

# Individualized Term for Each Fetus: From Surge in Amniotic Fluid Optical Density (AFOD)

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## Abstract

Objective:

To assess the trend of rise in Amniotic Fluid Optical Density (AFOD) with the onset of spontaneous term labor.

Methods:

Amniotic Fluid (AF) samples collected by amniocentesis for lung maturity assessment in 12 preterm labor subjects were utilized for AFOD estimation. After successful tocolysis and continuation of pregnancies, AFOD estimations were repeated when women presented with labor pains again before 37w+6days. AF samples were also collected while doing amniotomy at spontaneous labor in all subjects. Un-centrifuged fresh AF samples were used for AFOD estimations with colorimeter at 650nm. Babies were evaluated for functional maturity in terms of RDS, color of the skin, and adherence of vernix caseosa to skin surface at birth.

Results:

Among these 12 subjects the CRL gestational age at delivery ranged from 35w+3days to 42w+0days. The AFOD values at amniotomy ranged from 0.74 to 1.54. In 11 subjects who underwent repeat amniocentesis we could observe a slow and prolonged rise in AFOD till a value around 0.40 was reached. After this value, the AFOD rose rapidly like a surge, which coincided with the onset of spontaneous labor. All babies born were functionally fully mature irrespective of gestational age and birth weight. In 6 subjects the duration of surge was observed to range from 6 to 10 days.

Conclusion: There was a definite surge of AFOD which coincided with completion of fetal functional maturity and onset of spontaneous labor. All these factors occurring at different gestational ages with different fetuses indicate individualized term gestation for each fetus.

## INTRODUCTION

In spite of great scientific advancement, the mechanism behind the gestational age at which the spontaneous onset of labor is taking place with each pregnancy, and the gestational age at which completion of functional maturity is attained with each fetus has eluded the obstetrician. S. Ram, et al. had reported, the Mean AFOD at spontaneous labor with complete fetal functional maturity was  $0.98 \pm 0.271$ ,<sup>2</sup>. Different fetuses attain completion of functional maturity at different gestational ages with different birth weights, at any time between 36wks to 42+wks<sup>1, 2</sup>.

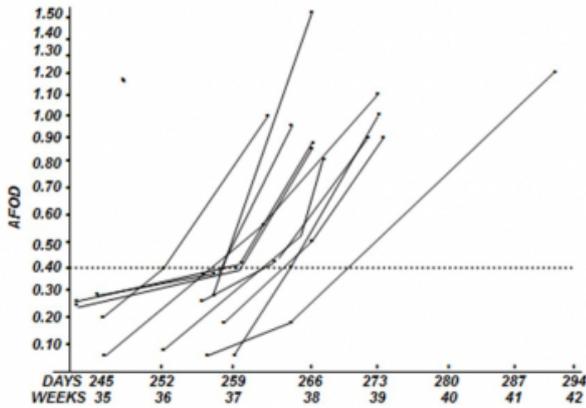
Surge like rise in different biochemical substances which participate in the process of labor was reported in animal studies<sup>3</sup>. Amniotic fluid surfactant lecithin concentrations

are reported to increase from 43 micro grams/ml at 34-35wks to 147 micro grams/ml at term before labor. Further these levels are known to increase up to 232 micro grams/ml with labor. Narendran.V.et al. had reported, raising levels of surfactant lecithin induces progressive detachment of vernix from fetal skin surface, leading to progressive increase in AF turbidity during third trimester<sup>4</sup> (Fig.1). M. J. Verpoest.et.al had reported an exponential rise in amniotic fluid macro score (a system to express the degree of cloudiness) with the onset of spontaneous labor regardless of duration of gestation<sup>5</sup>. There is a surge in sebaceous gland activity, size and number producing sebum, which is a primary constituent of vernix caseosa before the onset of term labor<sup>4</sup>.



