Journal of Biomedical Sciences
Research Article Peer-review, Open Access

A study of normal and abnormal cardiotocograph (CTG) in antenatal period with perinatal outcome in BMCH

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Abstract

Cardiotocography (CTG) is the gold standard test for foetal monitoring throughout both the antepartum and intrapartum periods in the vast majority of hospitals in industrialised nations. The researchers wanted to compare the pregnancy outcomes and perinatal outcomes (Upto 3 days after birth) among the normal and abnormal CTG and to reveal the association between abnormal findings of CTG with that of pregnancy outcomes and perinatal outcomes (Upto 3 days after birth). From July 2008 to December 2008, in BMCH only indoor patients were included in the cross sectional study. 50 consecutive normal and 50 consecutive abnormal tracing collected from the antenatal patients who were admitted to obstetric department only non-labor patients will be included. There was no significant difference between normal and abnormal CTG groups regarding parity and gestational age. But significant difference observed between normal and abnormal CTG groups regarding age and gravidity of patients. In normal and abnormal CTG group gestational age of the most of patients were between 35-37 weeks. Also Eight out of 50 normal CTG neonates and 20 out of 50 abnormal CTG were admitted into NICU. A statistically significant ($P<0.05$) difference was observed when normal and abnormal CTG results compared. One neonate was admitted more than 7 days in normal CTG groups and 6 neonates in abnormal CTG groups were admitted more than 7 days in NICU.

Key words: CTG, NICU, Perinatal Outcomes, Pregnancy Outcomes, BMCH, etc.

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Introduction

Electronic fetal monitoring, or EFM for short, is a more prevalent name for the cardiotocograph these days. It is a recording of the fetal heart rate (FHR), which may be obtained from either a transducer placed on the belly or a probe placed on the fetal scalp. A second transducer that is put on the belly measures the uterine contractions that are taking place over the fundus in addition to the fetal heart rate [1].

The screening method was first developed in the 1970s with the intention of enhancing the identification of fetal hypoxemia, hence lowering the risk of hypoxemia, cerebral palsy, and perinatal death, especially in high-risk pregnancies [2]. CTG was originally created in 1950, and it was made accessible on a commercial scale in 1961. Its inventors, Doctors Orvan Hess and Edward Hon, were responsible for its creation. Later on, Dr. Konrad Hamrnacher worked with Hewlett-Packard to build a more refined version of the device that was antepartal, non-invasive, and beat-to-beat [3]. Its first use was during labor to identify signs of fetal distress; however, it was subsequently adapted for use in antepartum fetal monitoring as a contraction stress test (CST), operating on the same principles. The use of a cardiotocograph (CTG) during the third trimester of pregnancy to check on the health of the fetus is referred to as a nonstress test (NST), and nonstress tests are now considered a routine form of antepartum fetal monitoring [3].

Antenatal cardiotocography is performed with the intention of identifying any signs of acute or chronic fetal asphyxia that may be present [4]. During labor, intrapartum cardiotocography is performed with the intention of identifying any signs of fetal distress. The objective of the obstetrician who is caring for the pregnant woman is not only to avoid the death of the fetal but also with the discovery of fetal compromise and the prompt delivery of such newborns in an attempt to maximize their potential for the future [5]. Uteroplacental insufficiency is responsible for a significant number of prenatal fetal fatalities, and prompt delivery has been shown to avert a significant percentage of fetal deaths. The researchers found that a healthy prognosis for the fetus was guaranteed if the fetal heart rate rose in response to either fetal movement or uterine contractions [6]. In 1969, Kubli, Kaesar, Kinselman, and Hammacher conducted research in Europe on the fluctuations and oscillations of the fetal heart rate that occur in pregnancy when there is no stress. They made the observation that a lack of FHR acceleration was linked to a bad mortality result [7].

