



AMNIOTIC FLUID OPTICAL DENSITY AS A PREDICTOR OF NEWBORN'S FUNCTIONAL MATURITY – A PROSPECTIVE CLINICAL STUDY

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ABSTRACT A prominent cause of neonatal morbidity and mortality appears to be Respiratory Distress Syndrome (RDS). Consequently, monitoring for fetal lung maturity plays an important role in setting up plans for obstetric management. Cesarean sections done at less than 39 weeks gestation are at greater risk of neonatal morbidity including respiratory distress, hypoglycaemia, sepsis, NICU admissions, hospitalization for more than 5 days, etc our study aims at correlating fetal maturity with amniotic fluid optic density.

AIMS AND OBJECTIVES

- To establish correlation between Amniotic fluid Optical density (AFOD), gestational age, birth weight and functional maturity of the newborn.
- To obtain mean AFOD at spontaneous onset of labor.
- To study the functional maturity of the newborns, especially in terms of lung maturity by means of presence or absence of RDS in babies born out of spontaneous labor and in those born by elective termination.

MATERIALS AND METHODS

- Place:** This study was carried out from the cases collected from the Department of Obstetrics and Gynaecology, Dr. Pinnamaneni Siddhartha Institute of Medical Sciences & Research Foundation, Chinna Avutapalli, Vijayawada, Andhra Pradesh.
- Duration:** 18 months between April 2016 and October 2017
- Study Design:** Prospective study.
- Study Population :** 101 cases.

Inclusion criteria:

Women who underwent first trimester scan and crown rump length estimation.

Exclusion criteria:

- Blood stained, and meconium stained amniotic fluid samples.
- Premature rupture of membranes.

Under aseptic precautions amniotic fluid samples were collected while doing amniotomy after 3-4 cm dilatation by an intramuscular needle fitted with a 2ml disposable syringe. Amniotic fluid samples are collected at caesarean section after careful incision on the uterus from the bulging membranes. The color and turbidity of the fresh uncentrifuged sample was objectively quantified by colorimetry. The measurement of AFOD was done at 650 nm after the reading of control test tube with tap water. Babies are observed for the amount of Vernix on their skin immediately after birth before drying of the baby. APGAR scores at 1 minute and 5 minutes were obtained. Babies were observed for classical signs of respiratory distress (tachypnea >60 breaths/min, grunting, retraction of ribs, sternum).

KEYWORDS :

INTRODUCTION

The pulmonary system is among the last of the fetal organ systems to mature, both functionally and structurally. One of the most important preventive measures in obstetrics is the individual evaluation of the most appropriate time to terminate a pregnancy. (1) It is a conventional decree that babies born between 37-40 weeks of gestation are completely mature. Even after 40 weeks "full term" an incidence of 0.25% RDS has been recorded. (2) In one large study, about 0.05% who were delivered electively between 37 and 40 weeks required mechanical ventilation. (3)

However, fetal maturation is a time-spatial process which means that from the increase of spatial parameters one can calculate the individual time of maturation expressed in the number of technical quanta and gestational age is a biologic continuum and new data reveal important insights into the outcomes of babies born during this 5-week period called term (4). Both fetus and mother in the last 3-4 days of pregnancy undergo rapid pre-labor changes necessary to delivery and sudden adaptation of fetus to extra uterine life. Labor which starts ≥ 1 week before its own individual term (preterm) as well as delayed due to disturbance of its initiation (postponed pregnancy) is possible in the large six-week range (37⁰⁷ - 43²⁷).

SURFACTANT

The internal surface of the alveolus is covered with a thin coat of fluid. Pulmonary surfactant decreases the surface tension of water, increases lung compliance and prevents collapse of alveoli during expiration. (2)

The amount of lecithin is difficult to quantify, the ratio of lecithin (which increases with maturity) to sphingomyelin (which remains constant during gestation) (L/S ratio) is determined. L/S ratio of 2:1 usually indicates pulmonary maturity. The presence of phosphatidylg-

lycerol, also is indicative of fetal lung maturity and useful in maternal diabetes. (2)

RESULTS

In this observational study encompassing 101 pregnant women ,56 were spontaneous deliveries, out of these,9 women delivered on the day of EDD which corresponds to 8.9%, while ,23.76% deliveries took place at gestational age between 37 and 40 weeks,10% delivered spontaneously before 37 weeks and 12.87% delivered after 40 weeks as per **Table 2**.

Table 2: Percentages of spontaneous deliveries at different Gestational ages

Gestational age (days)	No. of spontaneous deliveries	Percentage of spontaneous deliveries
≤ 258	10	9.9
259-279	22	21.76
280	9	8.9
≥ 281	15	13.87
Total	56	56

Out of a total 101 women,62 were primigravidae, 32 were secondary gravidae ,4 were third and 3 were fourth gravidae. The mean AFOD was found to be 0.91 in the primi gravidae and 0.98 in the multi gravidae in the non RDS group, while it was 0.33 in the primigravidae and 0.33 in the multigravidae in the RDS group and no statistically significant difference was found. A total of 56 had spontaneous onset of labor and 45 had terminated electively. The mean AFOD at spontaneous onset of labor was found to be 0.96 \pm 0.26 and the mean AFOD for elective termination of pregnancies was 0.75 \pm 0.31. The mean period of gestation in days for the total number of cases was

268.584±13.895; it ranged from 196 days to 290 days and the median was 269 days. In the non RDS group the period of gestation ranged from 236 days to 290 days with the mean being 271.3±10.993, and the median being 271 days. In the RDS group, the period of gestation ranged from 196 days to 286 days, the median being 257.5±20.251 and the median was 257 days.

