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ANALYSIS OF INTRAPARTUM CARDIOTOCOGRAPHY FINDINGS IN LABOUR, ITS CORRELATION WITH UMBILICAL ARTERIAL BLOOD PH AND NEONATAL OUTCOME

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ABSTRACT

Introduction: *Cardiotocography (CTG) is being used in all labouring women to detect intrapartum hypoxemia which further requires confirmatory tests. But in a setting where these facilities are not available, umbilical artery pH analysis can help not only in identifying neonates with intrapartum hypoxemia but can also help in anticipating neonatal adverse outcomes. The aim of the study was to analyse intrapartum cardiotocography and its correlation with umbilical artery pH and neonatal outcome.*

Methods: *Total of 317 consecutive single, term, labouring women were included in the present study. After taking CTG, it was classified into normal, non-reassuring and abnormal groups according to National Institute of Clinical Excellence (NICE) guideline 2017. At birth umbilical cord arterial blood was taken to detect neonatal hypoxemia. At the same time, APGAR score at 5 minute of birth, NICU admission and neonatal mortality was also recorded. Neonates with umbilical artery blood pH of ≤7.2 were considered as asphyxiated.*

Results: *Among 317 women 48.8% had normal CTG, 35% had non-reassuring and 15.4% had abnormal CTG. APGAR score was found to be <7 in 17.3%, and same number of neonates had NICU admission. Out of 113 non-reassuring CTG, 5.9% had acidosis. This number was much higher in abnormal CTG group where 11% had acidosis. There were 6 neonatal mortalities. A statistically significant association was found between intrapartum CTG and umbilical artery pH and neonatal outcomes.*

Conclusions: *Cardiotocography is an effective screening tool that is routinely used in all labouring women for screening of fetal hypoxia. By doing that timely intervention can be under taken to avoid neonatal morbidity and mortality.*

Keywords: *Intrapartum CTG, Neonatal Outcome, Umbilical Artery pH*

INTRODUCTION

Major part of the current preventive obstetric practice includes methods to identify, avoid and treat asphyxia.[1] Intrapartum fetal surveillance has now become the fundamental part of management of labour as it is easy to perform, simple, cheap, non-invasive and without any contraindication.[2]

Continuous electronic fetal monitoring (CEFM) was first introduced in 1970.[3] This method was adapted by >75% of birth attendant in early 1990s and increased more up to 85% by 2003.[4] However it was not supported by scientific evidence of efficacy in preventing most perinatal morbidities.[5] As a test cardiotocography (CTG) has certain limitations of its subjective interpretations and poor intra and inter-observer agreement.[6] Inspite all of these, it remains the mainstay of fetal monitoring in labour with its false positive rate of 99.8%.[7-8]

The reason for intrapartum monitoring is to determine early signs of fetal hypoxia which is evident by metabolic acidosis in fetal blood, umbilical cord or very early neonatal blood sample.[9]

Afterbirth the degree of hypoxia can be determined subjectively by APGAR scoring and objectively by umbilical artery pH.[10] Long term neurological sequelae can be better predicted by APGAR score but pH <7.0 at birth fulfills the criteria to cause cerebral palsy. Whereas APGAR score of 0-3 beyond 5 minutes is nonspecific to asphyxic insult but only suggest intrapartum timing.[11-12]

As a screening test CTG can detect fetal hypoxia but confirmatory tests are also required to confirm the diagnosis and to detect false positive patterns to avoid unnecessary interventions.[13-14] According to ACOG, cord blood sampling for acid base status is advisible as intrapartum event might be associated with an adverse outcome.[15]

But in a setting where confirmatory tests are not available umbilical artery analysis can help in diagnosing neonates with intrapartum hypoxemia and its related future sequelae like cerebral palsy.

