MATERNAL AND FETAL OUTCOME OF NORMAL AND ABNORMAL CARDIOTOCOGRAPHIC FINDINGS AT A TERTIARY HOSPITAL IN GHANA

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Abstract

Background: Cardiotocography (CTG) provides important information about the interaction between fetal cerebral and cardiac activities which are both modified by hypoxia. The duration and severity of hypoxia and associated biochemical abnormalities all influence the manifestations of fetal heart rate abnormalities. Antenatal fetal heart rate monitoring with CTG has potential in preventing intrauterine fetal death.
Aim: The aim of the study was to compare the maternal and fetal outcome of pregnancies with normal and abnormal antepartum CTG tracings.
***Methodology*:** This descriptive retrospective review compared 200 consecutive women with normal and 200 with abnormal CTG tracings**.** The study lasted six months and spanned a period of time from beginning of January to end of June 2011. Demographic, pregnancy and delivery outcome data were retrieved from participants' charts and simple descriptive analysis was performed. Means and their standard deviations of continuous variables were calculated and difference between group mean were compared using the student t-test. Categorical variables were summarized as proportions and the chi-square test used to test for difference between groups. A p-value < 0.05 was considered statistically significant.
Results: Women with normal and abnormal CTG tracings were comparable in their demographic characteristics. Abnormal CTG tracings were associated with higher rate of preterm delivery (38.8% vs 18.8%, p = 0.001), caesarean section (77.9% vs 47.0%, p = 0.001) low birth weight (25.5% vs 9.1%, p = 0.001) and NICU admissions (36.5% vs 17.6%, p = 0.001). There was no difference in Apgar score or stillbirth rate between the two groups. Pregnancies with abnormal tracing were delivered about a week earlier than those with normal tracing**.** (37.8±2.9 vrs 38.3±2.6, p=0.001). Longer interval between tracing and delivery was associated with stillbirth.
Conclusion: Abnormal antepartum CTG tracing was associated with higher preterm delivery, caesarean section, low birth weight and NICU admission. Longer interval between abnormal tracing and delivery was associated with higher stillbirth rate. Active and adequate resuscitation of babies with abnormal tracing can reduce perinatal morbidity.

Key Words: Childhood, malignant, tumours, orofacial, Ghana

INTRODUCTION

Cardiotocography (CTG) is a commonly used test for antepartum and intrapartum fetal health monitoring in high income countries. This test provides information about the fetal cerebral and cardiac activities, which are modified by hypoxia. Antenatal fetal assessment with the Non Stress Test (NST) was introduced into the United States in the 1970s[1]. The normal baseline fetal heart rate tracing results from complex sets of interactions that are regulated by intrinsically controlled mechanisms.

To produce a normal fetal heart rate (FHR) pattern, the fetal heart must possess intact electrical conduction pathways, myocardial neuro-hormone receptors, sympathetic and parasympathetic reflex arcs, and inherent contractility[2].

NST reactivity occurs through an autonomic neural linkage between peripheral fetal heart activity and midbrain cardio-regulatory centers, which strengthens as the fetus matures. Fetal heart rate patterns that first signal cellular hypoxia and acidosis depend on the duration and severity of these biochemical abnormalities[3].

However, these patterns may not be uniformly expressed by all compromised fetuses. FHR patterns associated with pre-terminal fetal asphyxia may exhibit relatively fixed FHR baselines, loss of FHR variation, disappearance of accelerations, or the appearance of spontaneous late FHR decelerations[4].

At term, nearly 90% of fetal movements elicit reactive accelerations[5]. Current test criteria typically consider an NST to be reactive if there are two accelerations exceeding 15 beats per minute amplitude and 15 seconds duration in a 20-minute window for term pregnancies and 10 beats per minute amplitude and 10 seconds duration for gestational ages below 32 weeks[6].

