Original Research Article

The effectiveness of intrapartum cardiotocography with fetal outcome-a hospital-based study

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ABSTRACT

Background: The determination of the fetal condition during labour is important to minimize fetal mortality, morbidity and neurological sequelae of fetal hypoxia. The study aims to evaluate the effectiveness of intrapartum cardiotocography (CTG) in detecting fetal outcomes.
Methods: This cross-sectional observational study was conducted at the department of obstetrics and gynecology in the centre for women and child health (CWCH), Ashulia, Dhaka from November 2020 to August 2022. The study was carried out with a total of 63 pregnant women (n=63) who had delivered their child either by lower uterine caesarian section (LUCS) or normal vaginal delivery (NVD) during the study period.
Result: Among the participants, almost half participants (47.6%) were aged between 25-29 years. Intrapartum CTG was reactive in around half (54%) of the participants, while non-reactive in 46% of the participants. During the study period, intrapartum CTG was reactive in 34 patients. Of them, only 19 patients had an NVD, while 15 patients despite normal intrapartum CTG also underwent LUCS due to various reasons such as having meconium-stained liquor or slightly stained liquor, non-progressing labour or prolonged labour, premature rupture of the membrane (PROM), fear of NVD etc. During the study period, all twenty-nine patients having intrapartum non-reactive CTG underwent LUCS. During the study period, intrapartum CTG was non-reactive in 29 cases. However, after delivery, the baby's APGAR score was ≥7 for the 20 neonates of those 29 non-reactive CTG cases. On the other hand, intrapartum CTG was reactive in 34 of the participants. Among them, 3 neonates were delivered through NVD. However, meconium-stained liquor was found and the baby's APGAR score was <7, which required NICU admission. In total, thirteen neonates (13, 20.6%) had required admission to the neonatal intensive care unit (NICU).
Conclusions: CTG is one of the reliable methods of monitoring the fetus. Non-reactive CTG record with a high probability indicates the likelihood of the presence of perinatal asphyxia. Instant and adequate decisions regarding obstetric intervention and optimal procedures should be taken if fetal distress is suspected.

Keywords: Intrapartum CTG, Fetal outcome, CTG interpretation, Perinatal asphyxia, Fetal distress

INTRODUCTION

Cardiography (CTG) is a constant recording of the fetal rate attained via an ultrasound transducer located on the mother's abdomen. CTG is extensively used as a process of assessing fetal well-being, primarily in pregnancy with an increased risk of complications.[1] In 1970, CTG monitoring was developed and introduced in late1950 and early 1960 and was invented by Edward Hon, Roberto Caldeyro-Barcia and Konrad Hammacher.[2] CTG measures a baby's heart rate and it also screens the contractions in

the womb (antenatally) at the same time, and monitors the baby for any signs of distress during labour.[3] Perinatal asphyxia is a deficiency of blood flow or gas interchange to or from the fetus before during or just after the birth process.[4] Perinatal asphyxia accounts for an estimated 900,000 deaths each year and is one of the primary causes of early neonatal mortality universally.[5] The first minute after a baby is born-the "Golden minute™"-is the critical frame for the commencement of neonatal revival among the 10 million nonbreathing babies born annually.[6] Perinatal birth asphyxia is a significant cause of acquired brain injury occurring in the neonatal period. A consistent prompt marker for prophesying injury severity and consequence remains elusive.[7] CTG can be done from the 28th week of pregnancy. However, most doctors advised to do it after the 32nd week. It is specially applied to monitor the high risk of pregnancies due to diabetes, high blood pressure, and women who underwent several infertility tests.[8] Intrapartum fetal observation not only provides the idea about the fetal condition but also recognizes fetuses at risk of hypoxic damage so that perinatal outcomes can be enhanced by proper and timely interference.[9] Admission test by CTG is used to indicate both the state of oxygenation of the fetus on the admission of the mother non-invasively and to check the fetal reserve by recording fetal heart rate (FHR) during the phase of the temporary blocking of the uteroplacental blood source under the physiological strain of constant uterine contraction. This short recording of FHR on admission helps to regulate the capability of the fetus to tolerate the stress of labour.[10] APGAR is a rapid test implemented on a baby at 1, 5, and 10 minutes after birth. This test checks a baby's heart rate, muscle tone, and other signs to see if extra emergency care is needed. The 1-minute score determines how well the baby tolerated the birthing process and the 5-minute score tells the health care provider how well the baby is doing outside the mother's womb.[11] Dr Virginia Apgar, an anesthesiologist at Columbia university developed the APGAR score in 1952.[12] The APGAR score defines the state of the newborn infant instantly after birth and when properly applied, is a tool for standardized assessment.[13] A score of 7 to 10 after five minutes is 'reassuring' and a score of 0 to 3 is concerning. It indicates a need for increased intervention, usually in assistance for breathing.[14] However, several reasons for low APGAR scores exist, such as perinatal asphyxia, congenital infections, maternal fever in labour, a diagnosis of chorioamnionitis, malformations and preterm birth.[15] The objective aims to investigate the effectiveness of intrapartum CTG with fetal outcomes.

