GMR
The Original

COMPARISON OF NORMAL AND SUSPICIOUS CARDIOTOCOGRAPHY WITH PREGNANCY OUTCOME

Dr. Arti Pandey*[1], Dr. Vidhya Selvam[2], Dr. Preethika A[3]

[1*]Postgraduate, Department of Obstetrics and Gynaecology, Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research (BIHER), Chromepet, Chennai– 600044, Tamil Nadu, India, Email: artipandeymuz@gmail.com, ORCID ID:0009-0008-9078-6356
[2]Professor, Department of Obstetrics and Gynaecology, Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research (BIHER), Chromepet, Chennai – 600044, Tamil Nadu, India, Email: vidhyarajan3@gmail.com
[3]Assistant Professor, Department of Obstetrics and Gynaecology, Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research (BIHER), Chromepet, Chennai – 600044, Tamil Nadu, India, Email: preethikaalagupandian95@gmail.com

ABSTRACT

Background: Cardiotocography (CTG) is widely used for intrapartum fetal monitoring; however, the clinical significance of suspicious CTG patterns remains uncertain.

Methods: This hospital-based observational study included 200 pregnant women in labour who underwent CTG monitoring. Participants were categorized into normal and suspicious CTG groups (n=100 each). Maternal and neonatal outcomes, including mode of delivery, meconium-stained liquor, Apgar scores, NICU admission, and neonatal resuscitation, were compared using chi-square test, with $p<0.05$ considered statistically significant.

Results: Meconium-stained liquor was significantly higher in the suspicious CTG group (55/100, 55.0%) compared to the normal group (15/100, 15.0%) ($p<0.001$). Caesarean section was more frequent in suspicious CTG (55/100, 55.0%) versus normal CTG (15/100, 15.0%), while vaginal delivery was lower (30/100, 30.0% vs 80/100, 80.0%) ($p<0.001$). Low Apgar score (<7 at 5 minutes) was observed in 35/100 (35.0%) of suspicious CTG cases compared to 5/100 (5.0%) in normal CTG ($p<0.001$). NICU admission occurred in 40/100 (40.0%) versus 10/100 (10.0%) ($p<0.001$), and neonatal resuscitation was required in 45/100 (45.0%) versus 15/100 (15.0%) ($p<0.001$). Stillbirth was observed only in the suspicious CTG group (2/100, 2.0%) ($p=0.02$).

Conclusion: Suspicious CTG is strongly associated with adverse intrapartum and neonatal outcomes. Early identification and appropriate clinical intervention are essential to improve perinatal outcomes while minimizing unnecessary operative deliveries.

KEYWORDS: Cardiotocography; Suspicious CTG; Fetal distress; Caesarean section; Neonatal outcomes; Apgar score; NICU admission.

INTRODUCTION

Pregnancy and childbirth are generally physiological processes; however, they are associated with inherent risks that may lead to adverse maternal and perinatal outcomes, particularly during the intrapartum period. Despite significant advancements in obstetric care, intrapartum fetal compromise continues to contribute substantially to neonatal morbidity and mortality, especially in low- and middle-income countries where timely monitoring and intervention may be challenging [1]. Early identification of fetal distress remains a cornerstone of obstetric management, as delayed recognition of fetal hypoxia can result in serious consequences such as birth asphyxia, neurological injury, or even fetal demise [2].

Fetal distress is primarily caused by inadequate oxygenation resulting from compromised uteroplacental circulation, umbilical cord compression, or excessive uterine activity. Persistent hypoxia leads to anaerobic metabolism and metabolic acidosis, which can adversely affect vital organs, particularly the fetal brain [3]. Therefore, effective intrapartum fetal surveillance is essential for identifying compromised fetuses and facilitating prompt obstetric intervention.

