm	0

Table 2: Relationship between lamellar body count (LBC) and RDS (*n* = 220)

RDS	*LBC < 41500 n = 69(%)*	*LBC >41500 n = 151(%)*	*p value*
Yes	51 (73.9%)	2 (1.3%)	0.000
No	18 (26%)	149 (98.6%)	

Table 4: Relationship between GDM and lamellar body count (LBC)

LBC count	*LBC <41500*	*LBC >41500*
With GDM	0	19
RDS	0	0

Table 6: Relationship between lamellar body count (LBC) and hypertensive disorders of pregnancy

Hypertensive disorder of pregnancy (41)	*LBC <41500 27 (65.8%)*	*LBC >41500 14 (34.1%)*	*p value*
Having RDS	24	0	0.19
No RDS	3	14	

in a study, compared lamellar body counts with lecithin/sphingomyelin ratio and they concluded that lamellar body count can accurately predict lung maturity when compared with L/S ratio. Roiz-Hernández et al.[6] suggested a cut off of 57,000, however in his study he collected samples of amniotic fluid both during cesarean section and vaginal delivery. The sensitivity and specificity of lamellar body counts in his study were on par with the L/S ratio in predicting fetal lung maturity. In case of vaginal delivery amniotic fluid was immediately collected from posterior fornix after the rupture of membranes, and bloodstained and meconium stained liquors were discarded from the study. We did not use fluid from the vaginal pool for calculation of LBC because of the risk of contamination and the possibility of false positive results. Haymond et al.[7] compared LBC count with fluorescent polarization of amniotic fluid and found that the LBC was on par with the fluorescent polarization of amniotic fluid in predicting RDS in the preterm fetus. Štimac et al.[8] suggested a cut off of 20,000 for fetal maturity.[8] In the current study, there were 77 preterm babies. Sixty-two babies had count less than 41,500. Among these 51 had RDS. The incidence of RDS sharply fell when the LBC count was >41,500. Only two babies out of 15 had RDS when LBC count was more than 41,500. In our study cases which had received steroids had significantly higher LBC count. There were 19 cases of diabetes complicating pregnancy and all had an LBC count of more than 41,500. All had received steroids and had good glycaemic control. In a study by Kafkaslı et al.,[9] they found good lamellar body count in diabetes complicating pregnancies which were well controlled. In our study, all patients with diabetes mellitus were delivered at term and had a good LBC count. Besnard et al. in a meta-analysis have suggested that LBC count can replace lecithin/sphingomyelin ratio in prediction of RDS.[10] Intraamniotic infection can falsely raise the LBC count.[11] In our study, there was no case of chorioamnionitis. LBC count is a good predictor of RDS in preterm infants. This test is very cheap to test which can be done easily in smaller settings for prediction of RDS. In the present study, the lamellar body count was not compared with any other standardized test. Amniotic fluid was collected only during cesarean section and not during vaginal delivery. Patients with rupture of membranes were excluded from the study. In future whenever preterm delivery is anticipated, amniotic fluid can be obtained by amniocentesis and LBC can be analyzed for prediction of RDS in the fetus. If the LBC is low, mothers can be referred to better centers for delivery. It may be useful for unbooked cases or who comes in the 3rd trimester with poor dating. Ultrasound in the third trimester is good for fetal growth and well being and not for dating. Often there is a dilemma to time the elective cesareans in cases with poor dating. LBC is thus a simple method to assess fetal lung maturity

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