The Role of Cardiotocography in Monitoring Fetal Condition During Labour in High Risk Pregnancy and Its Correlation with Perinatal Outcome

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Abstract

Background: Cardiotocography (CTG) is considered to be a non-invasive prenatal screening technique. It is used to monitor fetal condition during labor.

Objectives: this study aimed to evaluate the role of Cardiotocography as a screening tool during labor in high risk pregnancy for determining perinatal outcomes.

Methods: In this cross-sectional study, Cardiotocography was performed randomly on 200 pregnant women with risk factors (postdate, oligohydronomia, Pregnancy-induced hypertension, diabetes mellitus, anemia, intrauterine growth retardation, Antepartum hemorrhage, and pre-labor rupture of membrane who attended the labor ward of Duhok Teaching Hospital of Obstetrics and Gynecology from 20 October 2019 to 15 February 2020 and the results of CTG were categorized a reactive and non-reactive cardiotocography tracing groups and the perinatal outcomes were correlated with cardiotocography results.

Results: In this study, the mean age of patients was 27.41±6.09 years; ranged 18-42 years**.** There was no significant difference in the mean age of the patients (27.48±6.17 vs. 27.33±6.05 years), gravida (2.49±1.73 vs. 2.10±1.53) and gestational age (39.85±1.40 vs. 39.84±1.41weeks) between patients with reactive and non-reactive cardiotocography tracing, respectively. Patients with reactive cardiotocography were significantly more likely to have live babies (1.52±1.77 vs. 0.54±0.67) and no dead babies was recorded between reactive and non-reactive cardiotocography groups. The rate of caesarean section was significantly higher in patients with non-reactive cardiotocography (64.4% vs. 38.4%) and for bloody liquor (7.9% vs. 2.0%*).* It was also observed that low Apgar score 0-4 in first minute (12.9% vs. 4.0%) and 5-7 Apgar score in five minutes (34.7% vs. 9.1%) and admission to neonatal intensive care unit were significantly higher in patients with non-reactive than in those with reactive cardiotocography (59.4% vs. 26.3%), respectively.

Conclusions: This study showed that cardiotocography is a useful technique to determine perinatal outcomes in high-risk pregnancies.

Keywords: High-risk pregnancy; Cardiotocography; Complications.

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Introduction

Pregnancy and labor are considered to be a normal physiological process, but may be accompanied by some pathological changes. Although, most pregnancies progress normally, some are prone to complications for mother and/or baby in the antepartum and intrapartum periods[1,2].

Some of these complications may lead to adverse outcome in the early and late neonatal period. The detection of some risk factors has an important role in the improvement of maternal and neonatal outcomes[2]. Fetal monitoring during antenatal and intrapartum period has an important role in monitoring high risk pregnancy. There are many techniques available such as intermittent auscultation, continuous electronic fetal heart rate (FHR) monitoring, and invasive techniques which are used for fetal monitoring such as fetal blood sampling[3]. Cardiotocography is considered to be a non-invasive screening technique to monitor fetal condition both before and during labor. The role of cardiotocography is to record fetal heart rate (FHR) in relation to maternal uterine contractions for about 20-30 minutes. It is the most common form of fetal assessment during labor[4,5]. The advantages of cardiotocography (CTG) as a screening tool during labor are ease of administration, lack of contraindication, less expense, and easy interpretability. The CTG is a popular technique to assess intrapartum risk. The changes observed on the CTG trace could reflect a fetal response to the continuous hypoxic or mechanical stresses that happened during labor, for instance, umbilical cord compression or placental blood flow reduction. Hence, ongoing fetal monitoring is necessary for any fetus who is a candidate for 'high risk' of sustaining an intrapartum hypoxic injury. The accidents associated with labor, such as placental abruption, cord prolapse, and uterine rupture must be promptly diagnosed to take the timely and appropriate management strategies[6]. Cardiotocography is used to assess fetal wellbeing during labor. It is used to detect early signs of intrapartum fetal hypoxia in high risk pregnancies[6,7]. Fetal distress in labor as a result of fetal hypoxia if not corrected immediately it will result in decompensation of physiological response and cause brain damage and finally fetal death[8,9]. The fetal response to hypoxia by various compensatory mechanisms occurs and reflected as changes in the fetal heart rate pattern which can be identified on CTG, this means that fetal heart rate monitoring plays the most important role in assessment and management of higher risk pregnancies[6]. Despite routine and continuous electronic monitoring of FHR during labor has become a created obstetric practice in women with high-risk pregnancies in developed countries, but not in developing countries yet. Studying about CTG as a screening tool and its role in perinatal outcome in high risk pregnancy is limited in this region. In this regard, the current study was conducted to determine the role of CTG in monitoring fetal condition during labor in high risk pregnancy and prenatal outcomes.

