

# Role of Cardiotocography and Amniotic Fluid Index Together in Predicting Perinatal Outcome in Low-risk Pregnancies

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## Abstract

**Introduction:** The universal aim of maternity care provision is birth of a healthy baby to a healthy mother. Various invasive and non-invasive antepartum surveillance tests have been devised to access the fetal well-being. In developing countries like India, where workload is heavy with shortage of technical manpower and resource settings are poor, we need techniques which are adequate, simple, cost effective, easy to use, and less time consuming for better postpartum outcome.

**Materials and Methods:** This study was conducted over a period of 1½ years in 251 primigravidae with low-risk pregnancies at or near term who were observed with admission cardiotocography (CTG) and amniotic fluid index (AFI) and was followed during the course of labor to access mode of delivery, Apgar score at 0, 1, and 5 min of birth, and need for neonatal intensive care unit (NICU) admission.

**Results:** When both AFI and CTG together were correlated with mode of delivery, it was seen that in patients with cat 1 CTG irrespective of AFI, most of the patients were delivered by NVD and in cat 3 CTG patients irrespective of AFI, most of them were delivered by lower segment cesarean section (LSCS). In patients with cat 2 CTG, significant number of those was delivered by LSCS who had low AFI. When AFI and CTG together were studied for Apgar score at “1-min” of birth and NICU admission, it was seen that irrespective of AFI, low Apgar, and NICU admission was mostly seen in cat 3 CTG patients, but there was no neonatal mortality in our study. Data were entered into a Microsoft Excel Spreadsheet, relationship between categorical variables was analyzed using a Chi-square test and data were analyzed using STATA version 15.

**Conclusion:** Therefore, admission CTG along with AFI can effectively detect fetal distress if already present at admission and thereby avoid unnecessary delay in decision to deliver timely and improve fetal outcome. These simple, cost effective, non-invasive, and less time-consuming tests can identify those patients who need continuous fetal monitoring in low resource settings and fetal outcome can be improved.

**Key words:** Amniotic fluid index, Apgar, Cardiotocography, Neonatal intensive care unit

## INTRODUCTION

Birth of a healthy baby to a healthy mother is the universal aim of maternity care provision. More care is being taken during labor to prevent an outcome such birth asphyxia and avoid its consequences. However, despite best efforts occurrence of birth asphyxia (2/1000 births in developed

countries and up to 10 times higher in developing countries) continues to happen in obstetric practice.<sup>[1]</sup> According to a WHO estimate in 2014, about 4 million neonatal deaths occur yearly due to birth asphyxia, representing 35% of deaths of children under 5 years of age.<sup>[2]</sup> To prevent damage due to fetal asphyxia, several antepartum surveillance tests have been devised.

Cardiotocography (CTG) ([NST]) is the most widely used primary non-invasive test for fetal well-being. The amniotic fluid index (AFI) as measured by the four-quadrant ultrasonic technique was added to antepartum testing to better identify fetuses at higher risk of poor perinatal outcome. The modified biophysical profile (MBPP) suggested by Devi

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and Swarnalatha combines NST as a short-term marker of fetal status and the AFI as a marker of long-term placental function. It is easier to perform and less time consuming than complete biophysical profile.<sup>[3]</sup> Thus, various antepartum surveillance techniques have been developed for prompt detection and management of obstetric complications. However, in developing countries like India, where workload is heavy with shortage of technical workforce and resource settings are poor, we need techniques which are adequate, simple, cost effective, easy to use, and less time consuming for better postpartum outcome.<sup>[1]</sup>

### Aims and Objectives

The objectives of the study were as follows:

- To identify whether admission CTG and assessment of AFI together have a role in identifying the perinatal outcome
- To identify whether admission CTG and AFI assessment together can predict fetal morbidity and mortality.

