Assessment of Antepartum Cardiotocography (CTG) in High Risk Pregnancy and Foetal Outcome: a Descriptive Study

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Abstract

Aim: To examine the efficacy of Antepartum Cardiotocography (CTG) in high risk pregnancies and its influence on fetal outcomes.

Materials and Methods: This observational study was conducted in the Department of Obstetrics and Gynaecology, NMCH Patna, Bihar, India for 12 months. A total of 100 patients having gestational age $\geq$ 36 weeks were included in the study. Patients with high-risk pregnancy conditions such as pregnancy-induced hypertension (PIH), eclampsia, diabetes, intrauterine growth restriction (IUGR), thyroid disorder, heart disease, anemia, bad obstetric history (BOH), oligohydramnios, post-dated pregnancy, diminished fetal movements, and premature rupture of membranes lasting more than 6 hours were included.

Results: The distribution of fetal heart conditions, as measured by cardiotocography (CTG), showed that 73% of the subjects had normal CTG results, whereas 27% had abnormal CTG results. This difference was statistically significant with a p-value of 0.002. The relationship between CTG results and the method of delivery, it was found that 42.5% of vaginal deliveries had normal CTG results, and 7.4% had abnormal results. In contrast, 57.5% of caesarean section deliveries had normal CTG results, while a significant 92.6% had abnormal CTG results, with a p-value of 0.001, indicating a significant association. The relationship between CTG results and birth weight indicated that among those with a birth weight less than 2.5 kg, 27.4% had normal CTG results, and 63% had abnormal results. For those with a birth weight over 2.5 kg, 72.6% had normal CTG results, while 37% had abnormal results, with a p-value of 0.01, showing a significant correlation. Lastly, the relationship between CTG results and the APGAR score at one minute showed that among those with an APGAR score of 7 or less, only 4.6% had normal CTG results, while 81.2% had abnormal results.

Conclusion: The cardiotocograph may be effectively used as a reliable screening technique for fetal monitoring. If the cardiotocography (CTG) displays an aberrant pattern, it is recommended to supplement CTG with other test before any intervention.

Keywords: Antepartum cardiotocography, High risk pregnancies, Foetal Distress, Perinatal Outcome

Introduction

The most delightful sound for a woman is the cry of her newborn baby, while for the obstetrician it represents the successful outcome of diligent monitoring of both the mother and the fetus. The passage of the baby via the birth canal may cause a stressful reaction, which the fetus may exhibit as an abnormality in heart rate, known as a "stress response" [1]. Monitoring the fetus during labor is crucial to guarantee the birth of a healthy infant. Regular electronic monitoring of fetal heart rate (FHR) has become a standard procedure to detect fetal hypoxia in its early stages, allowing for prompt administration of suitable treatment. Cardiotocography (CTG) plays a crucial role in monitoring labor and identifying fetal distress. It has consistently served as a reliable and essential component of prenatal testing [2].

Abnormal FHR tracing may reliably indicate the evaluation of labor complicated by MSL (meconium stain liquor) [3]. Enrollment CTG refers to the continuous electronic monitoring of fetal heart rate (FHR) for a duration of 20 minutes, while simultaneously documenting uterine activity upon admission to the labor room. A normal fetus can handle intrapartum stress, whereas a weakened fetus cannot endure hypoxia. Therefore, the occurrence of intrapartum hypoxia and consequent hypoxic ischaemic encephalopathy is frequent in pregnancies that are at a high risk. Birth asphyxia, which occurs

during the course of childbirth, is the primary cause of perinatal death, as shown by sources [4,5]. CTG is easy to use, affordable and non-invasive test. This study aimed to assess the benefit of cardiotocography to improve perinatal outcome in high risk pregnancy.

Materials and Methods

This observational descriptive study was conducted in the Department of Obstetrics and Gynaecology, NMCH Patna, Bihar, India for 12 months. Institutional ethical committee approval was taken and written informed consent was obtained before starting the study. A total of 100 patients having gestational age ≥ 36 weeks were included in the study. Patients with high-risk pregnancy conditions such as pregnancy-induced hypertension (PIH), eclampsia, diabetes, intrauterine growth restriction (IUGR), thyroid disorder, heart disease, anemia, bad obstetric history (BOH), oligohydramnios, post-dated pregnancy, diminished fetal movements, and premature rupture of membranes lasting more than 6 hours were included. Patients with normal pregnancy, multifetal pregnancy, gestational age less than 36 weeks, high-risk pregnancies that progressed to labor and pregnancies with congenital fetal anomalies were excluded from the study. Cardiotocography monitoring was performed on included mothers and interpretations made based on fetal heart rate, base line variability and CTG was then designated as reactive or non reactive. On this basis the fetal outcome was predicted by Birth weight, Apgar score, liquor status, NICU admission and perinatal mortality.

