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ORIGINAL RESEARCH

Assessing fetal lung maturity by ultrasonography and color doppler and its effect on fetal outcomes

Dr. Anand Tambat[1], Dr. Rishab R. Bilala[2], Dr. Juhi Vijay Kedare[3], Dr. Pooja[4]

[1]Associate Professor, Department of Obstetrics and Gynaecology, JMF's ACPM Medical College, Dhule, Maharashtra, India
[2]Assistant Professor, Department of Radiodiagnosis, Government Medical College, Akola, Maharashtra, India
[3]Senior Resident, Department of Obstetrics and Gynaecology, Peripheral BMC- Maa Hospital, Chembur, Mumbai, Maharashtra, India
[4]Senior Resident, Department of Obstetrics and Gynaecology, Mahadevappa Rampure Medical College, Kalburgi, Karnataka, India

Corresponding author
Dr. Pooja
Senior Resident, Department of Obstetrics and Gynaecology, Mahadevappa Rampure Medical College, Kalburgi, Karnataka, India
Email: poojabhoge693@gmail.com

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ABSTRACT
Background: The presence of immature lungs in fetuses has been linked with various negative consequences including RDS (respiratory distress syndrome). The ability to postpone or continuation of birth is usually the deciding factor that efficiently assesses fetal lung maturity. **Aim:** The present study aimed to assess the value of the evaluation of amniotic fluid utilizing the ultrasonography for prediction of fetal lung maturity and its effect on fetal outcomes. **Methods:** The present study assessed 300 females that were pregnant females who visited the institute within the defined study period. These 300 pregnant females were then divided into two groups Group I included subjects that had RDS in the fetus and Group II included subjects whose fetuses did not have RDS. The data gathered were analyzed statistically. **Results:** The results of the present study showed the presence of a significant difference in RDS as well as non-RDS group concerning gestational age with p=0.0005. However, no significant difference was seen in RDS and non-RDS fetuses concerning abortion, parity, gravidity, and maternal age with p>0.05. Concerning fetal biometric assessment, study results showed a significant decrease in fetal biometric measurement values including AC, FL, and BPD in the RDS group compared to non-RDS fetuses with p<0.001. **Conclusion:** The present study concludes that ultrasound variables including amniotic FFP (fluid-free floating particles), DFE (distal femoral epiphysis), and PTE (proximal tibial epiphysis) are vital and accurate predictors for the assessment of respiratory distress syndrome with different degrees of performance.
Keywords: Distal femoral epiphyses, fetal lung maturity, pregnancy, fetal outcomes

INTRODUCTION

The liquid which is seen surrounding the developing fetus in the amniotic sac is known as AF (amniotic fluid) which is usually clear to pale yellow. The composition of amniotic fluid is diverse and contains a variety of fetal and amniotic components. The composition of amniotic fluid also largely varies with gestational age and has a mean pH of 7.2 and a specific gravity of 1.2.[1]

In early-term and preterm infants, lung immaturity still forms the leading reason for mortality and morbidity. However, gestational age (GA) is the strongest predictor for assessing lung maturity, transitory tachypnea, and respiratory distress syndrome in newborns are not only limited to premature births which are signified as 34 weeks. These concerns are comprehensively more common in late preterm infants in the gestational age of 34-36 weeks and early term as 37-38 gestational weeks newborns compared to neonates that are delivered at or after 39 weeks of gestation.[2]

As lung immaturity in neonates is associated with insufficient pulmonary surfactant production, RDS (respiratory distress syndrome) which was earlier known as hyaline membrane disease is the most common cause of respiratory distress in premature

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newborns. Using prenatal steroid medication,early provision of positive airway pressure, and,in a few cases,exogenous surfactant therapy, RDS can be avoided or its severity reduced.[3]

In the last few decades, liver imaging, relative characteristics of lung-to-placenta, lung tissue mobility,and Gray-level measurements, among other parameters have been used for attempting fetal lung ultrasound images without being invasive. Existing literature data has established a strong relationship between death and respiratory illnesses, however, the diagnostic accuracy is not sufficient to be useful for therapeutic reasons.[4]

Utilizing fetal ultrasonography for the prediction of fetal lung maturity has been suggested as a non-invasive alternative to amniocentesis for a long time. The link between imaging features of fetal lung vs. placental or hepatic tissue, lung tissue motility, and grey-scale measurements have all been attempted by utilizing the computer analysis of fetal lung ultrasound scans in the past 25 years.[5]The present study was aimed at assessing the value of the evaluation of amniotic fluid utilizing ultrasonography for the prediction of fetal lung maturity and its effect on fetal outcomes.