Subjects and methods

In this cross-sectional study, 200 high risk pregnant women who were admitted into the labor of Maternity Hospital in Duhok City were included between October 2019 and February 2020. The CTG indicators were documented for the patients in a pre-designed questionnaire. Patients with singleton pregnancy in the first labor stage with a gestational age between 37-42 weeks with high risk factors such as postdate, oligohydronomia,.Pregnancy-induced hypertension (PIH), diabetes mellitus (DM), anemia, intrauterine growth retardation (IUGR), Antepartum hemorrhage (APH), and pre-labor rupture of membrane (PROM) were included in this study. Patients with gestational age < 37 weeks and patients without the above mentioned risk factors were excluded in the study. The information of the study was collected in a pre-designed questionnaire as follows: the questionnaire had four parts: Part A: In this part general information of the patients were collected: age, gravida, parity, abortion, gestational age (by last menstrual period and/or 1st trimester ultrasound scanning), and stage of labor. Part B: The information included in this part was IUGR, post-term pregnancy, anemia, previous scar, PROM, oligohydramnios, PIH, DM, and APH. Part C: In this part, the results of CTG were documented. The patients were categorized as reactive CTG and non-reactive CTG according to the RCOG guidelines for the use of electronic fetal monitoring[10].Patients who had non-reactive CTG trace, intrauterine resuscitation done in form of changing maternal position, IVF (Intravenous Fluid) and stopping oxytocine

infusion and then repeating the CTG for 90 minute, if CTG trace remain non-reactive intervention done by instrumental delivery or cesarean section. The patients who displaced normality in all variables recorded by CTG were categorized as reactive CTG trace. Reactive CTG had baseline fetal heart rate baseline of 110-160, variability (bpm) ≥5, no decelerations, and presence of accelerations. The patients who had one of the following features were recognized as non-reactive CTG which has the following criteria: baseline FHR<100 or >180(bpm), sinusoidal pattern >10 minutes, variability <5(bpm) for more than 90 minutes, decelerations (atypical variable decelerations, late decelerations, and single prolonged deceleration for more than 3 minutes). Part D: Perinatal outcome which include: liquor color, mode of delivery, Apgar score in 1 minute and 5 minutes, NICU admission and perinatal mortality (total number of still births and death within the first seven days of life). For statistical analysis, data were presented in number and percentage or mean and standard deviation. The risk was determined in number and percentage. The comparison of cardiotocogr aphy between study groups was examined in independent t-test and Pearson Chi-squared tests. The significant level of difference was determined in a p-value <0.05. The statistical calculations are conducted in the statistical package for social sciences version 25 (SPSS 25; IBM Corp; USA). Ethical approval of the study was taken from the council of Kurdistan Board for Medical Specialties (KBMS). The study was performed according to the modified

Declaration of Helsinki. The Declaration of Helsinki is a set of ethical principles about human experimentation developed for the medical community by the world medical association (WMA).

Results

The analyzed results showed that the age of patients ranging between 18 and 42 years with mean value of 27.41±6.09 years. It was also observed that the means of gravida, parity, and abortion were 2.30±1.64, 1.20±1.54, and 0.0 respectively. The mean of gestational age was 39.85±1.40 weeks Table (1).

Table (1): General characteristics of women with high-risk pregnancy

Patients' characteristics (n=200)	Mean ± SD
Age (Range: 18-42 years)	27.41±6.09
GPA (Gravida, Para, Abortion)	
G (Range: 1-9)	2.30±1.64
P	1.20±1.54
A	0.0±0.0
Gestational Age (Range: 37-42 week)	39.85±1.40

The most prevalent risk among women were postdate pregnancy (50%), Pregnancy-Induced hypertension (35%), and Oligoydramnios (14.5%), as presented in Table (2).

Table 2: Risk factors of patients with high-risk pregnancy

	No.	%
Risk factors		
Post date	100	50
PIH	70	35
Previous scare	36	18
Oligohydramnios	29	14.5
Anemia	26	13
PROM	14	7
DM	11	5.5
APH	10	5
IUGR	6	3

IUGR: Intrauterine growth retardation; APH: Ante partum Hemorrhage; PIH: pregnancy-induced hypertension; PROM: Pre-labor rupture of membrane; DM: Diabetes Mellitus.

Table (3) shows that (51.5%) of the patients underwent a cesarean section delivery. Most of the patients had a clear amniotic fluid during labor.