Methodology

Data were collected through interviews, brief medical history, general physical examination, and sonographic findings. A structured questionnaire containing all variables of interest was used to gather the data. All collected data were compiled and analyzed using the Statistical Package for Social Sciences (SPSS) version 25.0 software. Tests of significance were performed using p-values and chi-square tests. A p-value of less than 0.05 was considered statistically significant.

Results

Table 1 showing baseline characteristics of patients indicate a diverse age distribution and delivery methods. Eight percent of the subjects were below 20 years, 33% were aged 20-25 years, 43% were 25-30 years, and 16% were 30-35 years old. Regarding delivery methods, 33% of the subjects had vaginal deliveries, while 67% underwent caesarean sections.

Table 2 showing distribution of fetal heart conditions, as measured by cardiotocography (CTG), showed that 73% of the subjects had normal CTG results, whereas 27% had abnormal CTG results. This difference was statistically significant with a p-value of 0.002.

As seen in table 3, 62% of the subjects had normal liquor color (clear), 27% had light meconium-stained liquor, and 11% had deep meconium-stained liquor. This distribution provides insight into the condition of the amniotic fluid at the time of delivery.

Table 4 showing pregnancy status of the subjects: 6% had chronic hypertension, 3% had gestational hypertension, 32% had preeclampsia, 17% had eclampsia, 14% had diabetes, 2% had heart disease, 12% had anemia, 6% had a history of poor obstetric outcomes (BOH), 7% had intrauterine growth restriction (IUGR), and 1% had other conditions.

Table 5 showing another critical measure the fetal birth weight, with 37% of the newborns weighing less than 2.5 kg (mean ± SD: 2.66 ± 0.19), and 63% weighing more than 2.5 kg. The APGAR score at one minute revealed that 24% of the newborns had a score of 7 or less, indicating a need for immediate medical attention, while 76% had a score greater than 7, suggesting healthier conditions immediately after birth.

Table 6 showing relationship between CTG results and the method of delivery, it was found that 42.5% of vaginal deliveries had normal CTG results, and 7.4% had abnormal results. In contrast, 57.5% of caesarean section deliveries had normal CTG results, while a significant 92.6% had abnormal CTG results, with a p-value of 0.001, indicating a significant association. The relationship between CTG results and birth weight indicated that among those with a birth weight less than 2.5 kg, 27.40% had normal CTG results, and 62.97% had abnormal results. For those with a birth weight over 2.5 kg, 72.60% had normal CTG results, while 37.03% had abnormal results, with a p-value of 0.01, showing a significant correlation. Lastly, the relationship between CTG results and the APGAR score at one minute showed that among those with an APGAR score of 7 or less, only 4.6% had normal CTG results, while 81.2% had abnormal results. For those with an APGAR score greater than 7, 95.4% had normal CTG results, and 18.8% had abnormal results, with a p-value of 0.002, highlighting a significant relationship between APGAR scores and CTG results.

Table 1: Baseline characteristics of patients

Variables	Number	Percentage (%)
Age group (years)		
Below 20	8	8
20-25	33	33
25-30	43	43
30-35	16	16
Method of delivery		
Vaginal	33	33
Caesarean section	67	67

Table 2: Distribution of fetal heart condition in patients

CTG	Number	Percentage (%)	p value
Reactive CTG (normal)	73	73	0.002
Non reactive CTG (abnormal)	27	27	

Table 3: Distribution of liquor colour in the study population

Liquor	Number	Percentage (%)
Normal colour (clear)	62	62
Light meconium	27	27
Deep meconium	11	11

Table 4: Pregnancy status of the patients

Pregnancy status	Number	Percentage (%)
Chronic hypertension	6	6
Gestational HTN	3	3
Preeclampsia	32	32
Eclampsia	17	17
Diabetes	14	14
Heart disease	2	2
Anaemia	12	12
BOH	6	6
IUGR	7	7
Others	1	1

Table 5: Distribution of fetal birth weight and APGAR score

Birth weight	Number	Percentage (%)
<2.5 kg	37	37
>2.5 kg	63	63
APGAR score		
≤7	24	24
≥7	76	76