At first, clinicians believed that monitoring FHR would address not one but two different issues. To begin, it would function as a diagnostic tool for moderate to severe cases of hypoxia. Second, FHR monitoring would make it possible to recognize the early stages of asphyxia, which would allow for prompt obstetric intervention that would prevent asphyxia-induced brain damage or death in the baby [8]. However, over time, more and more proof that it was effective started to gather. Several prospective, randomized trials including thousands of individuals have failed in proving the advantages of continuous electronic FHR as compared with intermittent auscultation, although an increase in the risk of cesarean section was reported [9]. Despite these findings, continuous electronic FHR was still preferred over intermittent auscultation [10, 11, 12].

Antepartum cardiotocography, often known as NST, has gained widespread acceptability as a screening test for fetal monitoring all around the globe [13]. The outcome of the NST was good, with a false negative rate of 7 out of every 10,000 instances, according to the combined findings of four investigations that included 10,169 patients [14, 15]. The fact that the chance of fetal issues is minimal when the test is positive (non-reactive) indicates that the false positive result is substantial. It accounts for fifty percent of morbidity and eighty percent of death. There will be approximately 35% of cases in which fetal blood sampling will show that immediate intervention is not necessary [16, 17]. The most serious

pattern of heart rate changes, known as fetal bradycardia with loss of baseline variability and late decelerations, is associated with significant fetal hypoxia in approximately 65% of cases [18, 19]. However, even among these cases, there will be approximately 35% of cases in which there will be no need for immediate intervention. Before a cesarean section is performed, then, any suspicion that the fetus is hypoxic has to be verified by additional techniques, in particular by testing the pH level of the fetal blood [20, 21].

Aims & Objective

The goals of this research are to compare the pregnancy outcomes and perinatal outcomes (upto 3 days after birth) among the normal and abnormal CTG and to find out the association between abnormal findings of CTG with that of pregnancy outcomes and perinatal outcomes (upto 3 days after birth).

Methodology

Study Design & Duration

From July 2008 to December 2008, it was a cross-sectional study. The Bangladesh Medical College & hospital, which offers a department of obstetrics and gynaecology, was one of many private hospitals in Dhaka where the study was conducted over six months. Only indoor patients were included in the study. 50 consecutive normal and 50 consecutive abnormal tracing collected from the antenatal patients who were admitted to obstetric department. Only non-labor patients were included.

Technique of Obtaining FHR Tracing

1. Patient will be place in supine position with a lateral tilt to prevent supine hypotension syndrome;
2. BP will be measured initiation of the CTG and every 10 mm interval.
3. The CTG transducer will be placed over the uterus after applying the jelly where fetal heart sound loudest.
4. By an external tocograph uterine contraction will be recorded and fetal movement by pressing event marker.
5. In doubtful cases tracing will be repeated.

Data Collection

On a data collection sheet that has been predetermined, all of the clinical information and data that is essential will be gathered.

Inclusion Criteria	**Exclusion Criteria**
Pregnancy between 32-42wks of gestation	Multiple pregnancy
Singleton gestation	Gestational age <32 wks
Age of the baby upto 3 days	Inability to obtain a satisfactory FHR tracing.
One of the following indication for FHR tracing present	Age of the baby> 3 days

Table 1: Inclusion & Exclusion Criteria Representation. (N.B: (A) H/O prior stillbirth; (B) Maternal medical conditions – DM, HTN, Anaemia; (C) Complication during pregnancy - Premature rupture of membrane, PET, Abruptio placenq, Undiagnosed 3 trimester bleeding, IUGR, Macrosomia, Oligohydramnios, Polyhydramnios, Postdated pregnancy, Less fetal movement, Rh Isoimmunization.)

Results & Observations

Fifty consecutive normal CTG and fifty consecutive abnormal CTG were analyzed for correlations with pregnancy and newborn outcomes in this cross-sectional research.

