Study of intrapartum cardiotocography and its correlation with perinatal outcome in high risk pregnancy

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Abstract:

Background: Use of an intrapartum cardiotocography (CTG) has increased in last few decades. Consequently, there is a considerable decrease in the overall perinatal mortality and morbidity. Today CTG is a first line investigation for antepartum and intrapartum foetal assessment and to detect intrauterine hypoxia. **Aim:** To study various patterns of intrapartum CTG in high risk pregnancy and to correlate the results with perinatal outcome. **Methods:** Prospective observational study was conducted on 215 high risk pregnant women admitted in department of obstetrics and gynaecology, Netaji Subhash Chandra Bose Medical College and Hospital Jabalpur from March 2018 to August 2019. Results of CTG were designated as reactive or non-reactive and perinatal outcome was assessed in the form of liquor status, Apgar score at one minute and five minute, birth weight, neonatal intensive care unit (NICU) admission, duration of NICU stay and perinatal mortality. **Results:** Out of 215 high risk cases, patients with reactive CTG were 88.37% (n=190) whereas those with non-reactive were 11.63% (n=25). Most common risk factor was hypertensive disorders of pregnancy (28.37 %) followed by post datism (15.35%), intrauterine growth restriction (IUGR) (12.56%), anaemia (10.23%), oligohydramnios (6.98%), previous LSCS (4.65%), Rh negative (3.72%) and GDM (1.4%). In non reactive group 9 (12.16%) newborn died. Mortality rate was 4.18%. On univariate predictive analysis of CTG for various outcomes like meconium stain liquor, mode of delivery (NVD vs LSCS), Apgar score at 1 minute (<4) and foetal outcome (healthy or dead) shown to have significant predictive value. While Apgar score at 5 minute, NICU admission rate andduration of NICU stay cannot be predicted with statistical significance. There was no maternal mortality observed. The proportion of healthy neonatal discharge was significantly higher in reactive group of patients ($p<0.0001$). **Conclusion:** Cardiotocography is a simple, easily available tool, which can be used to improve perinatal outcome in terms of neonatal morbidity and mortality by initiating early interventions following early detection of fetal hypoxia.

Keywords: Cardiotocography, fetal heart rate, high risk cases, early interventions.

Intrapartum foetal asphyxia with significant metabolic acidosis at delivery has shown to occur in approximately 20-25 infants per 1000 births. Foetal monitoring during labour identifies the foetuses at risk of hypoxic damage, so that appropriate intervention could be instituted to optimize neurological injury, including cerebral palsy. Electronic fetal heart rate monitoring (EFM) involves the use of a cardiotocograph (CTG). It records the fetal heart rate (FHR) to determine the fetal well-being in order to detect signs of intrapartum hypoxia. Therefore, there is a considerable decrease in the overall perinatal mortality and morbidity.[1]

The global perinatal mortality rates in developing countries like India is 26 per 1000 births. It ranges from 16 per 1000 births in urban areas to 28 per 1000 births in rural areas.[2] The current perinatal mortality and stillbirth rates

according to NFHS – 4 (2016-20017) are 48.5 and 19.2 per 1000 pregnancies respectively. Majority of foetal deaths (70-90%) occur before the onset of labour.[3]

The important causes to affect the perinatal outcome are hypertensive disorders of pregnancy (30%), pregnancy complication (30%), congenital malformations (15%), infection (35%) and unexplained (20%). The main causes of perinatal mortality are infection (33%), birth asphyxia and trauma (28%), preterm birth (34%) and congenital anomalies (5%).[3]

This study was conducted to find out the simple, accurate, less time consuming, non-invasive and cost-effective method of foetal surveillance so that we can fulfil dream of every mother of having a healthy baby.

Materials and methods

The prospective study carried out in 215 high risk pregnant women admitted in department of obstetrics and gynaecology, Netaji Subhash Chandra Bose Medical College and Hospital, Jabalpur from March 2018 to August 2019. Intrapartum cardiotocography monitoring was performed on these mothers and interpretations made based on fetal heart rate, base line variability, number of accelerations and deceleration and CTG was then designated as reactive or non-reactive. Fetal outcome was predicted by birth weight, Apgar score at one minute and five-minute, liquor status, NICU admission and perinatal mortality. Corelation of cardiotocography patterns with perinatal outcome was done.