## MATERIALS AND METHODS

This prospective observational study was conducted in the Postgraduate Department of Gynecology and Obstetrics of GMC, Srinagar, associated Lalladed Hospital over a period of 1½ years. During this period, 50,410 patients were admitted in our hospital, 19,805 patients under went lower segment cesarean section (LSCS) and 14,488 patients were delivered by NVD. Two hundred and fifty-one women with low-risk pregnancies (primigravidae) at or near term (37 weeks–40 weeks) were observed with admission CTG and AFI; these women were admitted either in early labor or induction of labor which was done and these women were followed during the course of labor and were assessed for mode of delivery and perinatal outcome.

### Inclusion Criteria

This included the following patients.

1. Term or near term patients (37 weeks–40 weeks)
2. Singleton pregnancy
3. Non-anomalous baby
4. Primigravidae
5. Intact membranes
6. Women in early labor or where induction of labor was done.

### Exclusion Criteria

The following patients were excluded from the study:

1. Multiple pregnancy
2. Pre-term (<37 weeks)
3. Recurrent missed abortions
4. Premature rupture of membranes
5. Congenital anomalies

6. Previous bad obstetric history
7. Maternal age above 40 or <19
8. Previous LSCS
9. Intra uterine death
10. Non-cephalic presentation/malpresentation.

### Parameters that were studied are

1. Age of the patients and gestational age at the time of admission
2. CTG changes (according to FIGO criteria for CTG interpretation)
3. AFI (By 4-quad technique)
4. Presence of meconium, cord around neck at the time of delivery
5. Mode of delivery (normal vaginal delivery, cesarean section)
6. Apgar score at 0, 1, and 5 min
7. Need for admission in neonatal intensive care unit (NICU).

### CTG

CTG is electronic fetal monitoring which records fetal heart rate (FHR) and uterine activity on a graph.

CTG includes four parameters:

FHR (normal 110–160 bpm)

Baseline variability (normal 5–25bpm)

- Absent – undetectable
- Minimal – ≤5 bpm
- Moderate – 6–25 bpm
- Marked – >25 bpm.

Acceleration (normal, 2 or more accelerations that peak at 15 bpm above baseline within 20 min of beginning of test).

Deceleration (none); decelerations are periodic, transient decreases in FHR, usually associated with uterine contractions. They can be subdivided into four main types by their shape and timing in relation to uterine contractions.

There are four types of decelerations as defined by the National Institute of Child Health and Human Development nomenclature, all of which are visually assessed.

- Early deceleration
- Late deceleration
- Variable deceleration
- Prolonged deceleration.

### CTG Interpretation

The cardiotocogram was interpreted as per FIGO guidelines.

**AFI Measurement Technique**

In 1987, Platt *et al.* discovered a four-quadrant method of assessing AFI. Using that technique, an AFI of 5 cm or less is defined as oligohydramnios.<sup>[4]</sup> Normal AFI values range from 5 cm to 25 cm. The AFI was interpreted in three categories (ranges).

- AFI < 5 cm
- AFI 5–15 cm
- AFI >15 cm.

AFI estimation with CTG at admission, these two parameters altogether can be used as valuable screening test to detect fetal distress as early as possible and prevent fetal morbidity and mortality.

**RESULTS**

1. Majority of our patients (64.14%) in our study were in the age group of 25–30 years
2. Out of total 251 patients, 94 (37.45%) had cat 1 CTG, 78 (38.08%) had cat 2 CTG, and 79 (31.47%) had cat 3 CTG
3. Most of the patients 168 (66.93%) had adequate liquor (AFI 5–15 cm), 56 (22.31%) had oligohydramnios (AFI <5 cm), and 27 (10.76%) had AFI >15 cm.
4. When both AFI and CTG together were correlated with mode of delivery, it was seen that in patients with cat 1 CTG irrespective of AFI, most of the patients were delivered by NVD and in cat 3 CTG patients irrespective of AFI, most of them were delivered by LSCS. In patients with cat 2 CTG, significant number of those was delivered by LSCS who had low AFI.