Variables	**Normal CTG N=50 (Mean ± SD)**	**Abnormal CTG N=50 (Mean ± SD)**	**P- Value**
Age (Year)	27.64 ± 3.32	24.18 ± 4.75	<0.05

Parity	1.09 ± 0.96	0.92 ± 1.04	>0.05
Gravidity	2.28 ± 1.29	1.80 ± 1.11	<0.05
Gestational Age	37.60 ± 2.10	36.90 ± 2.44	>0.05

Table 02: Maternal age, obstetric characteristics and gestational age of study subjects.

There was no significant difference between normal and abnormal CTG groups regarding parity and gestational age. But significant difference observed between normal and abnormal CTG groups regarding age and gravidity of patients. In normal and abnormal CTG group gestational age of the most of patients were between 35-37 weeks.

Gestational Age (Weeks)	Normal CTG	Abnormal CTG
32-34	6	11
35-37	12	14
38-40	32	25
41-43	0	0
Total	50	50

Table-02: Gestational age distribution among the two CTG groups.

However there was significant difference between the two groups regarding glycemic control, and abnormal CTGs were more associated with uncontrolled blood sugar level (1-8).

Indications	Normal CTG	Abnormal CTG
Diabetics Mellitus	22	15
Pre-eclampsia/chronic hypertension	7	9
Less fetal Movement	8	11
PROM	5	5
IUGR	4	4
Bad Obstetrical history	1	2
Polyhydramnios	1	1
Oligohydramnios	2	1
Cyanotic maternal heart disease	0	1
Rh iso-immunization	0	0
Abruptio placentae	0	1
Total	50	50

Table-O3: Indication for CTG.

Indications for CTG have been shown in table-3 pregnancy with diabetes mellitus was the most common indication in both the groups. Many pregnant women had more than one risk factors and were associated diabetes mellitus.

Types of abnormal CTG (N=50)	Number	Percentage
Tachycardia	8	16%
Bradycardia	0	-
Absent beat to beat variability	19	38%
Non-reactive	12	24%
Decelerations	11	22%

Table-04: Frequency of Major abnormality in CTG in the study population.

Many abnormal tracing had more than one abnormality. Among the abnormal CTG in Study subjects (Table-04), absent beat to beat variability were most frequently (3 8%) observed.

FHR pattern in CTG	Number	Normal outcome No (%)	Abnormal outcome No (%)
Reactive	50	44 (88%)	6 (12%)
Deceleration	11	4 (36.37%)	7 (63.64%)
Non-reactive	12	8 (66.67%)	4 (33.34%)
Absent beat to beat variability	20	5 (25%)	15 (75%)
Tachycardia	0	0 (0%)	-
Bradycardia	7	7 (100%)	-
Total	100	68	32

Table-05: Normal and abnormal fetal heart outcome & perinatal outcomes.

Maternal or obstetric	No. of cases	Normal outcomes	Abnormal outcomes
Diabetes Mellitus, with pre-eclampsia with IUGR	4	0	4
Diabetes mellitus with pre-eclampsia	5	3	3
Diabetes mellitus with IGUR with oligohydramnios	1	0	1
Diabetes mellitus with polyhydramnios	1	1	0
Pre-eclampsia	5	3	2
Diabetes mellitus	15	14	1
Pre-eclampsia with jaudice	2	0	2
Bad obstetric history	2	2	0
PROM	5	2	3
Less fetal movement	8	7	1
Maternal cardiac disease	1	1	0
	50	33	17

Table- 06: Influence of risk factors on outcomes with abnormal CTG subject.

Among the abnormal CTGs groups, who had more risk factors abnormal outcomes were more (table-6). Most of the patients in both the normal and abnormal CTGs groups were associated with DM Many pregnant woman had other risk factors associated with DM.

Groups	Association with Diabetes Mellitus	Controlled Blood Sugar	Uncontrolled Blood Sugar
Normal CTG	40	33 (84.61%)	7 (17.94%)
Abnormal CTG	37	24 (64.80%)	13 (33.13%)
Z/P Value	-	1.78/<0.05	1.78/<0.05

Table-07: Effect of Glycaemia on CTG.

