

Role of Cardiotocography in Predicting Perinatal Outcome

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Abstract- The aim of maternity care is the birth of a healthy baby to a healthy mother. Despite all efforts birth asphyxia occurs in 2 per 1000 births in developed countries and is almost 10 times higher in developing countries.¹ In order to assess the fetal wellbeing, several antepartum surveillance tests have been devised. The most commonly used surveillance method is Cardiotocography (CTG). This prospective observational study was conducted in the Post graduate department of Gynecology and Obstetrics of GMC Srinagar associated Lalla Ded Hospital over a period of one and a half year from December 2017 to August 2019. Two hundred and fifty one primigravidae with low risk pregnancies at term in early labour were subjected to admission CTG. They were followed during the course of labour and their mode of delivery and perinatal outcome was assessed. All women gave written and informed consent before being included in the study. This included Primigravidae with singleton term pregnancy, non-anomalous baby, with intact membranes admitted in early labour. The parameters that were studied were age of the patients, gestational age, CTG changes (According to FIGO criteria for CTG Interpretation), Presence of Meconium, cord around neck at the time of delivery, Mode of delivery, APGAR Score at 0, 1 and 5 Minutes and need for admission in NICU. CTG parameters studied were Fetal heart rate, Baseline variability, Accelerations and Decelerations. The cardiogram was interpreted as per FIGO guidelines. In our study, maximum number of women (64.14%) were in the age group of 25-30 yrs and 96(38.25%) women had gestational age of 40 weeks, followed by 39 weeks in 87(34.66%), 38 weeks in 41(16.33%) and 37 weeks in 27(10.76%).

Out of total 251 women, 94 women (37.45%) had Cat 1 CTG, 78 women (31.08%) had Cat 2 CTG and 79(31.47%) women had Cat 3 CTG. Of all these women 123(49%) delivered vaginally where as 128 (51%) delivered through Cesarean section (CS). In women with Cat 1 CTG (93.62%) delivered vaginally and 6.38% were delivered by CS as 4 of them had non-progression of labour, 1 had meconium stained liquor and 1 had non-descent of head. In women with Cat 2 CTG no significant difference was seen in mode of delivery as 42.31% delivered by NVD and 57.69% by LSCS. In women with Cat 3 CTG almost all (97.47%) were delivered by LSCS. However 2 of these women delivered vaginally while awaiting surgery. Thus, as the category of CTG changed from 1 to 3, the mode of delivery changed from NVD to LSCS and the results were statistically significant (Pearson Chi

square = 144.5384; $p < 0.001$). The most common indication for LSCS was non-reactive CTG in 77 cases (60.16%). In our study women with Cat 1 CTG, 96.81% had clear liquor. It was observed that in women with Cat 1 CTG majority (96.82%) of the newborns had a good APGAR score at "0-minutes" of birth. In newborns of women with Cat 1 CTG, none required NICU admission. Thus it was concluded that Pathological (cat 3) CTG at admission is associated with more cesarean deliveries for fetal distress, meconium stained liquor intraoperatively & with poor perinatal outcome.

Index Terms- CTG, APGAR, meconium, Primigravidae, perinatal outcome.

I. INTRODUCTION

The aim of maternity care is the birth of a healthy baby to a healthy mother. All birth attendants strive towards this goal and try to prevent the disastrous consequences of birth asphyxia. However despite all efforts birth asphyxia occurs in 2 per 1000 births in developed countries and is almost 10 times higher in developing countries.¹ According to a WHO estimate, it is responsible for 4 million neonatal deaths yearly, representing 35% of Under 5 mortality.² Fetal asphyxia is a condition of disturbed gas exchange leading to progressive hypoxemia, hypercapnia and metabolic acidosis. The damage to the fetal brain is of utmost concern as it results in hypoxic-ischemic encephalopathy or intraventricular hemorrhage and can cause developmental, intellectual or physical disability.³ In order to assess the fetal wellbeing, several antepartum surveillance tests have been devised. The most commonly used surveillance method is Cardiotocography (CTG) which was developed by Hon in 1958.⁴ Despite CTG having a considerable rate of false positive results and its evaluation being very subjective, it has many advantages. It is non-invasive, financially accessible, easy to operate and can be used in the absence of an obstetrician and in any hospital situation (outpatient care, delivery room, etc).⁵ It has no contraindications, findings can be documented and the state of the newborn evaluated by APGAR score, the existence of acidosis, hypoxic-ischemic encephalopathy and subsequent neuromotor development.^{6,7,8,9}

II. MATERIALS AND METHODS

This prospective observational study was conducted in the Post graduate department of Gynecology and Obstetrics of GMC Srinagar associated Lalla Ded Hospital over a period of one and a half year from December 2017 to August 2019. Two hundred and fifty one primigravidae with low risk pregnancies at term in early labour were subjected to admission CTG. They were followed during the course of labour and their mode of delivery and perinatal outcome was assessed. All women gave written and informed consent before being included in the study.

