International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Sengodan SS et al. Int J Reprod Contracept Obstet Gynecol. 2020 Dec;9(12):5060-5064
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20205247

Original Research Article

Amniotic fluid optical density at spontaneous onset of labour and it's correlation with gestational age, birth weight and functional maturity of newborn

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Received: 29 September 2020
Revised: 05 November 2020
Accepted: 06 November 2020

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ABSTRACT

Background: Respiratory distress is the common cause of neonatal morbidity and mortality. Babies born even at 40 weeks of gestation developed respiratory distress. The maturity of newborn is independent of gestational age and birth weight of newborn. In this study amniotic fluid optical density (AFOD) is correlated with the functional maturity of newborn.
Methods: In this study, hundred singleton pregnant women who underwent first trimester scan and crown rump length estimation, and who were on spontaneous labor were selected for this observational study. Under aseptic precautions AF samples were collected while doing amniotomy with 2 ml disposable syringe, also collected during caesarean section after careful hysterotomy from the bulging membranes. Amniotic fluid optical density studied with spectrometer at 650 nm. Birth weights were recorded for all the babies. Babies are also looked for the respiratory distress, NICU admission.
Results: In this study, respiratory distress was reported in 28% of newborns whereas 72% of newborns did not have distress. In the present study, 27% of newborns were admitted in NICU where as 73% of the newborns were on mother's side following delivery. Babies with AFOD 0.98±0.27 were functionally mature, skin was pleased brown in colour with little vernix, none of them had respiratory distress. Amniotic fluid optical density <0.4 developed respiratory distress.
Conclusions: Amniotic fluid optical density is a simple method to assess the functional maturity of newborn.

Keywords: AFOD, Functional maturity, Respiratory distress

INTRODUCTION

Respiratory distress syndrome remains a common cause of neonatal morbidity and mortality. The pulmonary system is among the last of the fetal organ system to mature both functionally and structurally.

Pulmonary surfactant increases the lung compliance and prevents the collapse of alveoli during expiration. Biochemical analysis of LS ratio of 2:1 and phosphatidyl glycerol indicates pulmonary maturity.[1,2] Among the biophysical methods, bubble formation tests, optical density at 650 nm, flourescense polarisation lamellar body concentration helps in determining the fetal lung maturity.[2-6]

Gestational age at delivery is unique to fetomaternal unit.[7] One of the most important preventive measures in obstetrics is the individual evaluation of most appropriate time to terminate the pregnancy.[8] It is a conventional degree that babies born between 37-40 weeks are completely mature. Even after 40 weeks full term, an evidence of 0.25% RDS has been recorded. About 0.05% who were delivered electively between 37-40 weeks

required mechanical ventilation.[9] The lung skin interaction by the surfactant causes vernix detachment, increases amniotic fluid turbidity.[10,11]

Though there are several techniques practiced in recent times to assess the maturity of fetus, role of amniotic fluid optical density (AFOD) in assessing the gestational age and functional maturity of newborn has been reported in several researches.[12-14] Amniotic fluid absorbance at 650 nm is considered as a standard investigation for lung maturity evaluation.[15] Even the low birth weight babies if functionally mature can be managed at home.[16] In our study we confirm this phenomenon in terms of AFOD which measures lung maturity, skin maturity as well as biological age. Hence this study was conducted to correlate the AFOD at spontaneous onset of labour with gestational age, birth weight and functional maturity of newborn.

Aims and objectives

To establish the correlation between amniotic fluid optical density (AFOD) with gestational age, birth weight and functional maturity of newborns and to study the functional maturity of the newborns, especially in terms of lung maturity by means of presence or absence of respiratory distress in babies born out of spontaneous labour.

METHODS

A prospective study conducted on hundred antenatal women, admitted for delivery in GMKMCH, Salem.

Duration of study:

July 2019 to December 2019.

Ethical committee approval

Ethical committee approval was obtained for this study to find the correlation between amniotic fluid optical density with gestational age, birth weight and functional maturity of the new born among antenatal mothers attending inpatient department of Obstetrical and Gynecology, from the ethics committee.

Inclusion criteria

Women who underwent first trimester scan and crown rump length estimation and women with regular menstrual cycles who underwent USG at less than 20 weeks gestation which is in agreement with the gestation age calculated from the last menstrual period.

Exclusion criteria

Blood stained and meconium stained amniotic fluid samples, intrauterine growth restriction, premature rupture of membranes, multiple pregnancies.