Table (3): Perinatal outcomes in women with high-risk pregnancy

Outcomes (n=200)	No.	%
Mode of delivery		
Cesarean section	103	51.5
Vaginal delivery	97	48.5
Liquor		
Bloody	10	5.0
Meconium	61	30.5
Clear	129	64.5

The weight of babies was ranged from 1.9 to 4.8kg with a mean weight of 3.30±0.47kg. It was observed that 52% of babies were female and 48% were male. Most of the babies had APGAR score 5-7 in 1 minute (91.5%) and >7 in five minutes (78.0%). On the other hand, there was no any still birth or early neonatal death Table (4).

Table (4): Fetal outcomes in the studied women with high-risk pregnancy

Baby weight (Range: 1.9-4.8)	3.30 (Mean)	0.47 (Sta. Deviation)
Sex		
Male	96	48.0
Female	104	52.0
APGAR Score (first min)		
0-4	17	8.5
5-7	183	91.5
APGAR Score (fifth min)		
5-7	44	22.0
>7	156	78.0

NICU admission		
Yes	86	43.0
No	114	57.0
Perinatal mortality **(PMM)**	0	0.0
IUGR: Intrauterine growth retardation; APH: Ante partum Hemorrhage; PIH: pregnancy-induced hypertension; PROM: Pre-labor rupture of membrane; DM: Diabetes Mellitus.		

Table (5) showed that there is no significant difference in the mean age of the patients (27.48±6.17 vs. 27.33±6.05 years; p=0.859), gravida (2.49±1.73 vs. 2.10±1.53; p=1.000), and gestational age (39.85±1.40 vs. 39.84±1.41 weeks; p=0.972) between patients who had reactive and non-reactive CTG, respectively. The patients who had reactive CTG were more likely to have live babies (1.52±1.77 vs. 0.54±0.67; p<0.001) compared to those who had non-reactive CTG, respectively.

Table (5): Comparison of general characteristics and risks between patients with reactive and non-reactive CTG outcomes

Patients' characteristics	Study Groups		p-Value
	Reactive (n=99)	Non-reactive (n=101)	
Age	**Mean±SD:** 27.48±6.17	**Mean ±SD:** 27.33±6.05	0.859[a]
Gestational age (week)	**Mean±SD:** 39.85±1.40	**Mean±SD:** 39.84±1.41	0.972[a]
Gravida	**Mean±SD:**2.49±1.73	**Mean±SD:**2.10±1.53	1.000 [a]
Para	**Mean±SD:**1.52±1.77	**Mean±SD:**0.54±0.67	< 0.001[a]
	N (%)	N (%)	
IUGR Yes No	2 (2.0) 97 (98.0)	4 (4.0) 97 (96.0)	0.683[c]
Postdate pregnancy Yes No	46 (46.5) 53 (53.5)	54 (53.5) 47 (46.5)	0.322[b]
Anemia Yes No	17 (17.2) 82 (82.8)	9 (8.9) 92 (91.1)	0.082[b]
Previous Scar Yes No	19 (19.2) 80 (80.8)	17 (16.8) 84 (83.2)	0.664[b]
PROM Yes No	7 (7.1) 92 (92.9)	7 (6.9) 94 (93.1)	0.969[b]

Oligohydramnios			
Yes	13 (13.1)	16 (15.8)	0.586[b]
No	86 (86.9)	85 (84.2)	
PIH			
Yes	36 (36.4)	34 (33.7)	0.689[b]
No	63 (63.6)	67 (66.3)	
DM			
Yes	3 (3.0)	8 (7.9)	0.129[b]
No	96 (97.0)	93 (92.1)	
APH			
Yes	2 (2.0)	8 (7.9)	0.101[c]
No	97 (98.0)	93 (92.1)	

[a]Independent t-test, [b]Pearson Chi-squared, and [c]Fishers' exact test was performed for statistical analyses. IUGR= Intrauterine growth retardation; APH= Ante partum Hemorrhage; PIH=pregnancy-induced hypertension; PROM = Pre-labor rupture of membrane; DM = Diabetes Mellitus.

Table (6) illustrates comparison of outcomes between reactive and non-reactive groups. It was shown that the patients who had non-reactive CTG were more prone to cesarean section (64.4% vs. 38.4%; p<0.001) and have bloody liquor (7.9% vs. 2.0%; p=0.007) compared to reactive CTG patients, respectively. In addition, the greater percentage of non-reactive CTG patients were more likely to have 0-4 Apgar score in 1 minute (12.9% vs. 4.0%; p=0.025) and 5-7 Apgar score in 5 minutes (34.7% vs. 9.1%; p<0.001) compared to a reactive group, respectively. Also; babies of non-reactive CTG were more likely to be admitted to NICU (59.4% vs. 26.3%; p<0.001). Furthermore, it was also found that the Meconium stained liquor had significantly (p=0.007) more in non-reactive CTG (37.6%) compared to reactive CTG trace (32.2%).