Table 6: Relationship of CTG according to method of delivery

Mode of delivery	CTG				Total		p value
	Normal		Abnormal		No.	(%)	
	No.	(%)	No.	(%)			
Vaginal	31	42.47	2	7.41	33	33	0.001
Caesarean section	42	57.53	25	92.59	67	67	
Birth weight							0.01
<2.5 kg	20	27.40	17	62.97	37	37	
>2.5 kg	53	72.60	10	37.03	63	63	
APGAR score							0.002
≤7	2	4.6	13	81.2	15	25.0	
≥7	42	95.4	3	18.8	45	75.0	

Discussion

Technology has significantly progressed in the areas of antepartum fetal surveillance and intrapartum monitoring [6]. The evaluation of fetal distress during childbirth cannot be determined by any one clinical or laboratory assessment. Cardiotocography (CTG) is a widely used test for monitoring the health of the fetus before and during childbirth in most hospitals in industrialized nations. However, the effect of CTG on the result of newborns is still a topic of debate among medical professionals [7]. CTG offers immediate and accurate information on the fetal state, unlike other techniques. The purpose of this test is to provide an indicator of fetal brain activity by measuring the cerebro-cardiac response, which is altered in the presence of hypoxia. The acceleration of fetal heart rate (FHR) is caused by the intact central nervous system (CNS) response mechanism. The absence of fluctuations in fetal heart rate (FHR) or the presence of decelerations indicates a suppression of this central nervous system (CNS) mechanism. The non-reactive cardiotocography (CTG) may be attributed to several factors, including fetal hypoxia, acidosis, fetal slumber, fetal abnormalities, and the administration of sedatives and opiates to the mother. These factors contribute to the absence of any concerning outcomes in the CTG. Although lacking specificity, cardiotocography is a valuable technology for monitoring the fetus before birth and continues to be the primary method for assessing the fetus throughout labor [6]. This research aimed to examine the antepartum and intrapartum cardiotocography and fetal outcome in pregnancies that are at a high risk. The baseline features of the research individuals suggest a varied age distribution and a range of delivery modalities. In terms of birth procedures, 33% of the participants had spontaneous deliveries, whilst the majority of 67% received cesarean sections. The research found that 73% of participants had a normal CTG, whereas 27% had an aberrant CTG. The research conducted by Khatun et al. reported an abnormal CTG in 37.7% of cases [8], whereas Bina I et al. observed an abnormal CTG in 20.7% of cases. When there are a greater number of risk variables, the overall consequences are more pronounced among the abnormal CTG group [9]. This research observed a higher occurrence of chronic hypertension, PIH, pre-eclampsia, eclampsia, BOH, diabetes, anaemia, IUGR, and aberrant outcomes. The risk factors for these conditions are interconnected, with one factor increasing the likelihood of others [10]. In the research, the newborns in the aberrant CTG group had an APGAR score of less than 7 at 1 minute, which was comparable to the findings of the study conducted by Dellinger et al. [11]. The aberrant CTG group exhibited a significantly higher percentage of newborns with an APGAR score of less than 7 at 1 minute compared to the normal CTG group, which aligns with findings from several previous research. Piazze et al. [8, 10, 12] propose that there may be a correlation between fetal heart rate (FHR) tracing and a poor APGAR score at 5 minutes in postdated pregnancy. The APGAR grading system has traditionally been used to assess the condition of the newborn at the time of delivery. Typically, it is presumed that this number indicates the extent of prenatal hypoxia. Nevertheless, current research [9] using cord blood analysis and fetal scalp blood pH has raised significant concerns about the dependability of APGAR score in assessing hypoxia. Based on an examination of many published publications, the APGAR score has been shown to have the following approximate accuracy rates in predicting hypoexemia: The sensitivity is 47%, specificity is 89%, positive predictive value is 56%, and negative predictive value is 86% [13]. According to this research, the fetal birth weight was identified as an important factor. Specifically, 37% of the infants had a weight of less than 2.5 kg, with an average of 2.66 kg and a standard deviation of 0.19 kg. On the other hand, 63% of the babies had a weight beyond 2.5 kg. In the research conducted by Divon et al., it was shown that 53 infants with a birth weight of less than 4000 gm and 10 infants with a birth weight more than 4000 gm had aberrant CTG readings [14]. Multiple studies have shown a correlation between an atypical prenatal CTG tracing and worse fetal outcome [12, 15-18]. Regarding the method of delivery, there was a significant prevalence of caesarean section in this research. The high occurrence of caesarean section in this research, despite normal test results, may be attributed to obstetrical factors such as a history of prior caesarean section, cephalopelvic disproportion, failed induction, severe preeclampsia, and severe intrauterine growth retardation. The rate of caesarean delivery for fetal distress was notably elevated in the group with aberrant CTG results. This discovery aligns with the findings of the research conducted by Dellinger et al. [11]. No perinatal deaths were recorded in either the normal CTG group or the aberrant CTG group in the current investigation. The research did not aim to prove a reduction in cesarean birth rates or establish a connection between electronic fetal monitoring and long-term neurological function and cerebral palsy. The purpose was to provide the pregnancy outcome and early neonatal outcomes specifically in instances of both normal and abnormal CTG readings.