The aim of our study was to correlate the intrapartum CTG findings with umbilical artery pH and neonatal outcome to see the sensitivity, specificity and positive predictive value of CTG.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted in the Department of Obstetrics and Gynaecology of National Medical College and Teaching Hospital for a duration of one year from 8th June 2021 to 7th June 2022. The ethical approval was obtained from the Institutional Review Committee of the National Medical College and Teaching Hospital (Registration number: F-NMC/532/077-078). All women fulfilling the inclusion criteria were admitted in the labor ward. After taking informed consent a complete history was taken followed by a general physical, systemic and obstetric examination. Patients then were subjected to CTG with the paper speed of 3 cm per minute with an external transducer and uterine contractions was recorded simultaneously. A CTG tracing was taken for 20 minutes. CTG interpretation was done by the researchers and was categorized as according to the classification proposed by Revised 2017 NICE (National Institute of Clinical Excellence) classification of fetal heart rate features. Based on baseline heart rate, variability and decelerations, the trace may be: Normal; all features are normal. Non-reassuring; one non-reassuring with two normal features. Abnormal; one abnormal and two non-reassuring features.[5] Following admission CTG, patients with normal CTG were monitored for progress of labour and partogram was plotted. In patients with non-reassuring and abnormal CTG delivery was expedited either by caesarean section or vaginally, depending upon the stage of labour.

At birth, after the delivery of the baby, 4 cord clamps were placed on the cord to isolate a 20 cm segment in the middle. Cord was cut in between the two sets of the clamps so that the isolated segment was remained independent and both the baby and placenta was still having clamp in place. Baby was handed over to the neonatologist. That isolated portion of the cord was identified for the umbilical artery. Then from the placental end of the cord about 1 ml blood was withdrawn in a pre-heparinized syringe which was collected into the EDTA tube. Samples was analysed within 5 to 10 minutes after their collection for pH.

At birth all neonates were attended by neonatologist. APGAR score was assessed at 1 and 5 minutes. Babies born were grouped as non-asphyxiated and asphyxiated. This was done on the basis of APGAR scoring done at 5 minutes. Score ≥7 was labelled as non-asphyxiated. Adverse neonatal outcome was recorded in terms of NICU admission and neonatal mortality from the neonatal case sheet

Neonates were classified according to cord blood pH value into two groups: acidosis group; pH ≤7.2, Normal group; pH >7.2,.[16-17] Correlation between intrapartum CTG and umbilical artery acidaemia was analysed and all neonates were respectively followed until discharge from the hospital or otherwise till death. Maternal variables recorded were include age, parity and gestational age. For a minimum of 270 patients to be study, 317 consecutive women were included in the study.

Selection Criteria

All participants who meet inclusion criteria in study period enrolled in study.

Inclusion criteria:All low-risk pregnant women of any parity in first stage of labour, with period of gestation ≥37 weeks upto 41 weeks with singleton pregnancy and cephalic presentation.

Exclusion criteria: Gestational age <37 and >41 weeks with multiple gestations, abnormal lie, USG confirmed fetal anomalies, acute hypoxic state of fetus, patients identified for elective LSCS, patient with previous C-section, medical disorders in pregnancy, pre-existing medical disorders, refusal to participate.

Data was entered into Microsoft Excel 2021 data sheet and analysed by using SPSS version 25 software. Categorical data was represented in the form of frequencies and proportions. Chi square was used as test of significance. p value of <0.05 was considered statistically significant.

RESULTS

Total 317 laboring women were enrolled for the study after fulfilling the inclusion criteria and informed consent. Mean age of the patients was 25.1 ± 3.9 years. Majority of the patients were in the range of 21 to 24 years. The study population comprised of 52 primigravida and 265 multigravidas. Mean period of gestation was 38.4 weeks. Majority were in the range of 38 to 38.6 weeks of gestation. All of them came with spontaneous onset and in latent stage of labour.

On performing intrapartum (admission) CTG it was observed that 8.5% had bradycardia. Whereas 2.8% had tachycardia. As far as variability was concerned 10.09% showed loss of variability and 34.7% had variability of less than five. Total 169 patients had normal variability. While observing accelerations and decelerations, 142(44%) had no acceleration and 3.4%, 4.4% and 9.4% had early, late,

and variable decelerations respectively (Table 1).

Overall, 48.8% of subjects had normal CTG and 35% had non-reassuring CTG. Remaining 15.4% had features suggestive of abnormal CTG. These findings are shown in Table 2.