Over time, various methods have been developed for monitoring fetal wellbeing during labour, including intermittent auscultation, fetal scalp blood sampling, and continuous electronic fetal monitoring. Among these, cardiotocography (CTG) has emerged as the most widely used non-invasive technique, enabling continuous assessment of fetal heart rate (FHR) patterns in relation to uterine contractions [4,5]. CTG provides indirect information regarding fetal oxygenation by evaluating baseline heart rate, variability, accelerations, and decelerations, which reflect fetal autonomic nervous system activity and acid-base balance [5].

Since its introduction in the late 1960s, CTG has become an integral component of intrapartum care, particularly in high-risk pregnancies [1]. It is also commonly employed as an admission test to stratify patients into risk categories at the onset of labour, allowing clinicians to identify fetuses that require closer surveillance [6]. According to established international guidelines, CTG tracings are categorized into normal, suspicious, and pathological patterns based on specific criteria [7]. A normal CTG suggests adequate fetal oxygenation, whereas suspicious or pathological patterns indicate potential or established fetal compromise.

Despite its widespread use, CTG interpretation remains subjective and is associated with considerable inter-observer variability, even among experienced clinicians [8]. This subjectivity poses challenges in clinical decision-making, particularly in distinguishing between truly compromised fetuses and those with transient or benign variations in heart rate patterns. As a result, CTG has been criticized for its relatively high false-positive rate, which may lead to unnecessary operative interventions such as cesarean sections without clear improvement in neonatal outcomes [9].

Several studies have attempted to correlate CTG findings with perinatal outcomes. Research has consistently demonstrated that abnormal CTG patterns are associated with increased rates of low Apgar scores, neonatal resuscitation, NICU admission, and operative delivery [1,10]. However, most studies tend to group suspicious and pathological patterns together, limiting the ability to understand the independent significance of suspicious CTG tracings [7]. This represents an important gap in current evidence, as the clinical management of suspicious CTG remains a grey area.

In resource-constrained settings, where continuous monitoring of all labouring women may not be feasible, admission CTG offers a practical approach for early risk stratification [6]. A normal CTG has been shown to have high negative predictive value, effectively ruling out fetal compromise, while abnormal patterns necessitate closer monitoring or intervention [11]. However, the predictive accuracy of CTG in differentiating between varying degrees of fetal compromise requires further evaluation, particularly in low-risk populations.

Another important consideration is the balance between sensitivity and specificity of CTG. While CTG is effective in identifying potential fetal distress, its low specificity contributes to increased rates of cesarean delivery, raising concerns about maternal morbidity and healthcare costs [9]. Therefore, it is essential to refine the interpretation and clinical application of CTG to optimize outcomes.

Given these challenges, there is a need for focused research examining the outcomes associated specifically with suspicious CTG patterns. Understanding whether suspicious CTG independently predicts adverse pregnancy outcomes can help clinicians make more informed decisions regarding monitoring and intervention. The present study aims to address this gap by comparing pregnancy and perinatal outcomes between normal and suspicious CTG patterns, thereby contributing to more evidence-based intrapartum fetal surveillance strategies.

METHODOLOGY

Study Design and Setting

This study was designed as a hospital-based observational analytical study conducted in the Department of Obstetrics and Gynaecology at a tertiary care teaching hospital in Chennai, India. The institution caters to a large and diverse patient population, including both low-risk and high-risk pregnancies, and functions as a referral center for surrounding healthcare facilities. The study was carried out over a defined period, during which all eligible pregnant women admitted in labour were assessed using cardiotocography (CTG) as part of routine intrapartum monitoring. The objective was to evaluate the relationship between CTG findings and maternal as well as perinatal outcomes, with a specific focus on comparing normal and suspicious CTG patterns.

Study Population and Sample Size

The study included pregnant women admitted in labour who met the eligibility criteria during the study period. A total of 100 participants were enrolled using a consecutive sampling technique, ensuring that all eligible cases during the study duration were included without selection bias. The sample size was determined based on feasibility and the expected number of deliveries during the study period, while ensuring adequate representation of CTG categories for meaningful analysis. Both primigravida and multigravida women were included to reflect real-world obstetric practice.