Under aseptic precautions, amniotic fluid samples were collected while doing amniotomy with a sterile syringe. Amniotic fluid samples were also collected at cesarean section, after careful incision in the uterus from the bulging membranes. Minimum 2 ml of amniotic fluid transferred to the plain test tube. Amniotic fluid optical density (AFOD) was measured using spectrometer. The wavelength was set at 650 nm, first the control test tube with water was read by the spectrometer followed by the amniotic fluid sample. The amniotic fluid optical density (AFOD) was shown immediately as digital number in the spectrometer.

Figure 1: Spectrometer with test tube containing amniotic fluid.

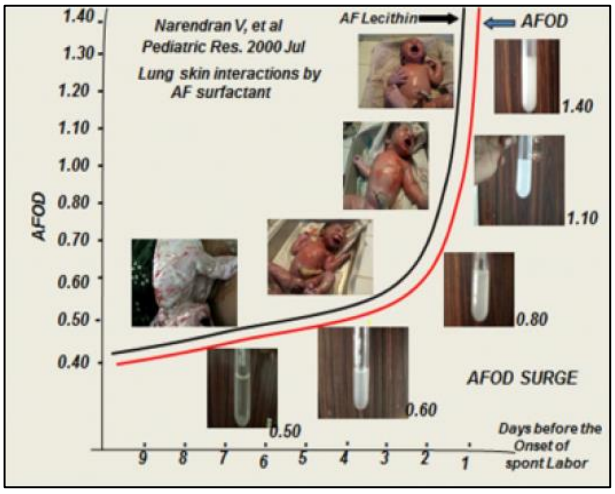

Figure 2: AFOD levels and fetal maturity.

Birth weights were recorded for all the babies by electronic weighing machine. APGAR scores at one minute and 5 minute were obtained. Babies were observed for clinical signs of respiratory distress. Clinical signs of respiratory distress (RR>60, grunting, retraction of ribs/sternum, low SPO_2 requiring O_2 for more than 2 hours (to exclude transient tachypnea of newborn), chest x-ray findings after 24 hours were suggestive of RDS. Factors like sepsis, gestational diabetes mellitus, pneumonia, meconium aspiration, congenital anomalies were excluded.

Data analysis

The data was entered in excel sheet and analyzed using statistical package for social sciences (SPSS- version 17). Descriptive statistics with mean, standard deviation (SD) and proportions (%) were calculated for continuous variables. To test the hypothesis chi Square test, independent sample t test and ANOVA were used appropriately. P value <0.05 was considered as statistically significant.

RESULTS

In this study, there were hundred participants included. Among them majority (47%) of them were in the age group of 21-25 years followed by 26-30 years (33%), less than or equal to 20 years (15%) and 31-35 years (5%).

Table 1: Proportion of participants in different gestational age.

Gestational age	Percentage
33-33 weeks + 6 days	5.0
34-34 weeks + 6 days	11.0
35-35 weeks + 6 days	5.0
36-36 weeks + 6 days	26.0
37-37 weeks + 6 days	20.0
38-38 weeks + 6 days	23.0
39-39 weeks + 6 days	5.0
40-40 weeks + 6 days	5.0

Spontaneous labour occurred most commonly in the gestational age group 36-36 weeks + 6 days of gestation (26%) followed by 38-38 weeks + 6 days of gestation (23%), 37-37 weeks + 6 days of gestation (20%) and 34-34 weeks + 6 days of gestation (11%). Also 5% of cases had spontaneous labour in the gestational age group 33-33 weeks + 6 days, 35-35 weeks + 6 days, 39-39 weeks + 6 days of gestation and 40-40 weeks + 6 days of gestational age. In this study, respiratory distress was reported in 28% of newborns whereas 72% of newborns did not have distress.

Table 2: Association between gestational age and respiratory distress.

Gestational age (in weeks)	Respiratory distress		P value
	Present	Absent	
33-33+6 days	5	0	0.000*
34-34+6 days	6	5	
35-35+6 days	3	2	
36-36+6 days	3	23	
37-37+6 days	2	18	
38-38+6 days	7	16	
39-39+6 days	0	5	
40-40+6 days	2	3	
Total	28	72	

Table 3: Difference in mean AFOD with respect to respiratory distress.

