Original Article

Fetal Heart Rate in Neonatal

Diagnostic Value of Electronic Fetal Heart Rate Monitoring in Predicting the Neonatal Outcome

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ABSTRACT

Objective: To Study the Diagnostic Value of Electronic Fetal Heartrate Monitoring in Predicting the Neonatal Outcome.

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Gynae/Obs department Abbottabad international Medical College Abbottabad, Shaheena Jameel Teaching Hospital Abbottabad, Idris Teaching Hospital Sialkot and PAF Hospital Islamabad from July 2019 to Dec 2019.

Materials and Methods: An admission cardiotography (CTG) was done for 20 minutes in all the cases and repeated at 4 hourly intervals. All the CTG traces were collected and interpreted according to Intenational Federation of Gynecology and Obstetrics (IFGO) guidelines as reactive, non-reactive and pathological. After delivery neonatal outcome was calculated using 5 min Appearance, Pulse, Grimace, Activity, and Respiration (APGAR) score and frequency of Neonatal Intensive care unit (NICU) admissions. The informed written consent was taking before history, examination and investigations. The permission of Ethical Committee was taken before collecting the data and get publishing in Medical Journal. All data was analyzed using SPSS Version 12.

Results: All data was analyzed using SPSS Version 12. Out of 204 patients who qualified for the study, 68.1% had reactive traces, 26% had non-reactive traces and 5.9% had pathological traces. The APGAR score at 5 min and frequency of NICU admissions were lowest in reactive group, intermediate in non-reactive group and highest in pathological group. Regarding the mode of delivery, the highest percentage of caesarean deliveries was observed in pathological group (58.3%). The sensitivity (88.88%) of EFHRM was found to be higher than specificity (70.76%). The positive and negative predictive values were 12.30% and 99.28% respectively. Fisher's exact test was applied between fetal heart patterns on CTG and 5 min APGAR score and the P value was found to be statistically significant.

Conclusion: The results of this study demonstrate that cardiotography (CTG) is capable of discriminating healthy fetuses from those at risk of acidemia at birth and a statistically significant association exists between patterns of FHR and neonatal outcome. As a diagnostic test it has high sensitivity but low specificity and low positive predictive value, thus supplementation with additional tests may help gain maximum benefit and reduce unnecessary operative deliveries.

Key Words: Intra partum cardiotocography, Electronic fetal monitoring, APGAR score

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INTRODUCTION

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Current work objectives to find better and early points for the new born acidosis of blood and the physical condition of a newborn baby[1]. Intrapartum cardiotocography monitors fetal heart rate (FHR) and uterine contractions and is commonly used for the early detection of fetal distress[2].

It is theorized that provided during the act of birth cardiotocography normal fetal heart rate could detect fetal oxygen deficiency and or acidosis allowing a timely involvement to reduce bad new born outcomes such as after birth cerebral paralysis. This depends on the theory that during birth oxygen deficiency may lead to changes in the fetal brain that directly affects the electrical activity of the fetal heart and could also induce neonatal cerebral palsy[3]. Really, cardiotocography normal fetal heart rate methods including baseline normal fetal heart rate and its change

appear to be independent values of fetal acidosis[3], were associated with a basic decrease in early new born death and morbidity[4]. At present, however, there is no agreement relating reactivity and extent of cardiotocography classifications in showing acidosis of blood, with 3 instructions for cardiotocography explanation provided by the International Federation of Gynecology and Obstetrics (FIGO), American College of Obstetrics and Gynecology (ACOG), and National Institute for Health and Care Excellence (NICE)[5].

The betterment in the accuracy of normal fetal heart rate pattern explanation through a continuous normal fetal heart rate centralization system is predict to be fruitful in reducing the prevalence of new born acidosis of blood[5]. To enhance the result effect of cardiotocography normal fetal heart rate, diagnostic algorithms are recently being found to be used in time software system for deciding [6].

In this work, we aimed at examination whether the during birth baseline and change methods of normal fetal heart rate are independently associated with nee born acidosis of blood and the Appearance, Pulse, Grimace, Activity, and Respiration scores of the new born baby without severe cases of morbidity and from uncomplicated pregnancies.

MATERIALS AND METHODS

An admission cardiotography (CTG) was done for 20 minutes in all the cases and repeated at 4 hourly intervals. All the CTG traces were collected and interpreted according to International Federation of Gynaecology and Obstetrics (FIGO) guidelines as reactive, non-reactive and pathological. After delivery neonatal outcome was calculated using 5 min APGAR score and frequency of NICU admissions. The informed written consent was taking before history, examination and investigations. The permission of Ethical Committee was taken before collecting the data and get publishing in Medical Journal. All data was analyzed using SPSS Version 12.