Inclusion criteria: Women who had gestational age >37 weeks in first stage of labour with high risk factors like anaemia, hypertensive disorders of pregnancy, diabetes mellitus, Rh negative, PROM, IUGR, previous section, post-date pregnancy, BOH, oligohydramnios, decrease fetal movements.

Exclusion criteria: Patient excluded in this study group were gestational age < 37 weeks and all antenatal patient without mentioned obstetric high-risk factors in inclusion criteria.

After taking informed written consent detail history of patient about high risk factors routine and required investigation and treatment given were recorded in proforma. The intrapartum cardiotocography was done for 20 mins and the rate of baseline variability, acceleration and deceleration were assessed according to RCOG criteria of CTG and here if any case of suspicious CTG, then it was repeated for another 20 mins and decision was taken either CTG reactive or nonreactive. If CTG trace was nonreactive then IV fluid, O2 and left lateral position was advised to patient for 20 minutes and repeat CTG was done for another 20 mins. If repeat CTG remain nonreactive then taken as fetal distress and decision for quick delivery was taken by instrumentation or operative method depending on cervical dilatation and station of fetal head. The patients were then followed up for the mode of delivery and the different variables of the perinatal outcome. At the time of delivery data of following variables were collected like fetal distress during labour, meconium stained liquor, 1 min Apgar < 4, 5 min Apgar score of < 7, NICU admission, indication for NICU admission, duration of stay in NICU and perinatal mortality.

Statistical analysis: All the records were checked and rechecked for their completeness and consistencies. Non-numerical entries were coded into nominal/ordinal distribution before analysis. Categorical variables were summarized in frequency and percent distribution and chi-square or fisher's exact test was performed as appropriate. Chi-square, odds ratio, sensitivity and specificities along with positive and negative predictive values were calculated for correlation of cardiotocographic results to different perinatal outcomes (e.g. mode of delivery, birth weight, MSL, Apgar score and neonatal mortality etc.)

Results

A total of 215 high risk patients were included in the study. Patients were subjected to two consecutive CTG (CTG1 and CTG2) as mentioned in figure 1.

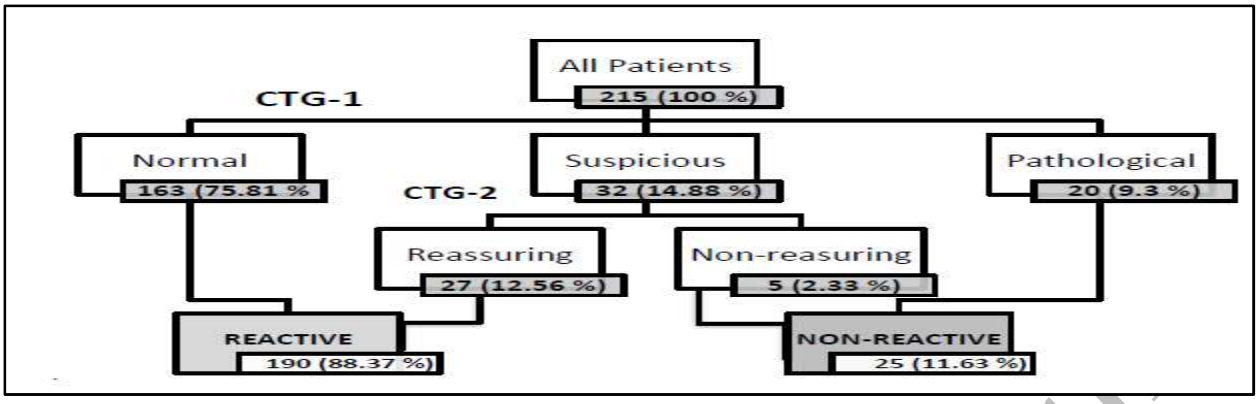

Figure 1: Showing distribution of patients following cardiotocographic evaluation

Maximum number of patients belonged to young adult age of 21-25 years followed by patients between 26-30 years of age. Study demographics and baseline characteristics mentioned in table 1. Most common risk factor presented in study was hypertensive disorder of pregnancy (28.37%), postdatism (15.35%), IUGR (12.56%), anaemia (10.23%), oligohydramnios (6.98%), previous LSCS (4.65%), Rh negative (3.72%) and GDM (1.4%) (table 2). Absence of acceleration found in all 25 non-reactive CTG patients (11.63 %) followed by reduced variability and late decelerations, which was seen in 8.37 % and 6.05 % of all patients respectively.