METHODS

This cross-sectional observational study was conducted at the department of obstetrics and gynecology in the CWCH, Ashulia, Dhaka from November 2020 to August 2022. The study was carried out with a total of 63 pregnant women (n=63) who had delivered their child either by LUCS or NVD during the study period NVD. A convenient sample selection method was done for the

selection of the participants. The participants were informed regarding the purpose of the study and all possible risks and written consent was obtained. Ethical approval was also obtained from the ethical review committee of the study hospital. All patients were in labour and they were admitted to hospital for delivery purposes. All pregnant mothers underwent general examination, abdominal examination, and bedside intrapartum CTG. Patients' progress of labour were checked at regular interval. Effacement of the internal OS, dilatation of external OS and the placental membrane was checked by vaginal examination with caution periodically. All necessary history and data collected through questionnaire that was prepared previously, and medical information was also collected and analyzed. After data collection was done, available data analyzed through SPSS software.

Intrapartum CTG

CTG is a continuous recording of the FHR obtained via an ultrasound transducer placed on the mother's abdomen. CTG is widely used in pregnancy as a method of assessing fetal well-being, predominantly in pregnancies with increased risk of complications.[16]

Inclusion criteria

Patients who were in labour and had given consent to participate in the study were included.

Exclusion criteria

Patients with a history of previous LUCS, patients who willingly choose the option of LUCS for childbirth were excluded from the study.

RESULTS

Among the participants, almost half the participants (47.6%) were aged between 25-29 years. Following that, only 7 (11.1%) patients had been admitted whose ages were less than 20. And 9 (14.3%) mothers had received hospital admission, whose ages were more than 30. The 9.5% of the study population were postdated pregnancy cases, and all the participants were admitted due to labour pain. The mean hospital stay duration of the participants was 3.2±SD days. 4(6.35%) patients had hypertension, 2 (3.2%) had asthma and 3 (4.8%) had GDM. Family history of diabetes and hypertension was found in 4 (6.35%) and 2 (3.17%) patients respectively (Table 1). Intrapartum CTG was reactive in around half (54%) of the participants, while non-reactive in 46% of participants (Figure 1). Based on general examination findings at admission, 15.87% of patients had anaemia, and around 1/3rd of patients (33.33%) had oedema.[10] And abnormal temperature was found in 3(4.76%) patients. At admission, the mean pulse rate, systolic, and diastolic blood pressure 79.14±3.8 SD, 113±2.7SD, and 74±1.3 SD respectively (Table 2). Most of baby (96.83%) was in cephalic presentation. (Table 3). During study period, intrapartum

CTG was reactive in 34 patients. Of them, only 19 patients had an NVD, while 15 patients despite normal intrapartum CTG also underwent lower uterine cesarean section (LUCS) due to various reasons such as having meconium-stained liquor or slightly stained liquor, non-progressing labour or prolonged labour, PROM, fear of NVD etc. During the study period, all twenty-nine patients having intrapartum non-reactive CTG underwent LUCS (Table 4). The majority of the patients (65.08%) had adequate liquor amount and 17.46% of patients had an average amount of liquor.[11] Most of patients (52, 82.53%) liquor was clear, while meconium-stained and slightly meconium-stained liquor was found in 3 (4.76%) and 6 (9.52%) cases respectively. Majority of patients (96.83%) had average blood loss, while the remaining 3.17% had higher than average blood loss (Table 5). Almost half of neonates (50.79%) found a cord around their necks after birth. APGAR score was 7/ less for 12.70% of neonates, 8 in 50.79% and 9 in 36.51% of the neonates. At 5 minutes after birth, the APGAR score was <7 for 2 of the neonates, 8 for 3.17% of neonates, 9 for 53.97% of the neonates and 10 for the remaining 38.10%. 20.63% of the neonates had required admission to the neonatal intensive care unit (NICU) (Table 6). During the study period, intrapartum CTG non-reactive in 29 cases. However, after delivery, the baby's APGAR score was ≥7 for 20 neonates of those 29 non-reactive CTG cases. Thus, the neonates were healthy and neonatal intensive care unit (NICU) admission was not required. On the other hand, intrapartum CTG was reactive in 34 of the participants. Among them, 3 neonates delivered through NVD. However, meconium-stained liquor was found and the baby's APGAR score was <7, which required NICU admission (Table 7).

Table 1: Characteristics of study population, (n=63).