This included Primigravidae with singleton term pregnancy, non-anomalous baby, with intact membranes admitted in early labour. The parameters that were studied were age of the patients, gestational age, CTG changes (According to FIGO criteria for CTG Interpretation), Presence of Meconium, cord around neck at the time of delivery, Mode of delivery, APGAR Score at 0, 1 and 5 Minutes and need for admission in NICU.

A. CTG parameters studied

- Fetal heart rate (Normal 110-160 bpm)
- Baseline variability (Normal 5-25bpm), Absent-undetectable, Minimal- ≤ 5 bpm, Moderate- 6 to 25bpm, Marked- ≥ 25 bpm
- Acceleration (Normal 2 or more): accelerations that peak at 15 bpm above baseline and last for at least 15 seconds within 20 minutes of beginning of test.
- Decelerations (None); Decelerations are periodic, transient decreases in fetal heart rate (FHR), usually associated with uterine contractions. They are subdivided into four main types by their shape and timing in relation to uterine contractions.
 - Early decelerations
 - Late decelerations
 - Variable decelerations
 - Prolonged decelerations
- Early decelerations are a result of increased vagal tone due to compression of the fetal head during contractions. A 'gradual' deceleration has a time from onset to nadir of 30 seconds or more. Early decelerations begin and end at approximately the same time as contractions, and the low point of fetal heart rate occurs at the peak of the contraction.
- Late decelerations are a result of placental insufficiency, which can result in fetal distress. A 'gradual' deceleration has onset to nadir of 30 seconds or more. In contrast to early deceleration, the low point of fetal heart rate occurs after the peak of the contraction, and returns to baseline after the contraction is complete.
- Variable decelerations are generally a result of umbilical cord compression and contractions may further compress a cord when it is trapped around the neck or under the shoulder of the fetus. They are defined as abrupt decreases in fetal heart rate, with less than 30 seconds from the beginning of the decrease to nadir of heart rate. The decrease in FHR is greater than or equal to 15 beats per minute, lasting greater than or equal to 15 seconds, and less than 2 minutes in duration.

B. CTG Interpretation

The cardiocotogram was interpreted as per FIGO guidelines

- Category 1 (Cat 1):
 - Baseline rate 110-160
 - Baseline FHR variability-moderate
 - Late or variable decelerations- Absent
 - Early deceleration- Present or Absent
 - Acceleration- Present or Absent
- Category 2 (Cat 2): FHR Includes all FHR tracing not categorized as Category 1 or Category 3.
 - Baseline Rate
 - Bradycardia not accompanied by absent baseline variability
 - Tachycardia

Variability

- Minimum baseline variability
- Absent baseline variability with no recurrent deceleration
- Marked baseline variability

Acceleration

- Absence of induced acceleration after fetal stimulation

Deceleration

- Recurrent variable deceleration accompanied by minimum or moderate baseline variability
- Prolonged deceleration more than 2 but less than 10 minutes
- Recurrent deceleration with moderate baseline variability
- Category 3 (Cat 3):

It includes FHR tracing, Absent baseline FHR variability and any of the following:

- a) Recurrent late decelerations
- b) Recurrent variable decelerations
- c) Bradycardia

Sinusoidal pattern ; it is a specific pattern described as smooth , sine wave-like undulating pattern with a cycle frequency of 3-5 beats per minute that continues for at least 20 minutes or more. The classical example of sinusoidal pattern is seen in cases of fetal anemia.

III. RESULTS

In our study, maximum number of women (64.14%) were in the age group of 25-30 yrs and 96(38.25%) women had gestational age of 40 weeks, followed by 39 weeks in 87(34.66%), 38 weeks in 41(16.33%) and 37 weeks in 27(10.76%).

Out of total 251 women, 94 women (37.45%) had Cat 1 CTG, 78 women (31.08%) had Cat 2 CTG and 79(31.47%) women had Cat 3 CTG. Of all these women 123(49%) delivered vaginally where as 128 (51%) delivered through Cesarean section (CS).