However there was significant difference between the two groups regarding glycaemic control, and abnormal CTGs were more associated with uncontrolled blood sugar level (Table-7).

Group	Normal Outcomes	Abnormal Outcomes	Sensitivity	Specificity	Positive Predictive	Negative Predictive

					Value	Value
Normal CTG	47	3	0.28	0.94	0.06	0.72
Abnormal CTG	28	22				

Table 08: Overall outcomes of normal and abnormal CTG.

Normal CTG was more predictive of normal outcomes than abnormal CTG regarding abnormal outcomes. Sensitivity of CTG was more than specificity (Table-08).

Variables	Delivery by LUCS	Vaginal Delivery
Normal CTG	36	14
Abnormal CTG	43	7
Z/P Value	1.75/<0.05	1.75/<0.05

Table-09: Mode of delivery across the two electronic fetal monitoring.

Significance of the difference was calculated by using proportion test. There was significant difference between the two electronic fetal monitoring groups regarding mode of delivery, caesarean section was more in abnormal CTG groups (table-09).

Variables	Normal CTG	Abnormal CTG	Z Value	P Value
Caesarian Delivery	36 (72%)	43 (86%)	1.75	<.05
Caesarean Delivery for Fetal Distress	7/36 (19.44%)	26/43 (60.45%)	4.12	<.05
Oligohydramnios	4 (8%)	11 (22%)	2.00	<.05
Meconium stained Liqour	3 (10%)	10 (20%)	2.12	<.05
Small Placentas	3 (6%)	13 (26%)	2.84	<.05

Table-l0: Comparison of Pg outcomes between normal a abnormal CTG.

It shows comparison of pregnancy outcomes between normal and abnormal CTG groups. 36(72%) vs 43(86%) had caesarean delivery, 7/36 (19.44%) VS 26/43(66.45%) had caesarean delivery due to fetal dishess, 3(10%) vs 10(20%) had meconium stained liquor, 4 (B%) vs I t(22%) was associated with oligohydramnios, 3(6%) vs 13(26%) had small placenta in normal and abnormal CTG groups respectively. There was significant difference in above mentioned criteria between two groups.

Outcomes	Normal CTG		Abnormal CTG		Chi square value	P value
	Yes	No	Yes	No		
1 min APGAR score<7	2	48	17	33	11.02	<0.01
5 min APGER Score<7	1	49	8	42	4.38	<0.05
Small for gestational age	5	45	15	35	7.03	<0.01
Admission in NICU	8	42	20	30	6.12	<0.05

Duration of stay in NICU	≤5 Days	7		14			
	≥5 Days	1		6			
Perinatal Mortality		1	49	3	47	1.95	>0.05

Table-ll. Distribution of early neonatal outcomes of the two electronic fetal monitoring groups.

The distribution of perinatal outcome of the two electronic fetal monitoring groups has been shown in table-l1. Low 1 minute APGER score was found in 1 eighteen occasions during 50 normal CTG, of the 50 abnormal CTG, 29 neonates were observed to have depressed evaluations. A statistically significant difference was observed when normal and abnormal CTG rvere compared. Low 5 minutes APGAR score was observed in normal and abnormal CTG were compared. Low 5 minutes APGER score was observed in 1 neonate out of 50 normal CTG results and in 8 neonates out of 50 abnormal CTG. Statistically significant differences was observed when normal and abnormal CTG results were compared (table-l2).Five small for gestational age neonates were identified out of 50 normal CTG and 15 neonates out of 50 abnormal CTG results. Statistically significant (P<0.01) difference between the normal and abnormal CTG results were observed in predicting IUGR (table- l2).

Eight out of 50 normal CTG neonates and 20 out of 50 abnormal CTG were admitted into NICU. A statistically significant (P<0.05) difference was observed when normal and abnormal CTG results compared. One neonate was admitted more than 7 days in normal CTG groups and 6 neonates in abnormal CTG groups were admitted more than 7 days in NICU.