MATERIALS AND METHODS

The present prospective cohort study was aimed at assessing the value of the evaluation of amniotic fluid utilizing ultrasonography for the prediction of fetal lung maturity and its effect on fetal outcomes.The study subjects were from the Department of Obstetrics and Gynecologyof the Institute. Verbal and written informed consent were taken from all the subjects before participation.

The inclusion criteria for the study were females with certain of their last menstrual cycle date which has been confirmed by ultrasonography in the first trimester of pregnancy, females with an uncomplicated singleton pregnancy, and pregnant females with a viable fetus. The exclusion criteria for the study were subjects with antepartum hemorrhage, meconium-stained fluid, intrauterine growth restriction, Macrosomic fetuses, multiple pregnancies, fetal malformations, and complications such as diabetes and hypertension.

All subjects were assessed for personal demographics, medical and obstetric history as educational level, smoking, age, and personal history. Obstetrics history including previous pregnancies, delivery mode, number of abortions, parity, and/or gravidity. The obstetric history also included duration, onset, gestational age, and last normal menstrual period. Medical history was also assessed including past or present history.

In the examination, vital signs are all vital factors for consideration. Abdominal assessment for fetal heart sound and fundal level was done. Palpation of the belly for detection of fetal size and presentation along with uterine activity. In laboratory assessment, all investigations were done based on the standard protocol of labor in the institute including urine analysis, random blood sugar, kidney functions, liver enzymes, CRP and grouping, and complete blood count.

In ultrasound assessment, all mothers were assessed prenatally on ultrasound for assessing fetal maturity signs, estimated fetal weight, umbilical artery doppler, and amniotic fluid index. The size and existence of epiphyseal ossification centers,placental grading (classification based on chorionic convolutions and calcifications), and other imaging parameters were used for assessing maturity. Few mature fetuses might not have these findings at term and few fetuses that have these traits can be immature as maternal diabetes is complicated by macrosomia. Generally, ultrasonography assessment for gestational age in the third trimester for indirectly assessing maturity is inferior compared to other approaches.

In technique, an abdominal ultrasound was done. On the same day following delivery, subjects were sent for obstetric ultrasound scans. The same person did an ultrasound examination to decrease the intraobserver variability. In ultrasound findings, placental grading was done following Grannum's categorization.InBPD (Biparietal diameter), an axial section of the fetal skull was measured from the outer to the inner skull table where a clear midline echo of septum pellucidum and thalamus could be seen.In epiphyseal centers, the lower limbs of the fetus were assessed and calipers were used for measuring proximal tibial epiphysis and distal femoral epiphysis. Amniotic fluid linear densities were also seen.

In postoperative treatment, each neonate was assessed by a Pediatrician to assess the following fetal outcomes admission to the neonatal intensive care unit (NICU), signs of a respiratory problem, admission, APGAR score at one and five minutes,weight, and fetal gender, and follow-up by Pediatrician for hospital duration and any adverse neonatal mortality and morbidity up to discharge.

The data gathered were analyzed statistically using SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk. NY, USA) for assessment of descriptive measures, Student t-test, ANOVA (analysis of variance), and Chi-square test. The results were expressed as mean and standard deviation and frequency and percentages. The p-value of <0.05 was considered.

RESULTS

The present prospective cohort study was aimed at assessing the value of the evaluation of amniotic fluid utilizing ultrasonography for the prediction of fetal lung maturity and its effect on fetal outcomes. The present study assessed 300 females that were pregnant females who visited the institute within the defined study period. These 300 pregnant females were then divided into two groups Group I included subjects that had RDS in the fetus and Group II included subjects

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whose fetuses did not have RDS. Mean maternal age and mean gestational age were significantly higher in subjects without RDS compared to subjects with RDSS with p=0.01 and 0.005. The residence status as rural and urban was statistically comparable in neonates with and without RDS with p=0.721. In gravidity, numbers were statistically comparable in neonates with and without RDS with p=0.609. In abortion, no abortions were significantly higher in RDS-positive subjects, one abortion was higher in RDS-negative subjects, and 2 abortions in RDS-negative subjects with p=0.01 (Table 1).