Table 1: Demographics and baseline characteristics of study population between groups

Variables		**Reactive (%)**	**Non- reactive (%)**	**P Value**
Number of patients		190 (88.37)	25 (11.63)	
Age (years)	≤20	19 (95)	1 (5)	0.1491
	21-25	99 (83.9)	19 (16.1)	
	26-30	52 (94.55)	3 (5.45)	
	>30	20 (90.91)	2 (9.09)	
Locality	Rural	104 (86.67)	16 (13.33)	0.3806
	Urban	86 (90.53)	9 (9.47)	
Monthly income	≤5000	141 (87.04)	21 (12.96)	0.7
	5001-10000	35 (89.74)	4 (10.26)	
	10001-15000	1 (100)	0 (0)	
	15001-20000	9 (100)	0 (0)	
	>20000	4 (100)	0 (0)	
Religion	Hindu	168 (88.42)	22 (11.58)	0.9508
	Muslim	22 (88)	3 (12)	
ANC visits	<3	139 (85.28)	24 (14.72)	0.0421
	4-6	40 (97.56)	1 (2.44)	
	>6	11 (100)	0 (0)	
Gestational age	<38	13 (100)	0 (0)	0.2107
	38-40	150 (88.76)	19 (11.24)	
	>40	27 (81.82)	6 (18.18)	
Gravida	Primi	125 (88.65)	16 (11.35)	0.3261
	Multigravida	42 (84)	8 (16)	
	Grand multigravida	23 (95.83)	1 (4.17)	
SBP	≤139	152 (89.94)	17 (10.06)	0.169
	>139	38 (82.61)	8 (17.39)	
DBP	≤89	127 (90.71)	13 (9.29)	0.1433
	>89	63 (84)	12 (16)	

Data is expressed as number of patients (percentage), P value was calculated using Chi- square test; p value <0.05 is considered significant.

Table 2: Comparing reactivity of CTG according to high risk factor				
High risk factors	**CTG trace**		**Total**	**P value**
	Reactive (%)	**Non-reactive (%)**		
Anemia	19(86.36)	3(13.64)	22	>0.05
GDM	3 (100)	0 (0)	3	>0.05
IUGR	21(77.78)	6 (22.22)	27	<0.05
Oligohydramnios	14 (93.33)	1(6.6)	15	<0.05
Postdatism	33(100)	0 (0)	33	<0.05
PE/Eclampsia	55(90.16)	6 (9.84)	61	<0.05
Previous LSCS	10 (100)	0 (0)	10	>0.05
Rh negative	8 (100)	0 (0)	8	>0.05
PROM	43(84.31)	8(15.69)	51	<0.05
Decrease fetal movement	4(80)	1(20)	5	<0.05
BOH	4(100)	0 (0)	4	<0.05
Total	190	25	215	
GDM – Gestational diabetes mellitus, IUGR – Intrauterine growth restriction, PE – Preeclampsia, PROM – Premature rupture of membrane, BOH – Bad obstetrics history.				