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Generally, performing an NST is not helpful if gestational age or estimated fetal weight is below the institutional threshold for survival. Non-reactivity may be associated with three differing scenarios which fail to meet reactivity criteria. This includes progression from the presence of accelerations of inadequate amplitude or frequency through the absence of accelerations in the presence of fetal movements to the complete absence of accelerations and fetal movements. This uncoupling phenomenon has been well characterized by several groups[7,8]. Non-reactivity may be associated with prolonged fetal sleep states, immaturity, maternal ingestion of sedatives, and fetal cardiac or neurologic anomalies[9].

Cumulative studies of NST performance suggest a false-negative rate of 0.3% within 1 week of a reactive NST and a false-positive rate of 50%[4]. False positive results may lead to unnecessary surgical interventions. False-positive test results in iatrogenic prematurity. This risk must be weighed against the risk of delaying delivery of a potentially compromised infant.

The interval between tests should be driven by the specific high-risk conditions of concern and the level of concern for fetal well being. Current data suggest that intervals between tests should be no greater than 7 days[10] given that the predictive power of the NST declines as the test interval lengthens. Recently, it has been shown that most NST parameters are reliable within 48 hours[9,11].

Fetal heart rate abnormalities, however, are infrequently associated with long-term adverse outcomes. Fetal heart rate patterns are classified as category I, category II and category III based on whether they are seen to be normal, indeterminate or abnormal respectively[12]. Category II patterns including fetal tachycardia, bradycardia and late decelerations but with good short term variability and requires further evaluation to exclude fetal acidosis. Category III patterns require emergency intrauterine fetal resuscitation and immediate delivery. Differentiating between these categories of fetal heart rate pattern is necessary for triage and management decisions.

Although electronic fetal monitoring (EFM) is currently used in more than 80% of births in the United States, there is controversy regarding its efficacy[13,14]. Various studies have evaluated the relationship between electronic FHR monitoring and neonatal outcome[15]. These studies noted a decrease in the incidence of seizures in fetuses assessed with EFM compared with fetuses monitored with auscultation[16]. However, EFM was not shown to be more effective than intermittent auscultation in lowering perinatal mortality rates[16,17]. Furthermore, these studies identified an increase in operative vaginal deliveries and caesarean sections in patients monitored with EFM during the intrapartum period[17].

While cardiotocography has been suggested as a theoretically effective intervention in low-resource healthcare settings[18], its efficacy and feasibility has not been assessed in these settings. Cardiotocography has recently been incorporated into management of high risk pregnancies in the department, however, there has not been any evaluation of this tool and its impact on maternal and fetal outcome. This baseline study will provide preliminary data based upon which future studies can be designed.

Methodology

This is a descriptive retrospective cohort study of four hundred (400) women who had non-stress test (NST) as part of their antenatal surveillance.

The study was performed at the maternity unit of the Korle-bu Teaching hospital, Accra, Ghana. The unit is the biggest tertiary obstetric referral center in Ghana where more than 80% of the patients are high risk clients referred from other health institutions. The center delivers about 10,000 women annually. In spite of its high risk obstetric population antenatal and intrapartum fetal monitoring did not include CTG until the late 2010.

The CTG tracing of women who were referred to the perinatal assessment center (PAC) for antenatal NST between January and June 2011 were retrieved. We included two hundred consecutive women with normal (category 1) and two hundred with abnormal (category II and III) last NST report before delivery for this review. We excluded pregnancies with gestation less than 28 weeks, multiple gestations and known gestations with congenital fetal anomalies.

Interpretation of CTG was done by two dedicated consultants independently based on the National Institute for Health and Clinical Excellence (NICE) guidelines 2001[19]. In few cases where their reports differ, they met and resolved the difference by consensus.

The findings included baseline fetal heart rate, short and long term variability, acceleration, early, variable, prolonged or late deceleration and contractions.

Advice was given to referring doctors as to the need to review the clinical picture, do further testing or deliver. In the event of an abnormal NST report, the test was either repeated within 24 to 48 hours, Biophysical profile or Umbilical Doppler velocimetry was recommended and for category III results immediate delivery was advised. Arrangement was made for active resuscitation by the neonatologist for babies with such reports. For this study, category II and III tracings were both classified as abnormal or non-reactive and category I as normal or reactive. The study utilized stored data of NST tracings from the perinatal assessment center database and delivery outcome information from participants' charts. All patient information was anonymized and completely de-identified prior to analysis.