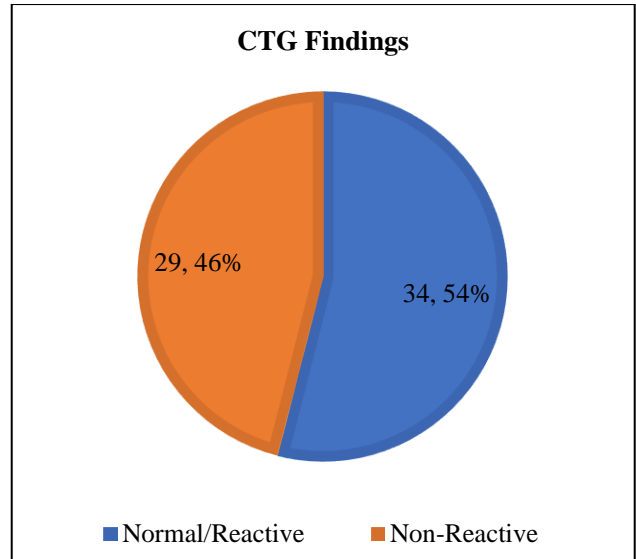| Findings	N	Percentage (%)
Age (Years)		
<20	7	11.11
20-24	17	26.98
25-29	30	47.62
≥30	9	14.29
Pregnancy duration		
36-40 weeks	57	90.48
>40	6	9.52
Comorbidities		
Anaemia	1	1.59
Hypertension	4	6.35
Asthma	2	3.17
GDM	3	4.76
Family history of comorbidities		
History of diabetes	4	6.35
History of hypertension	2	3.17
Mean duration of labor pain (Hours)		
Mean ± SD	6±2.19	
Mean age of the last child (Years)		
Mean ± SD	6.02±4.09	
Mean duration of the marriage (Years)		
Mean ± SD	5.73±4.36	

Figure 1: Distribution of the participants by CTG findings, (n=63).

Table 2: General examination findings of the participants at admission, (n=63).

Findings	N	Percentage (%)
Mild anemia	10	15.87
Oedema	21	33.33
Abnormal temp	3	4.76
Pulse at admission		
Mean	79.14±3.8 SD	
Systolic blood pressure (mmHg)		
Mean	113±2.7 SD	
Minimum	90	
Maximum	130	
Range	90-130	
Diastolic blood pressure (mmHg)		
Mean	74±1.3 SD	
Minimum	60	
Maximum	90	

Table 3: Distribution of the participants per abdominal examination findings on admission, (n=63).

Findings	N	Percentage (%)
Presentations		
Cephalic	61	96.83
Breech	2	3.17
Engagement		
Engaged	40	63.49
Not engaged	23	36.51

Table 4: Distribution of the admitted participants by mode of delivery, (n=63).

Delivery method	N	Percentage (%)
NVD	19	30.16
LUCS	44	69.84

Table 5: Distribution of the participants by per operative findings, (n=63).

Findings	N	Percentage (%)
Liquor amount		
Less than average	7	11.11
Adequate	41	65.08
Average	11	17.46
Scanty	3	4.76
Almost nil	1	1.59
Liquor color		
Clear	52	82.53
Meconium	3	4.76
Slight stained	6	9.52
Blood loss		
Average	61	96.83
Higher than average	2	3.17

Table 6: Distribution of neonates based on physical examination immediately after birth, (n=63).

Findings	N	Percentage (%)
Cord around neck		
Absent	31	49.21
Present	32	50.79
Apgar score at 1 min		
<6	1	1.59
6	5	7.94
7	2	3.17
8	32	50.79
9	23	36.51
Apgar score at 5 min		
<6	1	1.59
6	1	1.59
7	0	0
8	2	3.17
9	34	53.97
10	24	38.10
NICU admission		
Required	13	20.63
Not Required	60	95.24

Table 7: Comparison of intrapartum CTG interpretation and babys' Apgar score at 1 minute, (n=63).

Intrapartum CTG interpretation	APGAR score at 1 min	N	Percentage (%)
Non-reactive (False positive)	≥7	20	31.75
Non-reactive (True positive)	<7	9	14.3
Reactive (True negative)	≥7	31	49.2
Reactive (False negative)	<7	3	4.8

DISCUSSION

Cardiotocography, or CTG, uses an ultrasound transducer that is positioned on the mother's abdomen to continuously measure the FHR. It is frequently used throughout pregnancy to evaluate the health of the fetus, especially in pregnancies with a higher risk of problems. To carry out interventions before the fetus is injured, CTG recordings are used to detect when there is worry about fetal well-being. Proper interpretation of CTG findings can help greatly decrease the health-related risk of newborns.

It was observed that almost half of the participants were aged between 25-29 years. This was similar to the findings of another study where the mean age of the participants was 26.6 years.[17] The 90.5% of the present study population were admitted during their 36-40 weeks of pregnancy, and the mean hospital stay duration of the participants was 3.19 days. This was a normal duration of hospital stays considering a successful surgery. It is generally accepted that a longer duration of hospital stay after any surgery is a sign of a bad outcome.[18] The 6.35% of the study population had hypertension. Considering the family history of comorbidities among participants, 6.4% had a family history of diabetes, and 3.2% had a family history of hypertension.