Out of 317 patients, caesarean section was performed in 111(35%) patients and vaginal delivery was found in 206(65%) (Table 3).

In the present study, APGAR score at 5 min was found to be less than 7 in 55(17.3%) cases and between 7 to 10 in 82.6%. One baby with normal CTG had APGAR score <7. In non-reassuring cases 19 neonates had APGAR score <7 whereas in case of abnormal CTG's 35 (11.1%) neonate had APGAR score less than 7. Correlation of admission CTG with APGAR score was found to be statistically significant (P=0.0001) (Table 4).

Out of 317 babies, 60(18.9%) had cord blood pH ≤7.2 whereas 257(81%) had its value > 7.2. Among 155 women with normal CTG, no baby had acidosis. 20(6.2%) neonates from 113 mothers with non-reassuring CTG had pH ≤7.2 while 93(29.3%) had normal pH. In abnormal category of CTG, 40(12.6%) had pH ≤7.2 and rest of neonates (2.8%) had pH >7.2. Significant association was identified between the type of CTG and cord arterial blood pH (P=0.0001) (Table 5).

Overall, 55(17.3%) neonates had NICU admission. It was 19(5.9%) from non-reassuring CTG group and 35(11%) were from abnormal group. Correlation of admission CTG with NICU admission was found to be statistically significant (p=0.0001) (Table 6).

Among 55 babies who had NICU admission 6(1.8%) babies died which is also clinically significant (P=0.0001) (Table 6).

Table 1: Type of FHR pattern

Type of FHR pattern	Number	Percentage (%)
Bradycardia (<100)	27	8.5
Tachycardia (>160)	9	2.8
Absent variability	32	10.09
Reduced Variability	110	34.7
No acceleration	142	44
Early deceleration	11	3.4
Late deceleration	14	4.4
Variable deceleration	30	9.4

Table 2: Type of CTG pattern

Type of CTG	Number	Percentage (%)
Normal	155	48.8
Non-reassuring	113	35
Abnormal	49	15.4

Table 3: Mode of delivery

Mode of delivery	No.	%
Vaginal delivery	206	64
Caesarean section	111	35
Total	**317**	**100**

Table 4: Correlation of intrapartum CTG with Apgar score

Apgar score	Normal		Non-reassuring		Abnormal		P value
	No.	%	No.	%	No.	%	
< 7 55 (17.3%)	1	0.3	19	5.9	35	11	0.0001
7 – 10 262(82.6%)	154	48	94	29	14	4.4	
Total	155	48.3	113	34.9	49	15.4	

Table 5: Correlation of intrapartum CTG with umbilical artery pH

PH	Normal		Non-reassuring		Abnormal		P value
	No.	%	No.	%	No.	%	
≤7.2 60 (18.9%)	-	-	20	6.2	40	12.6	0.0001
>7.2 257 (81%)	155	48.8	93	29.3	9	2.8	
Total 317	155	48.8	113	35.5	49	15.4	

Table 6: Correlation of intrapartum CTG with NICU admission and neonatal mortality

Apgar score	Normal		Non-reassuring		Abnormal		P value
	No.	%	No.	%	No.	%	
NICU admission 55 (17.3%)	1	0.3	19	5.9	35	11	0.0001
Perinatal mortality 6 (1.8%)	-	-	2	0.63	4	1.26	

DISCUSSION

In this prospective study, three types of intrapartum CTG were, normal 48.8%, non-reassuring 35% and abnormal 15.4%. This was comparable with the study by Ray C et al.[9] who reported 50% category I, 36.5% category II and 13.3% category III CTG. Vishnu et al.[18] found 37% reassuring, 60% non-reassuring and 3% of abnormal CTG. When compare with the study of Khanum S et al.[19] the percentage of abnormal CTG was much higher (39.6%) perhaps because they included all women undergoing caesarean section for fetal distress.

We found that 88.7% had normal base line heart rate, 8.5% had bradycardia and 2.8% had tachycardia. In a study done by Vishnu et al.[18] tachycardia was found in 2%

in low-risk group of the study. However, the incidence of tachycardia is different from the study done by Aboulghar W et al.[10] who reported it 17% which could be due to inclusion of PROM in their study. In our study, 34.7% had reduced variability which is comparable with the study done by Ray C et al.[9] They found it to be 34.6% and 10.3% for minimal variability and absent variability respectively and 10.9% had absent variability.