In women with Cat 1 CTG (93.62%) delivered vaginally and 6.38% were delivered by CS as 4 of them had non-progression of labour, 1 had meconium stained liquor and 1 had non-descent of head. In women with Cat 2 CTG no significant difference was seen in mode of delivery as 42.31% delivered by NVD and 57.69% by LSCS. In women with Cat 3 CTG almost all (97.47%) were delivered by LSCS. However 2 of these women delivered

vaginally while awaiting surgery. Thus, as the category of CTG changed from 1 to 3, the mode of delivery changed from NVD to LSCS and the results were statistically significant (Pearson Chi square = 144.5384; $p < 0.001$). (Table I) .

Table I: Comparison of ctg with mode of delivery

CTG	Freq	Mode of Delivery	
		NVD	LSCS
Category 1	94 (37.45%)	88 (93.62%)	06 (6.38%)
Category 2	78 (31.08%)	33 (42.31%)	45 (57.69%)
Category 3	79 (31.47%)	2 (2.53%)	77 (97.47%)
Total	251 (100.00%)	123 (49%)	128 (51%)

(Pearson Chi square = 144.5384; $p < 0.001$)

The most common indication for LSCS was non-reactive CTG in 77 cases (60.16%) followed by meconium stained liquor in 41 cases(32.03%) and non-progression of labour in 10 cases(7.81%).(Table II)

Table II: Tabulation of ISCS indications

Indications	Frequency	Percentage
Non Reactive CTG	77	60.16%
Non-progression Of Labour	10	7.81%
Meconium Stained Liquor	41	32.03%
Total	128	100%

In our study women with Cat 1 CTG, 96.81% had clear liquor, 1.06% had meconium stained liquor and 2.13% had cord around neck at the time of delivery. In women with Cat 2 CTG, 43.59% had clear liquor, 21.79% had cord around neck and 34.62% had meconium stained liquor. In women with Cat 3 CTG, (56.96%) had meconium stained liquor, 36.71% had cord around neck and only 6.33% had clear liquor at the time of delivery.(Table III

Table III: Comparison of CTG with intra-operative findings

CTG	Intra-Operative findings			Total
	Clear liquor	Cord around neck	Meconium stained liquor	
Category 1	91(96.81%)	2 (2.13%)	1(1.06%)	94(100%)
Category 2	34 (43.59%)	17 (21.79%)	27 (34.62%)	78(100%)
Category 3	5 (6.33%)	29 (36.71%)	45 (56.96%)	79 (100%)

(Pearson chi square = 143.8903; $p < 0.001$.)

It was observed that in women with Cat 1 CTG majority (96.82%) of the newborns had a good APGAR score at “0-minutes” of birth with only 3.19% newborns having an APGAR of < 6 . In women with Cat 2 CTG APGAR of < 6 at “0-MINUTES” was seen in 15.38% of the newborns. In women with Cat 3 CTG 36.71% newborns had an APGAR < 6 . (Pearson Chi-square (4) =34.893; $p < 0.001$)(Table IV)

Table IV: Comparison between CTG and APGAR score at 0-minute, 1 minute and 5 minute

CTG	APGAR 0 minute			APGAR 1 minute			APGAR 5 minute		
	<6	6-8	>8	<6	6-8	>8	<6	6-8	>8
CAT1 n=94	3 (3.19)	87 (92.56)	4 (4.26)	0 (0.00)	10 (10.64)	84 (89.36)	0 (0.00)	1 (1.06)	93 (98.94)
CAT2 n=78	12 (15.38)	65 (83.33)	1 (1.28)	1 (1.28)	21 (26.92)	56 (71.79)	0 (0.00)	3 (3.85)	75 (96.15)
CAT3 n=79	29 (36.71)	48 (60.78)	2 (2.53)	13 (16.46)	21 (26.58)	45 (56.96)	6 (7.59)	11 (13.92)	62 (78.48)
Total	44 (17.53)	200 (79.68)	07 (2.79)	14 (5.58)	52 (20.72)	185 (73.71)	6 (2.39)	15 (5.98)	230 (91.63)

Pearson Chi-square (4) =34.893; $p < 0.001$ for APGAR at 0 minutes
 Pearson chi square (4) = 38.1239; $p < 0.001$ for APGAR at 1 minutes
 Pearson chi square (4) =28.0140; $p < 0.001$ for APGAR at 5 minutes

While evaluating the APGAR Score at 1 minute it was seen that in women with Cat 1 CTG patients none of the newborns had a low APGAR score at ‘1-MINUTE’ of birth while in women with

Cat 2 CTG 1.28% newborns and in women with Cat 3, (5.58%) newborns had a low APGAR score at 1minute. Numbers in brackets represent percentage
(Pearson chi square (4) = 38.1239; p<0.001)

At “5-minutes” of birth low APGAR was seen in only 6 newborns (7.59%) and all of them belonged to women with Cat 3 CTG.(Pearson chi square =28.0140 ; p<0.001) (Table IV)