The study results showed that for comparison of neonatal RDS and non-RDS concerning AC, FL, and BPD, AC (abdominal circumference) was significantly higher in non-RDS subjects compared to RDS subjects with p<0.001. FL (femur length) in fetuses was significantly higher in non-RDS subjects compared to RDS neonates with p<0.001. BPD ((Biparietal diameter) was significantly higher in non-RDS subjects compared to RDS neonates with p<0.001 (Table 2). On comparing RDS and Non-RDS neonates concerning placental grading, placental grading 0-I was seen in 72.3% (n=68) and 18.2% (n=92) RDS positive and negative subjects which was higher in RDS negative subjects, grading II was significantly higher in RDS negative neonates, and Grading III was significantly higher in RDS negative subjects compared to RDS positive subjects with p<0.001 (Table 3).

It was seen that for comparison of RDS and non-RDS neonates for colon grading, lung/liver echogenicity, and thalamic echogenicity, colon grading I was significantly higher in RDS positive subjects, grade II in RDS positive, and Grade III in RDS negative subjects with p=0.003. In lung/liver echogenicity, isoechoic echogenicity was significantly higher in RDS negative, hypoechoic echogenicity in RDS positive, and hyperechoic echogenicity equivalent in RDS positive and negative subjects each with p=0.417. In thalamic echogenicity, echo lucent was significantly higher in RDS-positive and echogenic lesions in RDS-negative subjects with p<0.001 (Table 4).

It was also seen that for comparison of RDS and non-RDS neonates for APGAR scores, APGAR 1 minutes and APGAR 5 minutes were significantly higher in RDS negative subjects compared to RDS positive subjects with p=0.001 and 0.01 respectively (Table 5). For sensitivity, specificity, NPV, and PPV in RDS neonates from the study showed that PTE had sensitivity, specificity, NPV, and PPV as 61.68%, 83.38%, 91.9, and 40.6 showing statistical significance with p=0.001. Similar significance was also seen for DFE and FFP concerning sensitivity, specificity, NPV, and PPV with p=0.001 and 0.001 respectively (Table 6).

Table 1: Comparison of non-RDS and RDS fetuses for demographics

Parameter	Neonatal respiratory distress syndrome (RDS)				p-value
	Positive		Negative		
	n=94	%	n=506	%	
Mean maternal age	29.60±4.94		31.53±4.95		**0.01**
Mean gestational age	35.66±0.74		36.02±0.79		**0.005**
Residence					0.721
Rural	50	53.2	256	50.6	
Urban	44	46.8	250	49.4	
Gravidity					
Once a time	8	8.5	76	15	0.609
At least twice	16	17	62	12.3	
At least thrice	8	8.5	68	13.4	
At least 4 times	12	12.8	70	13.8	
At least 5 times	20	21.3	60	11.9	
At least 6 times	10	10.6	54	10.7	
At least 7 times	12	12.8	66	13	
At least 8 times	8	8.5	50	9.9	
Abortion					
None	56	59.6	194	38.3	**0.01**
Once	20	21.3	212	41.9	
Twice	18	19.1	100	19.8	

Table 2: Comparison of neonatal RDS and non-RDS concerning AC, FL, and BPD

Parameter	RDS (mean)	Non-RDS (mean)	p-value
AC	278.70±13.90	307.94±8.65	**<0.001**
FL	60.65±3.49	67.84±2.84	**<0.001**
BPD	82.07±2.57	88.22±3.12	**<0.001**

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Table 3: Comparison of RDS and Non-RDS neonates concerning placental grading

Parameter	Neonatal respiratory distress syndrome (RDS)				p-value
	Positive		Negative		
	n=94	%	n=506	%	
Placental grading					
0-I	68	72.3	92	18.2	**<0.001**
II	16	17	270	53.4	
III	10	10.6	144	28.5	

Table 4: Comparison of RDS and non-RDS neonates for colon grading, lung/liver echogenicity, and thalamic echogenicity