- **Inclusion criteria**
  All labouring patients with
  - Gestational age $\geq$ 37 weeks (By dates or Ultrasound)
  - Singleton pregnancy
  - Cephalic presentation
- **Exclusion criteria**
  - Gestational age < 37 weeks.
  - Fetal congenital anomaly
  - Multiple pregnancy
  - Failure to get an adequate CTG trace

RESULTS

Total 204 women fulfilling the inclusion criteria were evaluated for fetal outcome in view of CTG changes and NICU admissions. Keeping in view FHR patterns on CTG, cases were divided into three groups that is reactive group, non-reactive group and pathological group. Out of total 204 case 139 (68.1%) were reactive, 53 (26%) were non-reactive traces and 12 (5.9%) traces were pathological.

In reactive group mean maternal age was 27.99 years; mean period of gestation was 38.6 weeks. There were 19.4% primigravida and 80.6% multigravida. Characteristics of study population are shown in table 7. Mode of delivery was 86.3% spontaneous vaginal deliveries, 9.4% instrumental deliveries and caesarean delivery in 4.3% as shown in table 8.

In non-reactive group mean maternal age was 28.49 years, mean period of gestation was 38.8 weeks. There were 34% primigravida and 66% multigravida (table 7). Mode of delivery was spontaneous vaginal delivery in 28.3%, instrumental delivery in 32.1% and 39.6% underwent caesarean section (table 8).

The third group was labeled as pathological group with mean maternal age of 31.1 years, mean gestational age of 38.4 weeks. There were 50% primigravida and 50% multigravida in this group (table 7). Mode of delivery was 33.3% spontaneous vaginal delivery, 8.3% instrumental deliveries and caesarean delivery was done in 58.3% of cases. Modes of deliveries are presented in table 8.

Regarding indications of caesarean delivery in study population, majority of caesarean deliveries were done due to fetal distress (58.82%) followed by relative CPD (17.64%) while the other indications were secondary arrest (11.76%), primary dysfunctional labour (8.82%) and obstructed labour in 2.94% of cases.

When the causes of caesarean sections were evaluated separately for 3 groups, it was found that the percentage of caesarean deliveries due to fetal distress was 0% in reactive group as compared to pathological group in which 100% caesarean sections were done due to fetal distress while in non-reactive group the caesarean deliveries done due to fetal distress were 61.9%.

In table 8 the main outcome measures are shown including APGAR score at 5 min and % of NICU admissions. In reactive group 99.3% of babies were born with APGAR score $\geq$ 7 while 0.7% had low APGAR score. In non-reactive and pathological group 5 min APGAR score $\geq$7 was observed in 96.2% and 50% while low APGAR score (<7) was seen in 3.8% and 50% of babies respectively.

Similarly, percentages of babies admitted to NICU in reactive, non-reactive and pathological groups were 0.7%, 3.8% and 58.3% respectively. There were no neonatal deaths in all 3 groups. This is presented in table 8.

Table 8 shows mean birth weight of 3.41 Kg in reactive group, 3.1 Kg in non-reactive group and 3 Kg in pathological group.

Out of total 204 babies, there were 51% girls and 49% boys. Neonatal gender ratio is presented.

While calculating diagnostic accuracy of CTG when pathological and non-reactive groups were considered collectively as a single group and compared with the reactive group the sensitivity and specificity calculated were 88.88% and 70.76% respectively. Positive predictive value was 12.3% and negative predictive value was 99.28%.

When the intermediate group that is the non-reactive group was ignored and the pathological group only was compared with the reactive group, the sensitivity and specificity values were 85.71% and 95.83% respectively The positive and negative predictive values were 50% and 99.28%.

Table No.1: Variables Distribution

Variables	Reactive Group (n=139)	Non-reactive Group (n=53)	Pathological Group (n=12)
Maternal Age (years) Mean±S.D	27.99±4.98	28.49±4.99	31.17±5.54
Estimated Gestational Age (weeks) Mean±S.D	38.6±3.0	38.86±1.12	38.41±1.56
Parity Primigravida	19.4%	34%	50%
Multigravida	80.6%	66%	50%

Table No.2: Percentages of Delivery Modes in 3 Groups

Mode of Delivery	Reactive Group (n=139)	Non-reactive Group (n=53)	Pathological Group (n=12)
Spontaneous Vaginal Delivery	120(86.3%)	15(28.3%)	4(33.3%)
Instrumental Delivery	13(19.4%)	17(32.1%)	1(8.3%)
Caesarean Section	6(4.3%)	21(39.6%)	7(58.3%)

Table No.3: Neonatal Outcomes

Variables		Reactive Group (n=139)	Non-reactive Group (n=53)	Pathological Group (n=12)
5 min APGAR Score	≥7/10	138(99.3%)	51(96.2%)	6(50%)
	<7/10	1(0.7%)	2(3.8%)	6(50%)
NICU Admissions	No	138(99.3%)	51(96.2%)	5(41.7%)
	Yes	1(0.7%)	2(3.8%)	7(58.3%)

Table No.4: Mean Neonatal Birth Weight

Variable	Reactive Group	Non-reactive Group	Pathological Group
Birth Weight (Kg) Mean±S.D	3.41±2.89	3.19±0.48	3.05±0.60

Fisher's exact test was applied and found that a statistically significant relationship exists between the type of CTG and the APGAR score at 5 min.