In newborns of women with Cat 1 CTG, none required NICU admission, in newborns of women with Cat 2 CTG only one required NICU admission whereas in women with cat 3 CTG , 13 newborns (16.45%) were admitted in NICU.(Pearson chi square (2) =20.757; p< 0.001)(Table V)

Table IV : Comparison of CTG with NICU admission

CTG	NICU ADMISSION		Total
	Absent	Present	
1	94 (100%)	0 (0.00%)	94 (100.00%)
2	77 (98.71%)	1 (1.28%)	78 (100.00%)
3	66 (83.54%)	13 (16.45%)	79 (100.00%)
Total	237 (94.42%)	14 (5.58%)	251 (100.00%)

Pearson chi square (2) =20.757; p< 0.001

IV. DISCUSSION

Our study was conducted over a period of one & a half years from December 2017 to August 2019, in the post-graduate

Department of Obstetrics & Gynecology, GMC Srinagar at LD Hospital. This is the only tertiary care Obstetrics and Gynecology facility which caters to the whole Kashmir valley. During this period 50410 women were admitted in our hospital, and 34285 deliveries were conducted. Of these, 19805 women delivered by LSCS and 14,480 women delivered vaginally. We studied 251 primigravidae with low-risk pregnancies at term, after taking proper written consent. In our study, most of the women (64.14%) were in the age group of 25-30 years with a gestational age of 39 to 40 weeks.

All the women in our study were subjected to admission Cardiotocography (CTG) which was interpreted as per the FIGO guidelines. Out of the total 251 women, 94(37.45%) had Cat 1 CTG, 78(31.08%) had Cat 2 and 79(31.47%) had Cat 3 CTG. Similarly **Bhartiya V (2016)**¹⁰, reported 60% of the CTG traces of non-reassuring pattern, 37% of reassuring pattern and 3% abnormal CTG traces. Our results also showed that most of the patients with cat 1 CTG were delivered vaginally whereas almost all the patients with cat 3 CTG were delivered by cesarean section except 2 patients who delivered vaginally while awaiting surgery (**TABLE I**). Results similar to our study were also observed in the study conducted by **Verma A et al**¹¹ in 2012 , **Rahman H et al (2012)**¹² , **Anand RS et al in 2016**¹ and **Shruti Prabha et al (2017)**¹³ ,

Anand RS et al (2016)¹ in a study to access NST as perinatal outcome predictors, observed that 39% of their patients delivered by lscs and 29.08% of the patients had meconium stained liquor. This is lower compared to our cesarean deliveries (51%).The most common indication for lscs was non-reactive CTG (60.16%), followed by meconium stained liquor (32.03%) and failure of induction (7.8%).(**TABLE II**)

On assessing the intraoperative findings our results showed that fetal distress was more in newborns of cat II & cat III CTG patients and not in newborns of cat 1 CTG patients (**TABLE III**). Similar results were also observed in a study to assess role of admission CTG in predicting perinatal outcome conducted by **Shruti Prabha et al (2016)**¹³ . They observed meconium staining of liquor in 77.8% of patients with ominous CTG, 33% of patients with equivocal CTG and only 3.5% of patients in reactive CTG group.

The perinatal outcome was assessed by observing APGAR score of the newborns at 0, 1 & 5 minutes of birth. We observed that among patients with Cat 1 CTG, almost all the newborns had an excellent APGAR score whereas in newborns of the patients with cat 3 CTG , a significant no of them had an APGAR <6 at 0,1 and 5 minutes of birth(**TABLE IV**). Similar results were also observed in the study conducted by **Begum MA et al**¹⁴ in 2002, which showed significant increase in overall abnormal outcome, low 1 & 5 minute APGAR score, in women with non reactive CTG. **Saima U et al (2017)**¹⁵ also analysed CTG findings in pregnancies with less fetal movements and birth asphyxia of newborns was seen in 72.5% of newborns in non-reassuring CTG group.

In our study the NICU admission was significantly higher in the newborns of patients with cat 3 CTG. (**TABLE V**) . **Gupta M et al**¹⁶ in 2017 also reported that the sensitivity of CTG for NICU admission was 75.5%, specificity was 77.25% with positive predictive value of 65.9%, however a high negative predictive value of 84.5% was also seen. Similarly **Saima U et al**

(2017)¹⁵, observed 51% NICU admission in non-reassuring CTG group compared to 18.4% in reassuring group. **Shruti Prabha et al (2017)¹³**, incidence of NICU admission was significantly high (77.8%) in ominous CTG group compared to only 1.1% in reactive CTG group.

V. CONCLUSION

From our study the following conclusions were drawn;

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

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