The mean duration of labour pain of the mothers was 6±2.19 hours. Active labour pain often lasts 4 to 8 hours. Failure to progress in labour results in intracranial haemorrhage, postpartum haemorrhage, fetal distress, perinatal hypoxia and intracranial haemorrhage of fetuses. Prolonged labour is also known as failure to progress in labour.[17]

Usually, labour lasts for approximately 20 hours or more in mothers and at least 16 hours in mothers who have previously given birth is called prolonged labour. Failure to progress in labour might have resulted from fetal malpresentation, progenies of uterine contractions, cervical dystocia/ stenosis and cepalopelvic disproportion.[19]

On general examination findings showed that 33.3% had oedema, 15.9% had mild anaemia, and another 4.76% had an abnormal temperature. Oedema is quite common during pregnancy. A study found almost 80% of the study population had oedema during pregnancy.[20]

In the present study, 3 (4.8%) patients had meconium-stained liquor. Intrauterine distress could cause the passage of meconium into the amniotic fluid. Placental insufficiency, gestational hypertension, preeclampsia, oligohydramnios, acidosis, and maternal drug abuse, especially the use of tobacco and cocaine. Perhaps, the passage of meconium might simply represent the normal gastrointestinal maturation of the baby.[21] or it might indicate an acute or chronic hypoxic event, thereby it would be a warning sign of fetal compromise and thus needed immediate intervention.[22,23]

At 1 minute after birth, the APGAR score was <7 in 6 neonates, and the remaining infants had a healthy APGAR score. Furthermore, at 5 minutes after birth, only 2 infants had an APGAR score of <7, while the remaining 61 newborns had an APGAR score of 7 or higher. 20.63% of the neonates had required admission to the neonatal intensive care unit (NICU). During the study period, intrapartum CTG was non-reactive in 29 cases.

After delivery, the baby's APGAR score was ≥7 for 20 of those 29 non-reactive cases, and the neonates were healthy, with no resuscitation required. On the other hand, intrapartum CTG was reactive in 34 of the participants. Among them, 3 neonates were delivered through NVD. However, meconium-stained liquor was found and the baby's APGAR score was <7, requiring NICU admission. Mothers who had no antenatal visits would not gain an opportunity for certain risk factors like maternal medical conditions, placental abruptions, preterm birth, prolonged labour, umbilical cord problems, etc., during pregnancy for the low APGAR score. Antenatal care efficiently could help to mitigate the problem of low APGAR scores.[24,25] Yeshaneh et al found that anaemia and low birth weight baby were the risk factors for the low APGAR score in their study.[26]

In the present study, there were 20 (31.8%) delivered undepressed child (false positive) and normal CTG record and delivered depressed child was found in 3 cases (4.8%) that were a false-negative record. Though, CTG is one of the reliable methods of observation of fetal status in pregnancy and childbirth. Pathological CTG record with a high probability indicates the possibility of the existence of perinatal asphyxia. Inopportunely CTG has a large number of positive findings. Several studies also found discrepancies such as false-negative records that are sick children with normal CTG interpretation and healthy babies with false-positive CTG records.[27-30]

CTG is a simple noninvasive test that can serve as a screening tool to detect fetal distress already present or likely to develop and could prevent unnecessary delay in intervention. Thus, it helps in preventing fetal morbidity and mortality. In the present study, the specificity of intrapartum CTG was found 61%. Due to its high specificity, it would have a role in the obstetric wards of developing countries like Bangladesh with the heavy workload and limited resources to help in triaging fetuses. Moreover, CTG is an important method of monitoring of fetus in pregnancy and labour. The present study also indicates pathological CTG records with a sensitivity of 75% indicate an ability to determine perinatal asphyxia.

CONCLUSION

CTG is one of the reliable methods of monitoring the fetus. Non-reactive CTG record with a high probability indicates the likelihood of the presence of perinatal asphyxia. Perhaps, CTG has also a large number of false-positive and false-negative findings as well. In the present study, 31.8%

of intrapartum CTG findings were falsely positive and 476% were false negative. Thus, fetal distress could be confirmed by ultrasound Doppler examination. PH monitoring is also advantageous in suspicious cases. Instant and adequate decisions regarding obstetric intervention and optimal procedures should be taken if fetal distress is suspected.

Recommendation

Further studies are required to minimize false positives and false negatives interpretation of CTG. Future studies should emphasize an alternate method of confirming intrapartum CTG findings to identify women whose babies are apparently at risk and reduce unnecessary LUCS as well in the vision of dwindling long-term morbidity for both mother and children.

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