Out of 50 normal CTG, there was 1 neonatal death. In case of 50 abnormal CTG results there were 3 perinatal deaths. There was non statistically significant (p>0.05) difference between normal and abnormal CTG results.

SN	Gestational age	Risk factors	Abnormality in CTG	Mode of delivery	Time of death	Cause of death	Comments
1	39 weeks	Less fetal Movement	CTG was normal, reactive	LUCS	Perinatal death 3 days after delivery	Asphyxia Septicemia	The death was inevitable
2	37 weeks	CTG with IUGR with PET with Less fetal movement	Non reactive with late deceleration	LUCS	Perinatal death 3 days after delivery	Prematurity asphyxia wt-l.5kg	The death was inevitable
3	35 weeks	DM with pregnancy induced hypertension with pre mature	Tachycardia with non reactive	LUCS	Perinatal Death 2 days after delivery	Asphyxia prematurity wt-l.8kg	The death was inevitable

		rupture of mem					
4	34 weeks	GDM with IUGR with PROM	Flat curve	LUCS	Perinatal death 1 day after delivery	Asphyxia prematunity septicaemia wt-l.2 kg	The death was inevitable

Table-l2: Evaluation of perinatal death in different cases.

It shows details of neonatal death in normal CTG and perinatal death in abnormal CTG groups. One neonatal death was observed in a woman 39 weeks pregnancy, who only complained for less fetal movement. CTG was reactive, normal. LUCS was done and the baby was admitted in NICU due to asphyxia and septicemia and died 3days after birth.

Second perinatal death was observed in a woman 37 weeks pregnancy who was suffering from gestational diabetes mellitus with uncontrolled blood sugar with IUGR with PET with less fetal movement, CTG was non-reactive and showed repeated late decelerations. An emergency caesarean section was done. The baby was of 1'5 kg weight, asphyxiated. The baby was admitted in NICU and died after 3 days of delivery.

Third perinatal death was observed in a woman 35 weeks pregnancy with diabetes mellitus, pregnancy induced hypertension and PROM with IUGR. Emergency caesarean section was done. weight of the baby was 1.8 kg. The baby was asphyxiated and premature. The baby was admitted in NICU and developed septicemias and died2days after delivery.

Forth perinatal death was observed in woman 34 weeks pregnancy with gestational diabetes mellitus, IUGR and pre mature rupture of membrane. Tracing was flat curve. Emergency caesarean section was done. The baby was asphyxiated & septicemia weighted 1.2 kg, less than 10th percentile. The baby was admitted into NICU and expired on first day of birth.

Discussion

The goal of the obstetrician caring for pregnant women is not only to prevent fetal death but to detect fetal compromise and timely delivery of such infants to maximize their future potential. 70% to 90% of fetal deaths occurred before the onset of labor. Several intrapartum fetal deaths occur among compromised fetuses facing labor stress and succumbing. A large number of antepartum fetal deaths are caused by uteroplacental insufficiency. Antepartum fetal testing by identifying uteroplacental deficiency and timely action has prevented many fetal deaths.

Although technology has made great advances in antepartum fetal surveillance and intrapartum monitoring, obstetricians should be aware of the limitation of these methods. The diagnosis of fetal distress during labor cannot be assessed by any single clinical or laboratory measurement. Despite the lack of specificity, cardiotocography is a useful procedure for antepartum fetal surveillance. The purpose of this study was to test the ability of a CTG to predict pregnancy outcomes and perinatal outcomes. In this study, fifty consecutive normal CTGs were collected from the patients after considering the inclusion and exclusion criteria of this study. CTG was taken from the patients at ≥32 weeks gestation because the likely hood of a nonreactive test is substantially increased early in the third trimester. Between 24 and 28 weeks gestation, approximately 50% of NSTs are nonreactive. Lavin et al. and Druzin et al. reported that 15% of NSTs remain noncreative between 28 and 32 weeks.