Conclusion

The cardiotocograph may be effectively used as a reliable screening technique for fetal monitoring. If the cardiotocography (CTG) displays an aberrant pattern, it is recommended to supplement CTG with other test before final decision about their mode of delivery.

References

1. Singhal M, Kanwat B, Chauhan M, Chaubisa P. A study on cardiotocography for predicting fetal prognosis in high-risk pregnancy. Int J Reprod Contracept Obstet Gynecol 2023; 12: 874-82.

2. Joshi H, Panwar SM, Singh A. Role of admission test by cardiotocography (CTG) as a predictor of perinatal outcome: a prospective study. Int J Clin Obstetr Gynaecol. 2019;3 (2): 128-33.

3. Khatun MN, Siddika MA, Akthar S, Chowdhury SM, Urmee MN, Ali MY, et al. Antepartum cardiotocography (CTG) in high risk pregnancy and fetal outcome at SZMCH, Bogura, Bangladesh. Int J Clin Obstet Gynaecol 2024;8(3):43-7.

4. Singh S, Premi HK, Gupta R. The role of non-stress test as a method to evaluate the outcome of high-risk pregnancy: a tertiary care centre experience. Int Surg J. 2020;7(6):1782-7.

5. Kumar A, Jaju PB. Admission test cardiotocography in labour as a predictor of foetal outcome in high-risk pregnancies. Int J Reprod Contracept Obstet Gynecol 2019;8: 13 31-6.

6. Gabbe SG, Niebyl JR, Simpson JL. Obstetrics, normal and problems pregnancies. 3rd ed. London: British Willa Pvt. Ltd.; 1999. p. 678-9, 327-9, 339, 403-4.

7. Krishna U, Tank DK, Daftari S. Pregnancy at risk: current concepts. 3rd ed. New Delhi: Japee Brothers Medical Publisher's Pvt. Ltd.; 2001. p. 179-82.

8. Pater JT, King T. Foetal heart rate monitoring: is it salvageable? Am J Obstet Gynecol. 2000 ;182:982-7.

9. Piazze JJ, Cerekja A, Buccheri M. Computerized FHR traces in post-term pregnancies. J Perinat Med. 2008;36:182-3.

10. Akter H. Antepartum cardiotocography (CTG) in high-risk pregnancy and fetal outcome in a tertiary level hospital of Dhaka city. Dissertation FCPS examination, Dhaka; c2012.

11. Delling GEH, Boehm FH, Crancmn. Electronic fetal rate monitoring: early neonatal outcomes associated with normal rate, fetal stress, and fetal distress. Am J Obstet Gynecol. 2000;12:214-20.

12. Murphy KW, Johnson P, Moorcraft J, Pattinson R, Russell V, Turnbull A. Birth asphyxia and the intrapartum cardiotocograph. Br J Obstet Gynaecol. 1990;97(6):470-9.

13. Clark SL, Nageotte MP, Garite TJ, et al. Intrapartum management of category II fetal heart rate tracings: towards standardization of care. Am J Obstet Gynecol. 2013;209:89.

14. Arias F. Practical guide to high-risk pregnancy and delivery. 2nd ed. New Delhi: Elsevier India Pvt. Ltd.; 2005. p. 418, 423.

15. Brown VA, Sawers RS, Parsons RJ, Duncan SL, Cooke ID. The value of antenatal cardiotocography in the management of high-risk pregnancy: a randomized controlled trial. Br J Obstet Gynaecol. 2002;89:716-22.

16. Flynn AM, Kelly J. Evaluation of fetal wellbeing by antepartum fetal heart monitoring. Br Med J. 1997. p. 936-9.

17. German Society of Gynecology and Obstetrics (DGGG), Maternal Fetal Medicine Study Group (AGMFM), German Society of Prenatal Medicine and Obstetrics (DGPGM), German Society of Perinatal Medicine (DGPM). S1-Guideline on the use of CTG during pregnancy and labor: long version - AWMF Registry No. 015/036. Geburtshilfe und Frauenheilkunde. 2014;74(8):721-32.

18. Visser GHA, Huisjes HJ. Diagnostic value of the unstressed antepartum cardiotocogram. Br J Obstet Gynaecol. 2007;84:321-6.