The results show that when both CTG and AFI together are correlated with mode of delivery, cat 1 CTG patients in all AFI groups were delivered by NVD, whereas cat 3 CTG patients irrespective of AFI were delivered by LSCS. In cat 2 CTG patients, delivery by LSCS is seen significantly more in those with low AFI (<5 cm) than in those with AFI >5 cm.

1. When AFI and CTG together were studied for Apgar score at “1-min” of birth and NICU admission, it was seen that irrespective of AFI, low Apgar, and NICU admission was mostly seen in cat 3 CTG patients, but there was no neonatal mortality in our study.

When AFI and CTG together are compared with Apgar score at “0-min” of birth, newborns of cat 1 CTG group show good Apgar score in all AFI ranges, whereas cat 3 CTG patients irrespective of AFI show low Apgar score in significant number of newborns. In cat 2 CTG patients, low Apgar is seen mostly in those newborns who belong to low AFI group.

At “1-min” of birth, all newborns of cat 1 CTG group had a good Apgar score irrespective of the AFI whereas in cat 3 CTG group, low Apgar was seen in significant number of newborns in all AFI groups and in cat 2 CTG patients, low Apgar was seen in only one newborn belonging to low AFI group.

At “5-min” of birth, only six newborns had an Apgar score <6 and all of them belonged to cat 3 CTG patients with one of them in low AFI group and 5 in AFI 5–15 cm group, but no neonate in cat 1 or cat 2 CTG patients had a low Apgar at “5-min” of birth.

When AFI and CTG both together are compared with NICU admission, in Cat 1 group, no neonate was admitted in NICU at the time of birth irrespective of the AFI, whereas significant number of newborns in cat 3 CTG group required NICU admission in all of the AFI ranges. In cat 2 CTG patients, only one newborn belonging to low AFI group required NICU admission at the time of birth.

**DISCUSSION**

In our study [Table 1 of results], we also evaluated the role of CTG and AFI together in predicting the perinatal outcome and for determining the mode of delivery. The results of our study showed that patients with cat 3 CTG and low AFI <5 cm, all required LSCS, whereas patients with cat 1 CTG and AFI >5 cm are at lowest risk and can be induced to deliver vaginally. In our study, we also evaluated the role of admission CTG and AFI together in predicting the perinatal outcome by studying Apgar score at 0, 1, and 5 min [Tables 2-4 of results]. The results showed that in patients with cat 1 CTG and adequate liquor, all the newborns had an excellent Apgar score at the time of birth, whereas in patients with category 3 CTG irrespective of AFI, Apgar score <6 was seen in 16% of the newborns. In the group of patients with cat 3 CTG irrespective of AFI, a significant number of the newborns required NICU

**Table 1: Comparison of AFI and CTG with mode of delivery**

CTG	AFI (cm)	Mode of delivery	
		NVD	LSCS
Cat-1	<5	11	2
	5–15	65	4
	>15	12	0
Cat-2	<5	6	17
	5–15	24	26
	>15	3	2
Cat-3	<5	0	20
	5–15	2	47
	>15	0	10

Pearson Chi-square=148.99; P<0.001. CTG: Cardiotocography, AFI: Amniotic fluid index, LSCS: Lower segment cesarean section

**Table 2: Comparison of AFI and CTG with Apgar-0**

CTG	AFI (cm)	Apgar-0	
		<6	>6
Cat-1	<5	2	11
	5-15	0	69
	>15	1	11
Cat-2	<5	9	14
	5-15	2	48
	>15	1	4
Cat-3	<5	9	11
	5-15	16	33
	>15	4	6

Pearson Chi-square =50.87, P<0.001. CTG: Cardiotocography, AFI: Amniotic fluid index