The mean AFOD for Non-RDS cases (N=89) 0.93±0.24 found to be significantly higher when compared to the RDS cases (12) 0.33±0.08 and $p < 0.0005$.

The Total no of cases with AFOD <0.40 were 12 cases and all of them developed RDS. The mean birth weight in total number of cases was 5.05±0.59, while it was 2.92±0.38 and 2.13±0.21 respectively in the non RDS and the RDS groups.

The mean birth weight (grams)/gestational age (in days) ratio for total cases was 10.455±1.384. The birth weight/ gestational age for non RDS group was ranged from 6.14 to 15.679 the mean being 10.429±1.664, and the median 10.467. For the RDS group, it ranged from 9.504 to 17.073, the mean was 9.466±2.478 and the median was 9.479. There was no statistically significant difference in birth weights adjusted to gestational age between the non RDS and RDS groups. ($p=0.0827$). as per **Table 3**.

The 101 cases were divided into groups according to gestational age, for comparison; less than 35 weeks, 35weeks+1day to 36 weeks, 36weeks+1day to 37 weeks, 37weeks+1day to 38 weeks, 38weeks+1day to 39 weeks, 39 weeks +1 day to 40weeks, and greater than 40 weeks. The chart showing the number of cases in each group divided according to the gestational age.

Out of the total number of cases of spontaneous onset of labor group of 56 only 2 cases developed RDS, while in the elective termination group, RDS was present in 5 out of 7 groups, including the group with period of gestation >280 days.

Table 3. Characteristics of AFOD and birth weight in non RDS and RDS groups compared with total study population

	Total	Non RDS	RDS
No. of cases	101	89	12
Mean period of gestation(days)	268.584±13.895	271.3±10.993	257.5±20.251
AFOD mean ±SD	1.26±0.32	0.93±0.24	0.33±0.08
Mean Birth weight(±SD)	5.05±0.59	2.92±0.38	2.13±0.21
Birth weight (grams)/ Gestational age (days)±SD	10.455±1.384	10.429±1.664	9.466±2.478

Table 4. Distribution of cases with and without RDS in different groups of spontaneous onset of labor and elective termination of pregnancy.

Gestation al age(in days)	Spontaneous onset of labor			Elective termination		
	Total	Without RDS	With RDS	Total	Without RDS	With RDS
<246	0	0	0	6	3(50%)	3(50%)
246-252	6	5(83.3%)	1(16.7%)	2	0(0%)	2(100%)
253-259	3	3(100%)	0(0%)	1	1(100%)	0(0%)
260-266	4	4(100%)	0(0%)	5	4(80%)	1(20%)
267-273	17	16(94.1%)	1(5.9%)	8	8(100)	0(0%)
274-280	16	16(100%)	0(0%)	17	14(82.4%)	3(17.6%)
>280	10	10(100%)	0(0%)	6	5(77.8%)	1(25%)

DISCUSSION

In our study between any two groups among 3 to 7 there is no radical change in mean AFOD values when cases of RDS were excluded for analysis and remained same after adjusting for birth weights. All the babies born with AFOD value around the mean 0.93±0.2 SD were fully functionally mature. Their skin was mature, pink with very little vernix caseosa adherent to the surface. None of the babies developed RDS when AFOD was more than 0.40. On the other hand, babies born with AFOD value < 0.40 (n=12) were functionally premature and developed varying degrees of RDS and had birth weights ranging from 2300 to 3000 gms. Their skin was premature, thin, shiny and red in color with plenty of vernix caseosa adherent to the surface. The largest

AFOD value at which babies developed RDS was 0.40. We observed that Babies born with AFOD value < 0.40, at a lower gestational age developed moderate to severe and prolonged RDS as compared to babies born with AFOD value <0.40 at a later gestational age who developed milder RDS for shorter duration.

Though 0.40 AFOD value is just enough to prevent RDS, fetal maturity is complete only when all systems attain complete functional maturity. Complete maturity of the babies is seen with the AFOD value around 1. At higher OD values there were less amount of vernix on body surface of new born. The inverse relation to AFOD values is proved in this study. (correlation coefficient -0.810).

Turner and Read⁽⁵⁾ and other investigators⁽⁶⁾ have shown an association between amniotic fluid turbidity assayed at 650 nm and fetal maturity.

During the third trimester of human gestation, there is a progressive increase in the turbidity of the amniotic fluid surrounding the fetus.

The skin maturation follows lung maturity resulting in complete functional maturity of fetus. Considering skin maturity as reliable endpoint, prematurity, optimum maturity and post maturity are part of a spectrum which can happen at any time within 36 to 42 weeks GA during which birth is taking place. population.

Induction of labor needs to be reviewed in light of AFOD values or its equivalent indicators which determine the preparedness of labor and hence the biological gestational age that is more relevant than "EDC" (Estimated Date of confinement) which itself is a misnomer.

CONCLUSION

- Each fetus has got its own maturity potential. Attaining completion of functional maturity takes place at different gestational ages (after 35+ wks) with different birth weights.
- AFOD can be used to estimate the quantum of functional maturity of fetus (marker).
- AFOD correlates well with functional maturity of the newborn.
- Babies are fully functionally mature at AFOD value around 1.
- Babies with AFOD <0.40 are premature and all of them developed RDS irrespective of the gestational age, while babies born with AFOD around 1 are completely mature. Those with AFOD >1.75 showed post mature changes.

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