Pregnancy and neonatal data were obtained from the patients' folders and the findings were correlated with the FHR tracing reports. Maternal demographic and pregnancy characteristics, indications for requesting for NST, gestational age at delivery, mode of delivery,

as well as delivery outcome information were collated. Statistical analysis was carried out using SPSS version 17 (SPSS Inc, Chicago,IL). Means and their standard deviation were calculated for continuous variables and proportions were also estimated for discreet variables. The differences between outcomes for patients with normal and abnormal NST results were compared using the t- test for continuous variables and chi-square test for non continuous variables. The differences were considered significant at p value < 0.05.

Ethical consideration

Ethical approval was granted by Ethics Committee of the University of Ghana Medical School and permission to carry out the study was granted by the Head of the Department of Obstetrics and Gynecology, Korle-Bu Teaching Hospital. We used stored NST data and supplemented with delivery information from patients' charts. All patient information was completely de-identified before analysis.

Results

The age of study participants ranged from 18-45 years with mean age of 30.4 ±5.7 years. More than half (52.9%) of the women had more than basic education, defined as nine years of formal education. Parity of the mothers ranged from 0 - 6 with a mean parity of 1.2 ± 1.7. The average weight of the women at booking was 72.3 ± 16.2kg. The mean gestational age at booking was 17.6 ± 7.1weeks, whilst the mean weight before delivery was 78.93±6.5kg.

All baseline characteristics including age, parity, gestational age at booking, maternal weight and height as well as last weight before delivery were similar for both groups. 'Table 1'. There was a significant difference in gestational age at delivery when reactive and non reactive groups were compared

The commonest indication for initiating a non-stress test was postdate followed by pre-eclampsia and gestational hypertension. Postdate as an indication is more likely to show significant reactivity on NST than Non reactivity when compared to other indications such as sickle cell disease, premature rupture of membranes, diabetes and pre-eclampsia. 'Table 2'.

Table 1. Demographic and baseline characteristics of women with antenatal non-stress test (NST)

Variable	Total Mean±SD	Non-reactive NST mean±SD)	Reactive NST mean±SD	p-value
Age /yrs (n=400)	30.4±5.7	30.7±5.8	30.0±5.5	0.179
Parity (n=395)	1.2±1.7	1.2±1.4	1.1±1.9	0.935
Weight at booking/kg (n=316)	72.3±16.2	71.1±15.6	73.3±16.7	0.224
Height of women/m (n=197)	1.58±0.13	1.59±0.08	1.57±0.18	0.218
Gestational age at booking/weeks (n=315)	17.6±7.1	18.1±7.2	17.1±6.9	0.223
Education status (n = 395) (%)				
Basic	186(47.1)	84(42.9)	102(51.3)	0.095
Post basic	209(52.9)	112(57.1)	97(48.7)	
GA at delivery (wks n = 393)	38.3 ± 2.6	37.8 ± 2.9	38.9 ± 2.1	0.001
Last weight before delivery (kg) n=313)	78.9± 16.5	78.0 ± 16.3	80.1 ±16.6	0.223

GA = Gestational Age

Table 2: Reasons for requesting non-stress test (NST)

Indication	Non Stress Test result		P-value
	Non – Reactive n (%)	Reactive n (%)	
Postdate	51 (43.2)	67 (56.8)	**0.016**
Pre-eclampsia	37 (57.8)	27 (42.2)	0.404
Gestational hypertension	30 (50.8)	29 (49.2)	0.907
Sickle cell disease	12 (60.0)	8 (40.0)	0.636
IUGR	10 (52.6)	9 (47.4)	0.981
PROM	13 (72.2)	5 (27.8)	0.094
Diabetes	12 (70.6)	5 (29.4)	0.140

IUGR? PROM?