**Table 3: Comparison of CTG and AFI With Apgar-1**

CTG	AFI (cm)	Apgar-1	
		<6	>6
Cat-1	<5	0	13
	5-15	0	69
	>15	0	12
Cat-2	<5	1	22
	5-15	0	60
	>15	0	5
Cat-3	<5	3	17
	5-15	9	40
	>15	1	9

Pearson Chi-square=29.46; P<0.001. CTG: Cardiotocography, AFI: Amniotic fluid index

**Table 4: Comparison of CTG and AFI with Apgar-5**

CTG	AFI (cm)	Apgar-5	
		<6	>6
Cat-1	<5	0	13
	5-15	0	69
	>15	0	12
Cat-2	<5	0	23
	5-15	0	50
	>15	0	5
Cat-3	<5	1	19
	5-15	5	44
	>15	0	10

Pearson Chi-square=17.86, P=0.022. CTG: Cardiotocography, AFI: Amniotic fluid index

**Table 5: Comparison of CTG and AFI with NICU admission**

CTG	AFI (cm)	NICU admission	
		Absent	Present
Cat-1	<5	13	0
	5-15	69	0
	>15	12	0
Cat-2	<5	22	1
	5-15	50	0
	>15	5	0
Cat-3	<5	17	3
	5-15	40	9
	>15	9	1

Pearson Chi-square=27.83; P<0.001. CTG: Cardiotocography, AFI: Amniotic fluid index, NICU: Neonatal intensive care unit

admission at birth [Table 5] of our results. Similar results were also observed in the study conducted by Eden *et al.*<sup>[5]</sup> in 1988, in which high-risk pregnancies were screened using a MBPP consisting of NST and ultrasound evaluation of amniotic fluid volume. Decreased amniotic fluid volume and spontaneous FHR decelerations were considered abnormal findings during antenatal testing and served as indications for delivery regardless of FHR reactivity. Despite interventions, decreased amniotic fluid volume and spontaneous decelerations were associated with an increased incidence of meconium staining, decelerations during labor, cesarean section for fetal distress, and small for gestational age infants. Similar results were also seen in the study by Anand *et al.*<sup>[1]</sup> in 2016 who concluded that AFI, NST, and color of liquor can effectively detect fetal distress already present at admission, thereby avoiding unnecessary delay and decrease in detection to delivery time and improve fetal outcome. Similar results were also observed in the study conducted by Sowmya *et al.*<sup>[6]</sup> in 2017, in which 70 patients with high-risk pregnancy were evaluated with the MBPP consisting of NST recording for 20 min, followed by ultrasound assessment of amniotic fluid volume, using four-quadrant technique. They concluded that when the MBPP is normal, it gives reassurance that the fetal status is good with good perinatal outcome. At the same time, when MBPP is abnormal, it indicates that the fetus may be compromised, thus MBPP can be used as primary antepartum fetal surveillance test to predict perinatal outcome and provide timely intervention in high-risk pregnancies.

## CONCLUSIONS

From our study, the following conclusions were drawn;

- Pathological (cat 3) CTG at admission irrespective of the AFI is associated with more cesarean deliveries for fetal distress, meconium stained liquor intraoperatively and with poor perinatal outcome
- Cat 2 CTG is associated with more cesarean deliveries, especially in those patients who have low AFI
- Cat 1 CTG is associated with good perinatal outcome and most of the patients can be induced to deliver vaginally almost with any value of AFI
- In patients with cat 2 CTG and low AFI and those with cat 3 CTG, continuous fetal monitoring should be done till delivery, especially in a hospital like ours with heavy workload. Pediatrician should be kept available for the immediate and proper resuscitation and triaging of babies
- Therefore, admission CTG along with AFI can effectively detect fetal distress if already present at admission and thereby avoid unnecessary delay in decision to deliver timely and improve fetal outcome.

These simple, cost effective, non-invasive, and less time-consuming tests can identify those patients who need continuous fetal monitoring in low-resource settings and fetal outcome can be improved.

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