Table (6): Comparison perinatal outcomes between reactive and non-reactive CTG groups

Outcomes	Study Groups		p-value
	Reactive (n=99)	**Non-reactive (n=101)**	
Mode of delivery			
Cesarean section	38 (38.4)	65 (64.4)	**<0.001[b]**
Vaginal delivery	61 (61.6)	36 (35.6)	
Liquor			
Bloody	2 (2.0)	8 (7.9)	**0.007[b]**
Meconium	23 (23.2)	38 (37.6)	
Clear	74 (74.7)	55 (54.5)	
Baby weight (kg)	**Mean±SD:** 3.36±0.43	**Mean±SD:** 3.22±0.54	0.056[a]
Sex			0.675[b]

Male	49 (49.5)	47 (46.5)	
Female	50 (50.5)	54 (53.5)	
Apgar First min			
0-4	4 (4.0)	13 (12.9)	**0.025[b]**
5-7	95 (96.0)	88 (87.1)	
Apgar Fifth min			
5-7	9 (9.1)	35 (34.7)	**<0.001[a]**
>7	90 (90.9)	66 (65.3)	
NICU admission			
Yes	26 (26.3)	60 (59.4)	**<0.001[a]**
No	73 (73.7)	41 (40.6)	

[a]Independent t-test, [b]Pearson Chi-squared, and [c]Fishers' exact test was performed for statistical analyses. The bold numbers show a significant difference. NICU= Neonatal Intensive Care Unit.

Discussion

This study showed that the patients with bloody liquor and non-reactive CTG were more prone to cesarean section. These findings are in accordance with studies of (Faruqi et al., 2019; Khatun et al., 2009) who reported that most of the patients in the non-reactive CTG tracing group underwent a cesarean section (90.0%) compared to 90.0% by normal vaginal delivery in reactive CTG tracing group, and 3% by cesarean section)[11,12]. Regarding the perinatal outcome, babies of women with non-reactive CTG were more likely to have low Apgar score (0-4) in 1 minute and Apgar score (5-7) in five minutes, and babies were more likely to be admitted to NICU (Neonatal Intensive Care Unit). Some other studies (Faruqi et al., 2019; Sood, 2002; Behuria and Nayak, 2016) have found that the patients with non-reactive CTG tracing have less Apgar score compared to the patients with reactive CTG tracing[11,13,14]. In a study conducted by Faruqi et al., (2019) reported that Apgar score of the babies in the reactive CTG tracing in the first min was >7 among 98% babies, 5-6 in 2% babies,

and <5 in 0% compared to 92%, 5%, and 3% in nonreactive CTG tracing group[11]. In agreement with the current study, a study reported that babies of patients with non-reactive CTG were more likely to be admitted to NICU (75.7%v/s 22.8%). They found high sensitivity and specificity of CTG for NICU admission; 75.7% and 77.2%, respectively[6]. In another study, Sandhu et al., (2008) determined the predictive value of CTG tracing in the neonatal outcome in 150 patients with high-risk pregnancies[3]. This study reported that fetal distress was developed in 15% with a normal test and 73% of patients with an abnormal test during labor. The sensitivity, specificity, and positive predictive value of the admission test were 66.7%, 93.3%, and 53.3%, respectively[3]. The study showed that NICU admission was necessary for 1% and 33% in patients with normal and abnormal tests, respectively[3]. In addition, it was reported that the patients with meconium stained liquor were more likely to have non-reactive CTG than reactive one[6,15]. Similar results were reported by other researchers

(Gupta et al., 2017; Rahman et al., 2012)[6,15]. These researchers found that moderate-thick meconium stained liquor was substantially more prevalent in patients with non-reactive CTG tracing compared to equivocal or reactive on admission. Surprisingly, the data of present study did not show any significant differences in the IUGR, post-term pregnancy, anemia, PROM, previous scar, oligohydramnios, PIH, DM, and APH, and baby weight between the reactive and non-reactive CTG. These finding contradicting the results of other studied (Gupta et al., 2017; Rahman et al., 2012)[6,15]. The current study did not record any dead baby and out of 200 all of babies were survived. These unexpected results could be due to the fact that in current study early detection of fetal hypoxia and timely intervention has been conducted before it reaches the state of irreversible brain damage and death.

Limitations of the study

The findings reported in this study must be analyzed with caution, because the information was collected from one geographic area.

Conclusions

The results of current study revealed that, in general, the reactive and non-reactive CTG tracing had a clear impact on the perinatal outcome in high risk pregnancies, in spite of existence of non-significant differences in few cases. The CTG is considered a suitable technique to determine perinatal outcome in high - risk pregnant patients.

Conflicts of interest

There were no conflicts of interest.

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