After 32 weeks, the incidences of reactive and noncreative tests are comparable to those seen at term and eliminate concern regarding the immature fetal heart and central nervous system. Before 27 weeks gestation, the fetal heart rate response to fetal movement may be bradycardia. There was no significant

difference between the two CTG groups regarding the mean gestational age and parity, but a significant difference was observed regarding mean maternal age and gravidity. Both of the groups included patients who were relatively elderly and of low equality. Though the mean gestational age of the CTG groups showed no significant difference, in the abnormal CTG group, the frequently observed gestational age was lower than the standard CTG group because the early intervention was taken by following the irregular fetal heart rate pattern. CTG showing only tachycardia showed no abnormal outcomes, as it is an early sign of fetal distress; the effects were sound as interventions were taken early.

In this study, 75% of tracing showing absent beat-to-beat variability showed abnormal outcomes. Studies done by Shields et al. and Langer et al. demonstrated that the fundamental component of ominous fetal heart rate pattern is absent or markedly decreased fetal heart rate variability. CTGs showing decelerations were associated with 63.64% abnormal outcomes. In this study, deceleration included spontaneous decelerations in antepartum CTG, moderate to severe variable slowdown, and late deceleration. This study's non-reactive CTGs are associated with 33.34% abnormal outcomes, most associated with reduced baseline variability and basal fetal heart rate abnormality. The most serious pattern of heart rate changes, namely fetal bradycardia with loss of baseline variability and late decelerations, is associated with significant fetal hypoxia in about 65% of cases. When the risk factors increase, overall abnormal outcomes are higher among the strange CTG group.

In this study, it was seen that when diabetic patients developed preeclampsia and intrauterine growth retardation, abnormal outcomes were more, and the risk factors are interrelated, one predisposing to others. In this study, it was observed that normal CTG was extremely predictive of expected outcomes, the negative predictive value was 0.06 & the negative predictive values were 0.72. This study showed that CTG was highly sensitive. Still, the specificity was relatively poor, similar to numerous works done by others that CTG is suitable for detecting the fetus at risk for asphyxia. Still, most newborns with abnormal FHR patterns are not asphyxiated at birth.

Concerning mode of delivery, this study had a high incidence of cesarean section. Despite expected test results, the high incidence of cesarean section in these studies was due to obstetrical complications, like the history of previous cesarean section, cephalopelvic disproportion, severe pre-eclampsia, and severe intrauterine growth retardation. Despite average test results, cesarean section and induction rates are more in diabetic pregnancies. This study showed a significant difference between the standard and abnormal CTG groups regarding the mode of delivery and cesarean section for fetal distress, which was similar to the observation of Dellinger et al. The association of oligohydramnios, meconium-stained liquor, and small placenta were more in the abnormal CTG group than normal CTG, similar to the study done by Platt et al., differs from Dellinger et al. Reduced liquor volume before labor is considered an indication of placental insufficiency and cord compression, both of which increase the risk of fetal hypoxemia.

In the past, the presence of the meconium in the amniotic fluid was considered a sign of fetal hypoxia. However, most recent literature tends to disregard the importance of intrapartum meconium as a sign of fetal hypoxia. Meiss PJ, in his study, showed that intrapartum meconium is an insignificant finding in 50% of the cases. In contrast, early heavy or late meconium is suggestive of fetal hypoxia. Meconium in the presence of an uneventful labor without FHR abnormality has no great significance. In contrast, meconium in the complicated struggle with FHR abnormalities has a greater risk of fetal hypoxia than meconium alone or FHR abnormalities alone.