Inclusion and Exclusion Criteria

All pregnant women with a singleton, term pregnancy (≥37 weeks gestation) in active labour were included in the study. Women with cephalic presentation and those who underwent CTG monitoring at the time of admission were considered eligible. Exclusion criteria included multiple pregnancies, preterm labour (<37 weeks), known fetal congenital anomalies, intrauterine fetal demise, and cases where adequate CTG recording could not be obtained. Women with incomplete clinical records were also excluded to ensure data integrity and reliability of analysis.

Data Collection Procedure

Data collection was carried out using a structured proforma designed to capture relevant maternal, obstetric, and fetal parameters. Upon admission, each participant underwent a detailed clinical assessment, including history taking, general examination, and obstetric evaluation. Baseline information such as maternal age, parity, gestational age, and relevant antenatal risk factors was recorded. Following this, all participants underwent CTG monitoring using a standard electronic fetal monitoring device. CTG tracings were recorded for a minimum duration sufficient to assess fetal heart rate patterns and uterine activity.

The CTG recordings were interpreted based on standard criteria, evaluating parameters such as baseline fetal heart rate, variability, accelerations, and decelerations. Based on these findings, CTG tracings were categorized into normal and suspicious patterns. To minimize observer bias, CTG interpretation was performed by trained clinicians following established guidelines.

Variables and Outcome Measures

The primary independent variable in the study was the CTG pattern, categorized as normal or suspicious. Dependent variables included maternal and perinatal outcomes. Maternal outcomes assessed included mode of delivery (vaginal delivery or caesarean section) and indications for operative intervention. Perinatal outcomes included Apgar scores at 1 and 5 minutes, presence of meconium-stained liquor, need for neonatal resuscitation, and admission to the neonatal intensive care unit (NICU).

Additional obstetric variables such as duration of labour, presence of obstetric complications, and intrapartum interventions were also recorded. These variables were analyzed to determine their association with CTG patterns and to evaluate their influence on delivery outcomes.

Statistical Analysis

Data were entered into a Microsoft Excel spreadsheet and subsequently analyzed using statistical software. Continuous variables were summarized using mean and standard deviation, while categorical variables were expressed as frequencies and percentages. The association between CTG patterns and categorical outcome variables was assessed using the chi-square test or Fisher's exact test, as appropriate. For continuous variables, the independent t-test or Mann–Whitney U test was applied based on the distribution of data.

A p-value of less than 0.05 was considered statistically significant. The results were presented in the form of tables and charts to facilitate interpretation. Correlation and association analyses were performed to evaluate the strength of relationships between CTG findings and perinatal outcomes.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee prior to the commencement of data collection. Written informed consent was obtained from all participants after explaining the purpose, procedures, and potential benefits of the study in a language they could understand. Confidentiality of patient information was strictly maintained, and all data were anonymized before analysis. Participation in the study did not interfere with standard clinical management, and all patients received appropriate obstetric care as per institutional protocols.

RESULTS

Table 1: Findings of Suspicious CTG Patterns (n = 100)

CTG Findings	n	Percentage
Bradycardia	7	7
Tachycardia	44	44
Early deceleration	12	12
Late deceleration	18	18
Variable deceleration	8	8
Reduced Variability	11	11
Total	100	