Table 3: Cardiotocography result and various perinatal and delivery outcomes			
Parameters	**Reactive group**	**Nonreactive group**	**Total**
NVD	77 (89.53)	9 (10.47)	86
LSCS	113 (87.6)	16 (12.4)	129
Apgar score at 1 min			
>4	146 (99.32)	1 (0.68)	147
<4	44 (64.71)	24 (35.29)	68
Apgar score at 5 min			
>7	120 (91.6)	11 (8.4)	131
<7	70 (83.33)	14 (16.67)	84
Birth weight			
Normal	103 (89.57)	12 (10.43)	115
Low birth weight	87 (87)	13 (13)	100
Meconium stain liquor			
Absent	187 (91.22)	18 (8.78)	205
Present	3 (30)	7 (70)	10
NICU admission			
Not admitted	168 (91.3)	16 (8.7)	187
Admitted	22 (70.97)	9 (29.03)	31
Duration of stay in NICU			
<2 days	16 (69.57)	7 (30.43)	23
>2 days	6 (75)	2 (25)	8
Treatment given			
Yes	9 (50)	9 (50)	18
No	13 (100)	0 (0)	13
Perinatal mortality			
No	183 (91.04%)	18 (8.96%)	
Yes	7 (50%)	7 (50%)	

On univariate predictive analysis of CTG for various outcomes like meconium stain liquor, mode of delivery (NVD vs LSCS), Apgar score at 1 minute (<4) and foetal outcome (healthy or dead) shown to have significant predictive value while Apgar score at 5 minute, NICU admission rate, NICU stay and possibility of treatment cannot be predicted with statistical significance. Sensitivity, specificity, positive predictive values and negative predictive value along with odds for univariate analysis with statistically significant of cardiotocography for various above

indices are mentioned in table 4. There was no maternal mortality observed in this study. The proportion of neonate discharge healthy was significantly higher in reactive group of patients (p<0.0001). A neonatal mortality of 12.2 % was seen the patients of non-reactive CTG.

Table 4: Predictive indices - sensitivity, specificity, positive predictive value and negative predictive value along with odds for univariate analysis with statistically significant of cardiotocography for various perinatal outcomes.

Parameters	Odds	Sensitivity	Specificity	Positive predictive value	Negative predictive value	P value (Chi-square)
MSL	>1.339	100 % (97.7 to 100 %)	3.85 % (0.68 to 12.98 %)	76.53 % (70.4 to 81.72 %)	100 % (17.77 to 100 %)	<0.0001
Mode of Delivery	2.148	44.17 % (36.77 to 51.84 %)	73.08 % (59.75 to 83.23 %)	83.72 % (74.51 to 90.05 %)	29.46 % (22.28 to 37.83 %)	0.66
Apgar score at 1 minute	6.352	78.53 % (71.61 to 84.14 %)	63.46 % (49.87 to 75.2 %)	87.07 % (80.69 to 91.57 %)	48.53 % (37.05 to 60.17 %)	<0.0001
Apgar score at 5 minutes	1.81	64.42 % (56.81 to 71.36 %)	50 % (36.89 to 63.11 %)	80.15 % (72.51 to 86.08 %)	30.95 % (22.08 to 41.49 %)	>0.05
NICU admission rate	4.385	90.8 % (85.37 to 94.34 %)	30.77 % (19.91 to 44.27 %)	80.43 % (74.11 to 85.52 %)	51.61 % (34.84 to 68.03 %)	<0.0011
NICU stay	1.578	98.77 % (95.64 to 99.78 %)	1.92 % (0.1 to 10.12 %)	75.94 % (69.76 to 81.2 %)	33.33 % (1.71 to 88.15 %)	>0.05
Treatment (Y/N)	1.429	90.18 % (84.65 to 93.87 %)	13.46 % (6.68 to 25.27 %)	76.56 % (70.09 to 82 %)	30.43 % (15.6 to 50.87 %)	>0.05
Foetal outcome	12.22	98.16 % (94.73 to 99.5 %)	18.64 % (10.74 to 30.38 %)	76.92 % (70.74 to 82.13 %)	78.57 % (52.41 to 92.43 %)	<0.0001

Chi-square test; p value <0.05 is considered significant.

Discussion

Over the years, it has been recognized that fetal morbidity and mortality increases during labor in both high and low risk population. In 1989, ACOG indicated that foetuses of laboring women could be assessed by electronic fetal monitoring or by intermittent auscultation of fetal heart tones.[4] Auscultation however is necessarily intermittent, subjective and difficult to verify and document. Also, in the third world countries like ours, with busy labor ward and a minimum staff, sole reliance on auscultation would prove ineffective and dangerous. In such a scenario, an alternative to labelling patients for electronic fetal monitoring or at least stringent auscultation might be a short recording of FHR on admission for labor.