Parameter	Neonatal respiratory distress syndrome (RDS)				p-value
	Positive		Negative		
	n=94	%	n=506	%	
Colon grading					
I	10	10.6	38	7.5	**0.003**
II	56	59.6	182	36	
III	28	29.8	286	56.5	
Lung/liver echogenicity					
Iso-echoic	34	36.2	226	44.7	0.417
Hypo-echoic	34	36.2	140	27.7	
Hyper-echoic	26	27.7	140	27.7	
Thalamic echogenicity					
Echo lucent	68	72.3	118	23.3	**<0.001**
Echogenic	26	27.7	388	76.7	

Table 5: Comparison of RDS and non-RDS neonates for APGAR scores

Parameter	RDS (mean)	Non-RDS (mean)	p-value
APGAR 1 minutes	2.96±0.80	5.24±0.77	**0.001**
APGAR 5 minutes	5.89±0.81	7.6±1.12	**0.01**

Table 6: Sensitivity, specificity, NPV, and PPV in RDS neonates from the study

Parameter	Sensitivity	Specificity	NPV	PPV	p-value
PTE	61.68	83.38	91.9	40.6	**0.001**
DFE	85.09	89.70	96.8	60.4	**0.001**
FFP	93.60	91.28	98.5	665	**0.001**

DISCUSSION

The present study assessed 300 females that were pregnant females who visited the institute within the defined study period. These 300 pregnant females were then divided into two groups Group I included subjects that had RDS in the fetus and Group II included subjects whose fetuses did not have RDS. Mean maternal age and mean gestational age were significantly higher in subjects without RDS compared to subjects with RDSS with p=0.01 and 0.005. The residence status as rural and urban was statistically comparable in neonates with and without RDS with p=0.721. In gravidity, numbers were statistically comparable in neonates with and without RDS with p=0.609. In abortion, no abortions were significantly higher in RDS-positive subjects, one abortion was higher in RDS-negative subjects, and 2 abortions in RDS-negative subjects with p=0.01. These data were comparable to the previous studies of Pallavi L et al[6] in 2017 and Wang J et al[7] in 2019 where authors assessed subjects with demographics, pregnancy, and fetal data comparable to the present study in their respective studies.

It was seen that for comparison of neonatal RDS and non-RDS concerning AC, FL, and BPD, AC (abdominal circumference) was significantly higher in non-RDS subjects compared to RDS subjects with p<0.001. FL (femur length) in fetuses was significantly higher in non-RDS subjects compared to RDS neonates with p<0.001. BPD ((Biparietal diameter) was significantly higher in non-RDS subjects compared to RDS neonates with p<0.001. On comparing RDS and Non-RDS neonates concerning placental grading, placental grading 0-I was seen in 72.3% (n=68) and 18.2% (n=92) RDS positive and negative subjects which were higher in RDS negative subjects, grading II was significantly higher in RDS negative neonates, and Grading III was significantly higher in RDS negative subjects compared to RDS positive subjects with p<0.001. These results were consistent with the findings of Shapiro-Mendoza et al[8] in 2013 and Rasheed FA et al[9] in 2012 where the comparison of neonatal RDS and non-RDS

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concerning AC, FL, and BPD reported by the authors in their studies were comparable to the results of the present study.

The study results showed that for comparison of RDS and non-RDS neonates for colon grading, lung/liver echogenicity, and thalamic echogenicity, colon grading I was significantly higher in RDS positive subjects, grade II in RDS positive, and Grade III in RDS negative subjects with p=0.003. In lung/liver echogenicity, isoechoic echogenicity was significantly higher in RDS negative, hypoechoic echogenicity in RDS positive, and hyperechoic echogenicity equivalent in RDS positive and negative subjects each with p=0.417. In thalamic echogenicity, echo lucent was significantly higher in RDS-positive and echogenic lesions in RDS-negative subjects with p<0.001. These findings were in agreement with the results of Peacock JL et al[10] in 2012 and Sharma D et al[11] in 2019 where comparison of RDS and non-RDS neonates for colon grading, lung/liver echogenicity, and thalamic echogenicity comparable to the present study was also reported by the authors in their respective studies.