Table 3: Pregnancy outcome among women with normal and abnormal antenatal non-stress test (NST) tracing

Obstetric parameter	Total n (%)	Non-reactive n (%)	Reactive n (%)	p-value
Mode of delivery				
Vaginal	150(37.6)	44(22.1)	106(53.0)	0.001
Cesarean	249(62.4)	155(77.9)	94(57.0)	
Gestational age at delivery				
Preterm (<37wks)	113(28.8)	76(38.8)	37(18.8)	0.001
Term	280(71.2)	120(61.2)	160(81.2)	
Tracing to delivery interval/days	-	1.91±1.65	2.85±1.89	0.001
Birth weight /g				
Low birth weight (<2500)	69(17.4)	51(25.5)	18(9.1)	0.001
Normal birth weight	328(82.6)	149(74.5)	179(90.9)	
NICU admissions	108(27.1)	73(36.5)	35(17.6)	0.001
Apgar scores at 1 minute				
Abnormal (<7)	100(25.3)	58(29.1)	42(21.3)	0.073
Normal (≥7)	296(74.7)	141(70.9)	155(78.7)	
Apgar score at 5 minutes				
Abnormal (<7)	34(8.6)	19(9.5)	150.56(7.6)	0.492
Normal (≥7)	362(91.4)	180(90.5)	182(92.4)	
Stillbirth	29(7.2)	16(8.0)	13(6.5)	0.563
Birth weight/g (n=397)	3066±686	2938±721	3196±624	0.001
Length of baby/cm (n=376)	48.4±4.6	47.6±5.3	49.1±3.5	0.001
Head circumference /cm (n=376)	33.5±2.8	33.0±3.4	33.9±2.1	0.003
Chest circumference/cm (n=376)	32.1±3.3	31.6±3.8	32.7±2.7	0.002
Placenta weight /g (n=363)	678.7±15 3.1	670.5±149. 0	687.2±157. 3	0.301

Table 4: Relationship between tracing to delivery interval and fetal outcome

Fetal outcome	Numbers N	Interval from tracing to delivery/days Mean±SD	p-value
Live birth	290	2.30±1.75	0.027
Stillbirth	8	2.75±1.80	
Early neonatal death	1	7.0	
Total	299	2.33±1.81	

There was a significant difference in the gestational age at delivery for both reactive and non-reactive groups. P=0.001. Women with abnormal NSTs were delivered about one week earlier than those with normal tracing. There was also a higher proportion of preterm delivery, defined as delivery before 37 weeks, among women with abnormal tracing (38.8% vs 18.8% p< 0.001). The average interval between normal tracing and delivery was 2.85 days which was significantly longer than the 1.91 days when NST tracing was abnormal. Caesarean delivery rate was much higher in women with abnormal tracing (77.9% vs 47.0%, p<0.001). There was a higher incidence of low birth weight (defined as birth weight < 2500g) when NST was abnormal (25.5% vs 9.1%, p<0.001) compared to those with normal NST report. 'Table 3'. While NICU admission rate was higher in the babies with abnormal tracing (36.5% vs 17.6%, p = 0.001), there was no difference in the Apgar scores at 1 and 5 minutes in group with abnormal or normal NST report. Babies with abnormal tracing generally had smaller features than those with normal tracing. There was no difference in the stillbirth rate between the two groups. On the whole, live births had a shorter interval between their last NST tracing and delivery compared with babies that were still born 'Table 4'.

Discussion

This review showed that women who had normal or abnormal antenatal non-stress test were similar in their demographic characteristics. Pregnancies complicated by pre-eclampsia, sickle cell disease, diabetes mellitus, PROM and IUGR were associated with higher incidence of abnormal NST reports. Abnormal NST tracing was also associated with delivery at a lower gestational age,

shorter tracing to delivery interval, higher caesarean section and preterm delivery rates. Abnormal NST report was associated with higher incidence of low birth weight and NICU admission.