In present study 88.37% patients had a reactive CTG and 11.63% had a non-reactive finding. Similar ratio of reactive and non-reactive CTGs observed in a study conducted by Dhakare et al (2016) 86.9% patients showed reactive, 13.1% showed non-reactive admission tests.[1] In another study by Grivell et al (2015) 85% patients showed reactive CTG, 11% patients showed suspicious CTG and 4% patients showed pathological CTG.[5] In Hegde et al (2001) study, 84.5% patients showed reactive CTG, 9.5% patients showed suspicious CTG and 6% showed pathological CTG.[6]

Most common risk factor was PIH (28.37 %), postdatism (15.35%), IUGR (12.56%), anaemia (10.23%), oligohydramnios (6.98%), previous LSCS (4.65%), Rh negative (3.72%) and GDM (1.4%) in this study. PIH is being most common in our study. While in a study by Dhakare et al most common risk factor observed was PIH (15.6%), PROM (11.3%), IUGR (6.3%) and BOH (6.3%) followed by postdatism (41.8%). Oligohydramnios, diabetes, Rh-negative pregnancy were present in less than 5% of cases.[1]

Most of the patients were primi, followed by multipara and grand multipara patients who were proportionally distributed in reactive and non-reactive groups (p>0.05). In the study conducted by Hegde et al, primigravidae constituted 37.5% and multigravida constituted 62.5%.[6] These figures are almost similar to that of our present study.

Indramani et al also had predominance of primi patients in the study conducted on high-risk patients.[7] All these findings were similar to our study.

In this study, most common mode of delivery was LSCS in both the groups. Although slightly higher proportion of LSCS deliveries (64% vs. 59.47) were seen in non-reactive group but it was not statistically significant (p>0.05). In a study by Dhakare et al, they reported normal vaginal deliveries in 81.16% while LSCS in 7.73% in patients with reassuring CTG, normal vaginal deliveries in 83.67% while LSCS in 10.20% in patients with suspicious CTG, and normal vaginal deliveries in 80.00% while LSCS in 20.00% in patients with pathological CTG findings.[1] Our study had higher LSCS ratio than study by Dhakare et al in both the study groups.

Among all newborn babies, most of the newborn were having an Apgar score of > 4 at one minute in present study. There was significantly higher proportion of newborn with Apgar score of ≤ 4 seen in non-reactive group (p<0.0001). Intrapartum CTG and total Apgar score was only weakly related in study conducted by Gupta et al. Intra-partum CTG (silent pattern) and 5 mins Apgar score were the best predictors of severe neonatal morbidity in their study.[8]

Most of the new-borns (60.93%) in this study had Apgar score of > 7 at five minutes while score < 7 was seen in 36.84% reactive CTG group and 56% in non-reactive CTG group (p>0.05). Sandhu et al, they reported lower Apgar score only in 1 % cases of normal CTG group while 9 % and 13 % of lower Apgar in the patients of equivocal and abnormal CTG groups. Neonatal outcome showed higher correlation with CTG results in our study.[9] In study conducted by Verma et al concluded that CTG monitoring can be used as screening test in detection and timely intervention in high risk fetuses.[10]

In a study by Bhartiya et al, the prevalence of low birth weight was 53 % and normal weight babies (2500 g) were 47 %. In reassuring CTG group, prevalence of LBW and normal weight babies were 50 % in each group. In non-reactive cases, low birth weight was found in 33 % of cases, and this difference was not significant.[11] Similarly, almost half of the patients were having a normal birth weight and half were low birth weight babies in our study. This proportional distribution according to birth weight was statistically comparable between two groups (p>0.05).

Most of the patients were having clear liquor (95.35%) in our study. Meconium stained liquor presented in significantly higher (p<0.0001) proportion in non-reactive group (28%) of patients compared to reactive group (1 %). In a study conducted by Bhartiya et al in 128 high-risk women, 100 (72 %) had clear fluid and 28 (14 %) had meconium staining.[11] Among reassuring cases, meconium staining was found in 1 % only, and in non-reassuring cases, meconium staining was found in 12 % cases. Correlation of CTG results with MSL was found statistically significant (p = 0.000046) which was similar to present study.