**Figure 2**

There was a slow and prolonged raise in AFOD till a value around 0.40 was reached. After this value the AFOD rose rapidly like a surge which coincided with the onset of spontaneous labor (N=12).



**Figure 3**

Functionally premature baby with plenty of vernix and with RDS even at 40+wks GA with AFOD < 0.40 (left). Functionally fully mature baby with no vernix and RDS, even at 35+wks with AFOD > 0.98 ± 0.27, case No.3 in Table.1 (right).



**Table 1**

AFOD values at different gestational ages in each subject.

S No	First Amniocentesis		Rept Amniocentesis		Amniotomy at spont.labor		Birth Weight Kg	Days from AFOD 0.40-0.02		Skin color	Vernix on skin
	G.A	AFOD	G.A	AFOD	G.A	AFOD		to sp. Lab	RDS		
1	34w+6d	0.28	36w+5d	0.38	37w+5d	0.97	2.9	7	nil	mat pale brown	little
2	36w+4d	0.26	37w+5d	0.42	38w+5d	0.88	3.0	7	nil	mat pink brown	little
3	---	---	---	---	35w+3d	1.14	2.3		nil	mat pale brown	nil
4	34w+4d	0.25	37w+1d	0.40	38w+0d	0.84	2.8	6	nil	mat pink brown	little
5	36w+4d	0.06	37w+5d	0.18	41w+4d	1.20	3.7		nil	mat pale brown	nil
6	35w+0d	0.20	36w+0d	0.40	37w+3d	1.00	2.8	10	nil	mat pale brown	little
7	36w+6d	0.18	38w+0d	0.51	39w+1d	0.90	3.0		nil	mat pale brown	little
8	36w+0d	0.08	37w+6d	0.52	38w+2d	0.80	2.7		nil	mat pink brown	little
9	35w+0d	0.06	37w+4d	0.58	39w+0d	1.10	2.9		nil	mat pale brown	nil
10	37w+0d	0.05	37w+6d	0.40	39w+2d	1.00	3.0	10	nil	mat pale brown	little
11	36w+5d	0.41	---	---	37w+5d	0.94	2.8	7	nil	mat pale brown	little
12	36w+5d	0.29	---	---	38w+1d	1.54	2.9		nil	mat pale brown	nil

**DISCUSSION**

The physiology of onset and progression of labor is undoubtedly multi-factorial involving various rate limiting complex sequential inter related and mutually supportive

cascades. Some women have genetic pre-disposition to deliver pre term due to differences at molecular level. Polymorphisms in several genes regulating cytokines, genetic susceptibility to infections of low virulence, mutations of collagen synthesis, oxytocin receptors, parity and age are also involved<sup>10</sup>. These factors vary from race to race and also between each feto-maternal unit resulting in physiological variation in duration of pregnancy<sup>11,1,2</sup>

It is not an uncommon observation to observe, few babies born preterm, even at 35+wks gestation are fully functionally mature and do not develop RDS. On the other hand few babies born at term, even at 40+wks gestation are functionally premature and develop RDS<sup>1, 2</sup> Fig.3 (term RDS).

S. Ram, et al. had reported that the Mean AFOD at spontaneous labor with complete fetal functional maturity was found to be  $0.98 \pm 0.271$ , 2. Different fetuses attained this value at different gestational ages (between 36wks to 42wks) with different birth weights indicating individual term for each fetus<sup>1, 2</sup>.

In our current study of 12 preterm labor subjects, AFOD values at spontaneous labor ranged from 0.80 to 1.54 (Table 1). This mature AFOD readings at spontaneous labor occurred at different gestational ages ranging from 35w+3d to 41w+4d. All the babies were fully functionally mature with very little vernix on their skin surface, and none of them developed RDS indicating individual term for each fetus. In 11 subjects who underwent repeat amniocentesis and AFOD estimations, we could observe a slow and prolonged rise in AFOD till a value around 0.40 was reached. After this value, the AFOD rose rapidly like a surge, which coincided with the onset of spontaneous labor (Fig.2). In 6 subjects we had the opportunity to observe the duration of surge i.e., from AFOD value  $0.40 (\pm 0.02)$  to delivery, and was found to range from 6 to 10days (Table 1).