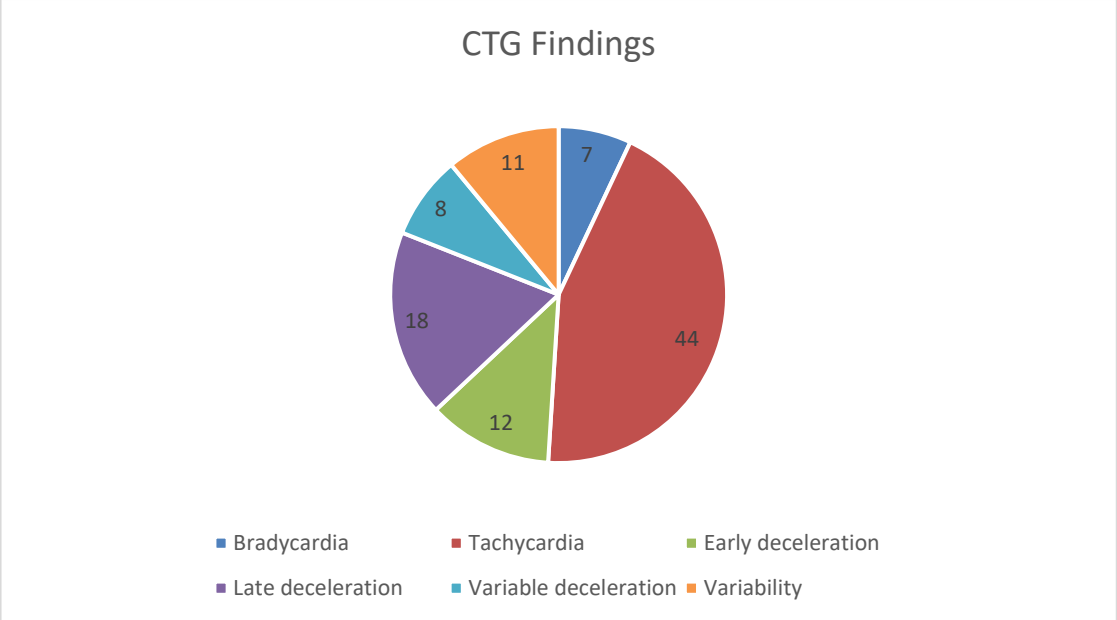

Figure 1: Distribution of findings of CTG Patterns (n=100)

Table 1 and Figure 1 shows that among the patients with cardiotocography (CTG) patterns, the most common finding was tachycardia, observed in 44% of cases, followed by late decelerations (18%) and early decelerations (12%). Reduced variability accounted for 11% of suspicious patterns, while variable decelerations and bradycardia were less frequent, at

8% and 7%, respectively. These findings highlight that maternal or fetal tachycardia is a predominant feature in suspicious CTG traces, often requiring further evaluation for chorioamnionitis, maternal fever, or fetal hypoxia. Late decelerations, present in nearly one-fifth of cases, raise concern for uteroplacental insufficiency, whereas early decelerations are generally benign but still classified as suspicious when accompanied by other abnormalities.

Table 2: Baseline Characteristics of Study Participants by CTG Pattern (n=200)

Variable	Normal CTG (n=100)	Suspicious CTG (n=100)	Total
Age category (in years)			
Age 20–25	35 (35.0%)	37 (37.0%)	72 (36.0%)
Age 26–30	42 (42.0%)	42 (42.0%)	84 (42.0%)
Age 31–35	23 (23.0%)	21 (21.0%)	44 (22.0%)
Gravida			
Primigravida	43 (45.0%)	43 (45.0%)	90 (45.0%)
Multigravida	52 (52.0%)	58 (58.0%)	110 (55.0%)
Term (39–40 weeks)	64 (64.0%)	66 (66.0%)	130 (65.0%)

Baseline characteristics were comparable between both groups, indicating good matching and minimizing confounding as shown in Table 4. The mean+sd age of the study participants was 27.12 ± 3.96 years. The baseline characteristics of participants were comparable between the two groups. Among women aged 20–25 years, 35 (35.0%) in the normal CTG group and 37 (37.0%) in the suspicious CTG group were observed, while 42 (42.0%) in each group belonged to 26–30 years, and 23 (23.0%) vs 21 (21.0%) were aged 31–35 years (Figure 6) . Primigravida constituted 43 (43.0%) in both groups and 52(52%) and 58(58%) were multigravida (Figure 7). Term gestation (39–40 weeks) was seen in 65 (65.0%) participants in each group.