APGER score <7 at 1 minute was 4% among the regular CTG group, which was 5.102, shown by Dellinger et al., and 3.5%, conducted in the study done by Rana. Among the joint CTG group, the APGER score at 1 Minute was 32%,31%, and 20%, as shown in this study by Rana and Dellinger et al.. APGER

score <7 at 5 minutes among the regular CTG group was 2%,2%, and 1%, respectively, and APGER score <7 at 5 minutes among abnormal CTG was 16%, 17.1%, and 5% in this study, by Rana and Dellinger et al. respectively. The low APGER score at 1 and 5 minutes is more or less the same in this study and the study done by Rana but slightly differs from Dellinger et al. because they studied CTG from all types of patients, not only the high-risk cases. APGER scoring has been the conventional means of evaluating the status of the infant at birth. It is usually assumed that this score reflects the degree of neonatal asphyxia. However, recent studies using cord blood analysis and fetal scalp pH have cast doubts on the reliability of APGER scoring for asphyxia. An analysis of several published works on the subject gives the following approximate accuracy indexes for the APGER score in the prediction of hypoxemia sensitivity 0.28, specificity 0.94, positive prediction value 0.06, negative prediction value 0.72. Comparison of normal and abnormal test results concerning other outcome parameters, such as small for gestational age and admission in NICU, were similar to the results obtained by Platt et al. In the present study, one perinatal death was observed in normal CTG. In the abnormal CTG group, PNM was 60 per 1000 total birth, which is similar to the survey done by Rana. Perinatal mortality among the total study population. (n: 100) was 30 per 1000, which is more than reported by Platt et al, and Shamsuddin et al [10].

Conclusion

Although the clinical impact of cardiotocography on neonatal outcomes remains controversial, CTG is the most commonly used test for antepartum and intrapartum fetal surveillance in most hospitals in developed countries. CTG provides direct information on the fetal condition in contrast to other techniques. The rationale behind this test is that it gives an indication, via cerebrocardiac response of fetal cerebral activity, which is modified in the presence of hypoxia. The acceleration of fetal heart rate is due to the intact reaction of the CNS mechanism. The loss of fetal heart rate variability or decelerations reflects the depression of this CNS mechanism. However, it is not only the result of fetal hypoxia and acidosis. It can be due to fetal sleep, fetal anomalies, sedatives, and narcotics to the mother, which explain the healthy outcome of nonreactive CTG. The present study showed that the abnormal outcomes were three among the 50 normal tracings, and the average results were 47. Out of 50 odd tracing numbers, strange products were 28, and chronic effects were 22. The sensitivity of CTG was 0.28, specificity was 0.94, positive predictive value 0.06, and negative predictive value was 0.72 in the prediction of abnormal outcomes. Diabetes mellitus was the significant risk factor in normal and abnormal CTG groups. But among the strange CTG group, those who had abnormal results were more associated with diabetes mellitus along with pre-eclampsia and IUGR. So, diagnosis of fetal well-being using electronic fetal monitoring alone requires consideration of associated risk factors.

This study revealed that normal CTG was highly predictive of expected neonatal outcomes, but many neonates in the abnormal CTG group were not asphyxiated at birth. So, CTG can be continued as a good screening test of fetal surveillance, but it is not the sole criterion to influence the management of high-risk pregnancies. When CTG shows abnormal patterns, then antepartum CTG should be supplemented with amniotic fluid volume studies, oxytocin stress test, and biophysical profile, and intrapartum CTG should be augmented with fetal scalp blood sampling for scalp pH and acid-base status before intervention. The benefits of CTG in assuring fetal well-being in the future will depend on the standardization of interpretation, management, and determination of reliability, validity, and pragmatic efficacy of FHR monitoring. Computer analysis of FHR tracings can eliminate inter-observer variations from visual research and produce more consistent clinical responses to normal and abnormal FHR patterns.

Although new technologies such as purse oximetry and fetal electrocardiography analysis appear promising in their ability to improve the predictive value of fetal monitoring, standard electronic fetal

monitoring will likely remain in use for the foreseeable future. As the present study included a small sample size and easy neonatal outcomes were evaluated on a clinical basis, further randomized studies with larger sample sizes and early neonatal outcomes also a biological basis like umbilical cord blood gas analysis, fetal scalp pH may further confirm the result of the present study and will be more informative.

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