Witfield.et.al had shown a surge like raise in L/S area ratio with the onset of spontaneous term labor, in women who underwent serial AF sampling in their study<sup>6</sup>. Jacobus. H.P and Slothober.et al. had reported positive correlation between L/S ratio and AFOD at 650nm in randomly collected A.F samples<sup>12</sup>. From these two studies it can be inferred that there is a surge like rise in AFOD with the onset of spontaneous term labor, which is similar to our observation in this study.

Joze.H and Zabkar.et al in their study by amnioscopy,

reported rapid change of AF color from watery to milky with in the last 6 to 7 days before the onset of spontaneous labor. Also they have reported this color change in AF can take place at any time after 36wks<sup>13</sup>.

Narendran.V.et al. had reported lung skin interaction in which, progressively rising levels of amniotic fluid surfactant lecithin induces progressive detachment of vernix from fetal skin surface (Fig. 1)<sup>4</sup> during the late third trimester. This could be the reason for surge like raise in AFOD which coincides with the onset of spontaneous labor.

Skin is the last organ to mature, which is associated with rapid shedding of vernix caseosa in to amniotic fluid<sup>13, 14</sup>. Mazzucchelli.I.et al. had reported, pro-labor cytokines like IL6, IL8 are produced by human amniotic fluid cells<sup>15</sup>. Cytokines like IL1, which is highly expressed by corneocytes, is present in the normal human sebaceous glands, which serves as a signal for the onset of parturition<sup>16, 17</sup>. Pro labor cytokine rich vernix caseosa getting mixed with AF could be the reason for triggering the process of spontaneous labor at completion of fetal functional maturity. Nature tries to push the baby out whenever the baby is functionally mature and fit to survive outside.

The concept of individual term for each fetus is having many implications in obstetrics. Expected date of delivery is an unsettled issue. Only 3.38% deliveries take place on EDD (280y<sup>th</sup> day) by Nigel's rule. In babies who mature early the maturation process completes early, as early as 36wks. In babies who mature late the maturation process is delayed as far as up to 42+wks.

A fetus which completes maturation as early as 36wks becomes post mature or dysmature by 37+wks if labor does not start for some reason. On the other hand a fetus destined to complete maturation by 42wks, if delivered at 40wks, it becomes premature by 2wks and develop RDS (term RDS). This could be the reason for ACOG9 & RCOG18 guidelines recommending confirmation of lung maturity for elective termination of pregnancies before 38 w +6days

The definitions of preterm, term, post-term, and postdated pregnancies are made by obstetricians for clinical convenience. Nature does not have these definitions. Nature's philosophy is only to push the baby out when the baby is fully functionally mature and fit to survive outside.

AFOD estimation in preterm labor gives an idea about the functional maturity status of the fetus. With mature AFOD reading, babies can be delivered without any delay as in case of case No.3 in the Table.1 and Fig.3. In our study the time required for AFOD value to reach from 0.40 to 0.98 (surge) is around 8 days. AFOD estimation further helps us to predict the number of days required further for completion of maturity. This helps to avoid unnecessary waiting indefinitely for the onset of spontaneous labor.

On conclusion there is a definite surge in AFOD which coincides with completion of fetal functional maturity and onset of spontaneous labor. AFOD value around 0.98, completion of fetal functional maturity, and onset of spontaneous labor, which all go together can occur at any time after 36wks indicate individual term for each fetus<sup>1</sup>. As this is a small study, these results should be further evaluated by multicentrec studies with larger sample size. Further research in this area should be directed to find-out non-invasive equivalent alternatives to AFOD to avoid amniocentesis.

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