In present study, there was no acceleration in 44 %. Deceleration was present in 55% of CTG which is comparable with the study of Aboulghar W et al.[10] where it was 53%. In Ray C et al.[9] study deceleration was found in 17.9%.

In this study we found, overall APGAR score <7, after 5 min of birth in 17.3% of cases. It was 0.3%, 5.9% and 11% respectively in normal, non-reassuring and abnormal groups. While it was ≥ 7 in 82.6% which is comparable with the results of Vishnu et al.[18] They reported APGAR score <4 at 5 min in 7%, between 4-6 in 14% and between 7 to 10 in 79%. However, in low-risk group of Vishnu et al.[18] APGAR score less than 4 was found in 1%, 4-6 in 1% and ≥7 in 33%.

In a study done by Khanum S et al.[19] who took all patients with fetal distress undergoing caesarean section, APGAR score 0-3 was found in 11.9%, 4-6 in 48.5% whereas it was between 7-10 in 39.6%. This result is also comparable with our study.

In the present study, an umbilical artery pH of ≤7.2 at birth is taken as the cut off value to define acidosis. 18.9% of the neonates had acidosis which is comparable to the study by Ray C et al.[9] (18.3%) and Modarressnejad V et al.[20] (20.25%). In the study by Aboulghar W et al.[10] it was higher (34%) which can be again explained by the inclusion of women undergoing caesarean section due to fetal distress for some reasons, while in our study and in above two mention studies, consecutive term laboring women were included.

In our study about 55(17.3%) babies were admitted in NICU. Among 113 patients who had non-reassuring CTG, 19(5.9%) babies were admitted in NICU, 11% of the babies of abnormal group whereas only 1(0.3%) baby was admitted from normal CTG group which is statistically significant. This result is comparable with the study of Vishnu et al.[18] who reported overall 15% NICU admission. Our result is different from Sandhu et al. [21] in which NICU admission rate is much higher than our study perhaps because they took only high-risk pregnancies. They found 1%, 12%, and 33 % NICU admission respectively for normal, equivocal and abnormal test. Rajalekshmi et al.[1] found 6.5% of NICU admission among 400 deliveries. 1.1% from reassuring, 12.3% from non-reassuring and 47.4% from abnormal group.

In present study the neonatal mortality rate was found to be 1.8% which is statistically significant (p=0.0001). This can be compared with the perinatal mortality in low-risk group of Vishnu et al.[18] study, where mortality rate was 1%. Vishnu et al.[18] reported perinatal mortality rate of 5% in high-risk group.

In our study, CTG identified 49(15.4%) fetuses with an abnormal CTG and 133(35%) fetuses with non-reassuring CTG, which increase the need for caesarean section. This may be due to the absence of confirmatory test for fetal acidosis like fetal blood sampling. At birth 55 (17.3%) had APGAR score <7 and 60(18.9%) babies had pH ≤7.2. All babies with APGAR score <7 were admitted in NICU and 6 of them died. Significant association was found between the type of CTG, APGAR score, umbilical artery pH and neonatal outcomes. The sensitivity of abnormal intrapartum CTG to detect intrapartum fetal distress was 66.6%, specificity 96.4% and positive predictive value was 81.6% which is comparable to a study of Ducey at al. who reported it to be 57%, 98% and 75% respectively.[18]

LIMITATIONS

The study was hospital based and findings might not be representative of the general population. Due to the limited duration and number of samples, the projected result cannot be conclusively applied to large populations, so multicentric study is recommended.

CONCLUSION

In our study we found that CTG is an effective screening tool to predict the possibility of fetal hypoxia. In our study we found that the number of women having non-reassuring and abnormal CTG in low-risk women is not negligible and is ultimately associated with adverse neonatal outcomes. Therefore, CTG should be routinely used in all labouring women for screening fetal hypoxia so that timely intervention can be under taken to avoid neonatal morbidity and mortality.

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