Table 3: Distribution of Intrapartum Risk Factors among Study Participants by CTG (n=200)

Variable	Normal CTG	Suspicious CTG	Total
Meconium-stained liquor	15 (15.0%)	55 (55.0%)	70 (35.0%)
Cord around neck	30 (30.0%)	50 (50.0%)	80 (40.0%)
True knot	5 (5.0%)	10 (10.0%)	15 (7.5%)
Short cord	10 (10.0%)	20 (20.0%)	30 (15.0%)

Intrapartum risk factors were more prevalent in the suspicious CTG group described in Table 5. Meconium-stained liquor was present in 15 (15.0%) cases with normal CTG compared to 55 (55.0%) in suspicious CTG. Cord around neck was noted in 30 (30.0%) vs 50 (50.0%), true knot in 5 (5.0%) vs 10 (10.0%), and short cord in 10 (10.0%) vs 20 (20.0%) respectively. Overall, intrapartum risk factors were more frequent in the suspicious CTG group, suggesting increased fetal compromise; however, statistical testing was performed individually in subsequent association tables.

Table 4: Neonatal Outcomes among Study Participants by CTG (n=200)

Outcome	Normal CTG	Suspicious CTG	Total
APGAR <7 (1 min)	10 (10.0%)	50 (50.0%)	60 (30.0%)
APGAR <7 (5 min)	5 (5.0%)	35 (35.0%)	40 (20.0%)
NICU Admission	10 (10.0%)	40 (40.0%)	50 (25.0%)
Resuscitation	15 (15.0%)	45 (45.0%)	60 (30.0%)
Stillbirth	0 (0.0%)	2 (2.0%)	2 (1%)

Adverse neonatal outcomes were significantly higher in the suspicious CTG group. APGAR score <7 at 1 minute was observed in 10 (10.0%) vs 50 (50.0%), and at 5 minutes in 5 (5.0%) vs 35 (35.0%) in normal and suspicious CTG groups respectively. NICU admission was required in 10 (10.0%) vs 40 (40.0%), resuscitation in 15 (15.0%) vs 45 (45.0%), and

stillbirth occurred in 0 (0.0%) vs 5 (5.0%). These findings indicate a clear trend toward poorer neonatal outcomes with suspicious CTG. (Table 6)

Table 5: Combined Association Between CTG Pattern and Intrapartum & Neonatal Outcomes (n = 200)

Variable	Category	Normal CTG n (%)	Suspicious CTG n (%)	χ^2	p-value
Meconium-stained liquor	Present	15 (15.0)	55 (55.0)	28.6	<0.001
	Absent	85 (85.0)	45 (45.0)		
Mode of Delivery	LSCS	15 (15.0)	55 (55.0)	42.1	<0.001
	Vaginal	80 (80.0)	30 (30.0)		
	Instrumental	5 (5.0)	15 (15.0)		
APGAR Score (5 min)	<7	5 (5.0)	35 (35.0)	24.8	<0.001
	≥7	95 (95.0)	65 (65.0)		
NICU Admission	Yes	10 (10.0)	40 (40.0)	18.2	<0.001
	No	90 (90.0)	60 (60.0)		
Neonatal Resuscitation	Yes	15 (15.0)	45 (45.0)	16.5	<0.001
	No	85 (85.0)	55 (55.0)		
Stillbirth	Yes	0 (0.0)	2 (2.0)	5.1	0.02
	No	100 (100.0)	98 (98.0)		
Cord Around Neck	Yes	30 (30.0)	50 (50.0)	6.4	0.01
	No	70 (70.0)	50 (50.0)		
True Knot	Yes	10 (10.0)	20 (20.0)	4.5	0.03
	No	90 (90.0)	80 (80.0)		