Table No.5: Validity of EFHRM: Pathological + Non-reactive vs Reactive Group

Study Groups	5 min APGAR Score <7/10	5 min APGAR Score ≥7/10	Sensitivity	Specificity
Pathological+ Non-reactive Group	8	57		
Reactive Group	1	138	88.88%	70.76%

Table No.6: Validity of EFHRM: Pathological vs Reactive Group

Study Groups	5 min APGAR Score <7/10	5 min APGAR Score ≥7/10	Sensitivity	Specificity
Pathological Group	6	6		
Reactive Group	1	138	85.71%	95.83%

Table No.7: Validity of EFHRM (Predictive Values)

Study Groups	Positive Predictive Value	Negative Predictive Value
Pathological + Non-reactive Group vs Reactive Group	12.30%	99.28%
Pathological vs Reactive Group	50%	99.28%

Table No.8: APGAR Score at 5 min Type of CTG (Cross Tabulation)

Variables	Reactive Group n=139	Pathological Group n=12	P Value (Fisher's Exact Test)
APGAR Score ≥ 7	138	6	.000
APGAR Score < 7	1	6	

DISCUSSION

The main values of this work are that in a cohort of without complications childbirths without severe cases of new born medical condition, decreased of oxygen lack of circulation a disease in which the functioning of the brain is affected by some agent , or attacks:[1] increased mean and CV of the during birth fetal heart rate were linked with increased risk of acidosis of metabolism and low Appearance, Pulse, Grimace, Activity, and Respiration scores at birth;[2] fetal heart rate was not linked with mother age, history of diabetes

mellitus or high blood pressure or high blood pressure during pregnancy, delivery type, pregnancy, parity, pregnancy week, mean of uterus contractions. Besides the during delivery cardiotocography fetal heart rate, delivery type, and decreased consistency were also linked with new born acidosis of blood and the physical condition of a newborn baby during delivery new born deficiency of oxygen shows an important cause of after delivery cerebral paralysis or other nervous system outcomes and in a significant proportion of cases there is evidence of quality care related to fetal observation. Umbilical artery metabolic acidosis is commonly used to detect neurological injury[7].

A three-tiered FHR interpretation system for intrapartum cardiotocography FHR tracing interpretation was proposed[8]. As our work did not add complicated pregnancies, it supports using the normal cardiotocography fetal heart rate (category I), which has a result value of ninety-nine point seven percent of an Appearance, Pulse, Grimace, Activity, and Respiration score more than[7,8,9,10].

Using multivariate models to control confounds, cardiotocography fetal heart rate was recently found to be an independent values of fetal acidosis, respiratory morbidity in term new born[7,8], and results for preterm cesarean delivery for increased risk of neonatal and childhood morbidity[9,12,13]. In our multivariate model analysis, acidosis of metabolism at birth had an independent link with the cardiotocography fetal heart rate mean and variable and also with the type of delivery (delivery through surgery over vaginal) and parity. Our results are in agreement with the study of Heinonen et al. who also found that pregnancy, but not mother age, was an independent danger factor for new born acidosis. Corroborating our results with another study of women with a singleton term pregnancy that found previous cesarean delivery and null parity as risk factors for neonatal metabolic acidosis[9,10,14,15] may indicate that not only previous but also the current cesarean delivery may represent an actual challenge to the fetus. In two studies of poor new born adjustment at birth with severe new born acidosis (umbilical artery pH less than seven point ten) independent danger factors added abnormal cardiotocography fetal heart rate, maternal age thirty five years or older, parity, prior neonatal death or cesarean delivery[11,16,17]. Our data shows a costly role for cardiotocography fetal heart rate in showing new born acidosis in deliveries with Appearance, Pulse, Grimace, Activity, and Respiration five ranging from fairly low to normal without nervous system dangers.

Heart rate variability (HRV) analysis with search for new algorithms is commonly employed to measure alterations in autonomic tone with predictive value in diseases[12,18]. We have identified the CV of the heart rate as a sensitive measure of autonomic dysfunction and independently associated with vascular atherosclerosis[13,19]. In this work, we found that CV of during delivery cardiotocography fetal heart rate is an independent values of new born acidosis of blood and Appearance, Pulse, Grimace, Activity, and Respiration scores.

CONCLUSION

EFHRM can distinguish healthy fetuses from compromised fetuses with a high sensitivity but due to its low specificity and positive predictive value, the incidence of operative deliveries has increased. The neonatal outcome in terms of APGAR score has a statistically significant association with intrapartum FHR patterns.

Recommendations: Adequate knowledge to interpret CTG traces is essential.

The limitations of CTG should be known.

The clinical picture of the labouring patients should also be considered.

Additional tests like FBS should be used when in doubt especially in non –reactive patterns.

Further research is required to predict fetal hypoxia in order to minimize perinatal morbidity and mortality.

Author's Contribution:

Concept & Design of Study:	Major Asiya Yaqoob
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Conflict of Interest: The study has no conflict of interest to declare by any author.

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