In a study done in Bangladesh, out of 100 abnormal CTG, there was significantly higher caesarean delivery, lower Apgar score, higher requirement for neonatal resuscitation and admission at neonatal unit and higher perinatal death among the abnormal CTG group (20.) Similarly, another study from Nigeria reported higher incidence of caesarean delivery, high perinatal mortality and small for gestation among pregnancies with abnormal NSTs (21). This study also shows a higher caesarean delivery and NICU admission rate among babies with abnormal CTG tracing. There was, however, no difference in Apgar scores and stillbirth rate. This study also showed a significantly shorter waiting time between abnormal tracing and delivery. Overall, pregnancies with abnormal tracing were delivered about a week earlier than those with normal tracing due to the heightened concerns by both mothers and caregivers. This resort to earlier delivery may account for the higher incidence of prematurity and low birth weight among the abnormal NST group.

In a prospective randomized study of delivery outcome with 569 CTG tracings among 300 patients, non-reactive tracing was associated with higher incidence of stillbirths and neonatal deaths (22). Even though this study did not report on neonatal death, stillbirth rate did not differ between the two groups. This is probably due the prompt delivery of babies with abnormal tracing. While these babies were not stillborn, a higher proportion of them were admitted to the NICU. It may, therefore, be useful to follow up these babies at the NICU and even beyond the neonatal period in order to assess the impact of these abnormal tracing well after delivery.

The high incidence of prematurity and preterm delivery in the non-reactive group may be a reflection of their immature cardio-respiratory center of the brain and not necessarily a sign of compromise. Mature midbrain cardio-respiratory center, sympathetic and parasympathetic reflex arcs are required for appropriate fetal cardio-respiratory response to fetal movements. At term, nearly 90% of fetal movements elicit reactive acceleration (5).

Even though there was no statistically significant difference in the Apgar scores between the two groups at 1 and 5 minutes, 29.1% of the babies who had abnormal Apgar score at 1 minute had abnormal tracing while 21.3% had normal tracing. A low Apgar score at 5 minutes was recorded for 9.5% of babies in the abnormal tracing group and 7.6% in the normal tracing groups. The fewer number of babies with low Apgar score at 5 minutes is a reflection of active neonatal resuscitation done because adequate preparation was made for the fetuses that were perceived to be compromised intrapartum.

In a study to assess the effect of prompt intervention after a non-reactive test, a ten-point scoring system was used to assess 2770 antepartum cardiotocograms obtained in 405 high risk pregnancies (23). A score of 8 to 10 reliably predicted good condition at birth in 95 percent of pregnancies which ended within 24 hours and in 88 per cent of those which ended after three or four days. Poor fetal condition with little chances of a normal outcome was recorded for delays longer than that unless the cause could be effectively treated. Similarly in this study longer delay between NST and delivery was associated with poor fetal outcome, especially stillbirth.

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Limitations of the study

This study only compared the fetal outcome of pregnancies with normal and abnormal tracings. There is limited information on the newborns beyond the delivery period. Further follow-up of these newborns even well beyond the neonatal period will be helpful in detecting the actual impact of an abnormal tracing on the life of the baby. Even though this study also lumped category II and III NST results together which theoretically can cause overestimation of the adverse outcome in the abnormal group, the numbers of patients with category III tracing were so small that they could not vary the overall effect. There is limited information on maternal outcome or the actual indications for delivery, especially for babies that were delivered prematurely. Maternal health could be a major deciding factor in terminating a pregnancy prematurely which could also affect the perinatal outcome of the baby and not merely due to findings from a NST tracing.

Conclusion and recommendations

This study showed that pregnancies with abnormal CTG are associated with higher incidence of preterm delivery, caesarean section, low birth weight and NICU admissions. Generally, these pregnancies are terminated about a week earlier than those with normal tracing. Though stillbirth rate did not differ between the two groups, longer duration between tracing and delivery was associated with higher still birth rate. Prompt response to abnormal CTG tracing is therefore necessary. This response should be in the form of further investigations such as biophysical profile and umbilical artery Doppler studies to ascertain the underlying cause of the abnormal tracing. This could reduce the incidence of intervention and reduce caesarean delivery and prematurity. Where urgent delivery is indicated, adequate preparation for active resuscitation will be necessary to improve perinatal outcome. Further investigations should prospectively look at how various management or interventions can improve the outcome of abnormal tracing and how maternal conditions impact these results.

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