Out of 215 neonates only 31 required NICU admission in our study. In reactive group, 22 (11.58%) out of 190 neonates required NICU admission while in non-reactive group, 9 (36%) neonates out of 25 were admitted to NICU (p<0.005). Proportion of NICU admission was increased (p<0.05) with non-reactive CTGs compared to reactive CTGs, indicative of poor foetal outcome in patients with non-reactive CTG. In a similar study by Gupta et al, 75.7% babies with non-reactive CTG and 22.8% babies with reactive CTG were admitted in nursery concluded that there is statistically significant role of reactivity of CTG and NICU admission. (P< 0.001).[8]

Among new-born admitted in NICU the non-reactive group showed a significantly (p<0.0005) higher proportion of neonates admitted for longer duration than the reactive group. Though Smith et al showed no statistical difference in NICU stay in two study groups.[12] In Cochran review Grivell et al, did not show any difference in neonatal NICU stay.[5]

There was no maternal mortality in our study thus maternal outcome could not be quantified in our study. Most of the neonates discharged healthy in this study in both groups though the proportion of healthy discharge was significantly higher in reactive group of patients (p<0.0001). A neonatal mortality of 12.16 % was seen the patients of non-reactive CTG. In a study on foetal outcome by Bhartiya et al, among 128 high-risk cases, 31 neonates were admitted in NICU and 7 neonates died. Thus, death rate in high-risk cases was found to be 5 %. Among the reassuring cases, 5 % mortality was found. In non-reassuring group, 25 (12.5 %) neonates were admitted in NICU and five neonates died. Thus, mortality rate was 2.5 %. In abnormal cases, 2 neonates were admitted, and one died.

Correlation of labor admission test with NICU admission and mortality was found statistically insignificant (p = 0.2119).[11]

On univariate predictive analysis of CTG for various outcomes like meconium stained liquor, mode of delivery (NVD vs LSCS), Apgar score at 1 minute (<4) and foetal outcome (healthy or dead) shown to have significant predictive value while Apgar score at 5 minute, NICU admission rate, NICU stay and possibility of treatment cannot be predicted with statistical significance. Sensitivity, specificity, positive predictive values and negative predictive value along with odds for univariate analysis with statistically significant of cardiotocography.

Out of 215 high risk cases, majority had had reactive CTG. In line with present study findings Joshi et al reported that according to the 20 min admission CTG tracing done, 67% had reactive CTG, 21% had equivocal and 12% had ominous CTG. Similar reports were generated by previous study done by Hafizur R et al.[13]

In present study most common indication for performing CTG was PIH (37%) followed by previous LSCS (16%), oligohydramnios (14.5%) and postdatism (11%). In a systemic review by Grivell et al also highlighted PIH and previous LSCS as the most common indication for performing CTG which is line with the present study findings. [5]

In present study out of 74 non-reactive cases, majority have surveyed whereas 9 (12.16%) died with a mortality rate of 4.18%. In line with present study findings a similar study from Rajasthan by Gupta et al reported that out of 74 non-reactive cases 9 babies (12.2%) had died and 65 (87.8%) were survived with total perinatal mortality rate being 4.5%.[8]

Conclusion

Obstetrics is continuously empowered by the use of technology over manual skills. The keystone tools, which have changed antenatal and intra-partum evaluation, are ultrasonography, colour Doppler and cardiotocography, which now become a boon to Obstetricians. Thus, early diagnosis and prediction of obstetric complications leads to their timely management. In this study, we would like to conclude that cardiotocography is a simple, easily available tool, which can be used to improve perinatal outcome in terms of neonatal morbidity and mortality by initiating early interventions following early detection with the help of CTG. Cardiotocography definitely holds it place in perinatal evaluation of high risk patients in our setting to direct management but its wide spread use requires training and monitoring of this technique with further studies to consolidate data.

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