The study results also showed that for comparison of RDS and non-RDS neonates for APGAR scores, APGAR 1 minutes and APGAR 5 minutes were significantly higher in RDS negative subjects compared to RDS positive subjects with p=0.001 and 0.01 respectively (Table 5). For sensitivity, specificity, NPV, and PPV in RDS neonates from the study showed that PTE had sensitivity, specificity, NPV, and PPV as 61.68%, 83.38%, 91.9, and 40.6 showing statistical significance with p=0.001. Similar significance was also seen for DFE and FFP concerning sensitivity, specificity, NPV, and PPV with p=0.001 and 0.001 respectively. These results were in line with the findings ofThavarajah, H et al[12] in 2018 and Patil SD et al[13] in 2020 where the comparison of RDS and non-RDS neonates for APGAR scores reported by the authors in their studies was comparable to the results of the present study.

CONCLUSIONS

The present study considering its limitations, concludes that ultrasound variables including amniotic FFP (fluid-free floating particles), DFE (distal femoral epiphysis), and PTE (proximal tibial epiphysis) are vital and accurate predictors for the assessment of respiratory distress syndrome with different degrees of performance.

REFERENCES

1. Chen, C., Tian, T., Liu, L., Zhang, J. and Fu, H: Gender-related efficacy of pulmonary surfactant in infants with respiratory distress syndrome: A STROBE compliant study. Medicine. 2018;97:17.
2. Bonet-Carne, E., Palacio M., Cobo, T., et al: Quantitative ultrasound texture analysis of fetal lungs to predict neonatal respiratory morbidity. Ultrasound in Obstetrics & Gynecology. 2015;45:427-33.
3. Abdulla, TN., Hassan, QA. and Ameen, BA: Prediction of Fetal Lung Maturity by Ultrasonic Thalamic Echogenicity and Ossification Centers of Fetal Femur and Tibia. Italian Journal of Gynaecology& Obstetrics. 2018;30:29-36.
4. Abdou, A. M., Badr, M. S., Helal, K. F., Rafeek, M. E., Abdelrhman, A. A., & Kotb, M: Diagnostic accuracy of lamellar body count as a predictor of fetal lung maturity: A systematic review and meta-analysis. European Journal of Obstetrics & Gynecology and Reproductive Biology. 2020;5:100059.
5. Abd EL-Fattah, A., Yosry, L., Hammour, Z. and Chararah, D.A: Accuracy Of Ultrasound Prediction Of Fetal Maturity By Ossification Center Of Long Bones in The Cases Of Elective Cesarean Section At 38 Week Gestation. The Egyptian Journal of Fertility of Sterility. 2018;22:2-12.
6. Pallavi L., Sushil, K., Lakhkar, D.L., Soniya, D., Abhijeet, I., and Pooja, S: Assessment of Fetal Lung Maturity by Ultrasonography. Annals of International Medical and Dental Research. 2017;3:1.
7. Wang, J., Yan, J., Han, J., Ning, Y. and Yan, C: Risk factors for respiratory distress syndrome among Chinese infants of 34-42 weeks gestational age: a multi-center observational study. Int J Clin Exp Med. 2019;12:60-4354.
8. Shapiro-Mendoza, C.K. and Lackritz, E.M: Epidemiology of late and moderate preterm birth. In Seminars in Fetal and Neonatal Medicine. 2013;17:120-5.
9. Rasheed, F.A., Zahraa'M, A.S. and Hussain, S.A: Evaluation of thalamus echogenicity by ultrasound as a marker of fetal lung maturity. Open Journal of Obstetrics and Gynecology. 2012;2:270.
10. Peacock, J.L., Marston, L., Marlow, N., Calvert, S.A. and Greenough, A: Neonatal and infant outcome in boys and girls born very prematurely. Pediatric research. 2012;71:305-10.
11. Sharma D., Padmavathi, I. V., Tabatabaii, S. A., & Farahbakhsh, N: Late preterm: a new high-risk group in neonatology. The Journal of Maternal-Fetal & Neonatal Medicine. 2019;1:1-14.
12. Thavarajah, H., Flatley, C. and Kumar, S: The relationship between the five-minute Apgar score, mode of birth and neonatal outcomes. The Journal of Maternal-Fetal & Neonatal Medicine. 2018;31:1335-41.
13. Patil SD., Patil, S.V., Kanamadi, S., Nimbal, V. and Yeli, R: A Clinical Study of Fetal Lung Maturity Correlated by Various USG Parameters. Parity. 2020;5:12-4.