Variable	Respiratory distress	Mean±SD	P value
Amniotic fluid optical density	Present	0.4±0.1	0.000*
	Absent	1.2±0.1	

*Significant

Mean difference in AFOD among the cases with and without respiratory distress was found to be 0.4±0.1 and 1.2±0.1, respectively. The difference in AFOD with respect to respiratory distress was found to be statistically significant in this study with a p value of 0.000.

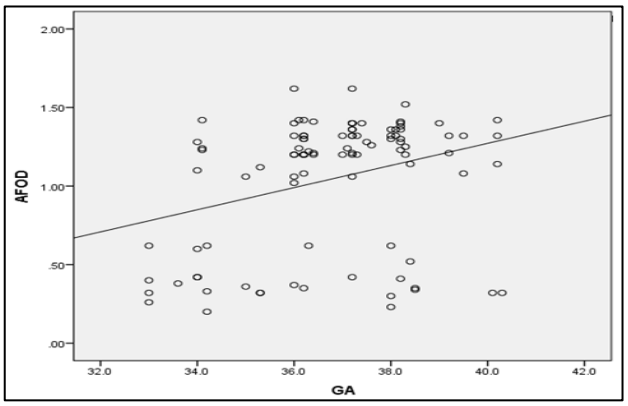

Figure 3: Correlation between gestational age and AFOD.

DISCUSSION

Gestational age by itself does not always exclude the possibility of respiratory distress syndrome because literature has reported prevalence of RDS after 40 weeks of gestation as 0.25%.[17,18] Though the percentage is small, the number increases to significant proportions when extrapolated to larger populations which are avoidable. American College of Obstetricians and Gynecologists guidelines recommend the obstetricians to confirm fetal pulmonary maturity prior to elective delivery less than 39 weeks gestation.[19] ACOG recommends the AFOD value >0.15 of a centrifuged amniotic fluid sample to confirm lung maturity. The onset of spontaneous labour takes place at AFOD value around 0.98.[21]

In this study, we observed that newborns with AFOD value <0.40 developed RDS. The findings are in accordance with the previous studies, AFOD represents indirectly the amount of surfactant.[21,22] Hence severity depends on the how low the AFOD value is or in other words how low the surfactant phospholipids are and not always how low the chronological age is. There could be other factors accounting for less severity of RDS like trial of labour or unknown constitutional factors at advanced gestational age despite low surfactant levels as revealed by low AFOD values.[23] However the severity could be

more than expected on rare occasions.[24-26] Exact measurements of AFOD is possible in AFI value of 9-16.[27] Ram et al reported mean optical density of 1.03±0.31 in babies devoid of RDS.[28,29] Babies With AFOD 0.98±0.27 are functionally mature, skin was pleased brown in colour with little vernix, none of them had respiratory distress.[30] Amniotic fluid optical density <0.4 developed respiratory distress.[31,32]

In our study, mean difference in AFOD among the cases with and without respiratory distress was found to be 0.4±0.1 and 1.2±0.1, respectively. The difference in AFOD with respect to respiratory distress was found to be statistically significant in this study. In this study, it was found that amniotic fluid optical density levels were high among the newborns with better APGAR score at five minutes. Thus shows a significant positive correlation between APGAR at five minutes and amniotic fluid optical density.

The onset of labour is more closely related to fetal functional maturity than either gestational age or birth weight.[33] The gestational age at delivery is unique to each feto-maternal unit · The understanding of AFOD prevents iatrogenic prematurity and complications of postmaturity thereby optimizing labour.

Limitation of this study is only 100 amniotic fluid samples are studied, further studies are needed.

CONCLUSION

In this study we conclude that each fetus has got its own maturity potential amniotic fluid optical density (AFOD) was found to be significantly associated with functional maturity of newborn. It was found that AFOD increases with gestational age.

AFOD is higher among the newborns with better APGAR score. In our study babies with AFOD <0.40 developed respiratory distress irrespective of gestational age and birth weight of newborn. Babies with AFOD 1.2±0.1 are functionally mature and did not develop respiratory distress irrespective of gestational age and birth weight of newborn, which is found to be statistically significant. Induction of labour needs to be reviewed in lights of AFOD which determines the preparedness of labour and hence the biological gestational age that is more relevant than the estimated date of confinement (EDC).

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Sengodan SS, Velumani S. Amniotic fluid optical density at spontaneous onset of labour and it's correlation with gestational age, birth weight and functional maturity of newborn. Int J Reprod Contracept Obstet Gynecol 2020;9:5060-4.