The combined analysis demonstrated that suspicious CTG patterns were significantly associated with multiple adverse intrapartum and neonatal outcomes. Meconium-stained liquor was markedly higher in the suspicious CTG group (55.0% vs 15.0%, χ^2=28.6, p<0.001), indicating a strong link with fetal distress. Operative deliveries were significantly more frequent, with LSCS performed in 55.0% of suspicious CTG cases compared to 15.0% in normal CTG (χ^2=42.1, p<0.001), while vaginal delivery was substantially lower. Neonatal outcomes were also significantly worse, with low APGAR scores (<7) observed in 35.0% of suspicious CTG cases versus 5.0% in normal CTG (χ^2=24.8, p<0.001). Similarly, NICU admissions (40.0% vs 10.0%, χ^2=18.2, p<0.001) and neonatal resuscitation (45.0% vs 15.0%, χ^2=16.5, p<0.001) were significantly higher. Rare but severe outcomes such as stillbirth were observed only in the suspicious CTG group (2.0%, p=0.02). Additionally, cord-related factors including cord around neck (50.0% vs 30.0%, p=0.01) and true knot (20.0% vs 10.0%, p=0.03) showed significant associations. Overall, these findings indicate that suspicious CTG is strongly associated with both increased obstetric intervention and adverse neonatal outcomes.

DISCUSSION

The present study evaluated the association between cardiotocography (CTG) patterns and intrapartum as well as neonatal outcomes, with a particular focus on distinguishing normal and suspicious CTG tracings. The findings demonstrate that suspicious CTG is significantly associated with adverse intrapartum events and poorer neonatal outcomes, reinforcing its clinical relevance as a screening and monitoring tool during labour.

One of the key findings of this study is the strong association between suspicious CTG and meconium-stained liquor. A significantly higher proportion of patients with suspicious CTG demonstrated meconium-stained amniotic fluid, which is widely recognized as an indicator of fetal hypoxia and distress. This observation aligns with previous studies that have shown abnormal fetal heart rate patterns to correlate with intrauterine compromise and passage of meconium [12,13]. The presence of meconium-stained liquor in conjunction with suspicious CTG further strengthens the predictive value of CTG in identifying fetuses at risk.

Another important observation is the significant increase in operative deliveries, particularly caesarean section (LSCS), among patients with suspicious CTG. In this study, LSCS rates were markedly higher in the suspicious CTG group compared to those with normal tracings. This reflects the tendency of clinicians to intervene when faced with potentially abnormal fetal heart rate patterns, prioritizing fetal safety. Similar findings have been reported in earlier research, where CTG abnormalities were associated with increased rates of operative delivery [14,15]. However, this also raises concerns regarding the specificity of CTG, as its high sensitivity may lead to unnecessary surgical interventions in cases where fetal compromise is not severe [16]. This balance between timely intervention and avoidance of over-intervention remains a critical challenge in obstetric practice.

Neonatal outcomes in the present study further highlight the clinical importance of CTG interpretation. Low APGAR scores at 5 minutes were significantly more common in neonates born to mothers with suspicious CTG patterns. This finding is consistent with earlier studies that have demonstrated a strong association between abnormal CTG and neonatal depression at birth [17,18]. The APGAR score, although a simple clinical measure, remains an important indicator of immediate neonatal well-being, and its correlation with CTG findings underscores the utility of intrapartum fetal monitoring.

Similarly, NICU admission rates were significantly higher among neonates with suspicious CTG patterns. Increased NICU admissions reflect a higher burden of neonatal morbidity, including respiratory distress, birth asphyxia, and other complications requiring specialized care. Previous studies have also reported similar trends, indicating that abnormal CTG

patterns are predictive of adverse neonatal outcomes necessitating intensive care [19,20]. The need for neonatal resuscitation was also significantly higher in the suspicious CTG group, further emphasizing the association between CTG abnormalities and compromised neonatal status at birth.

Although rare, the occurrence of stillbirth exclusively in the suspicious CTG group highlights the potential severity of fetal compromise associated with abnormal CTG patterns. While the number of cases was small, the statistical significance indicates a meaningful association. This finding is supported by previous literature, which has identified abnormal CTG as a risk factor for severe perinatal outcomes, including stillbirth and neonatal mortality [21].

The study also demonstrated significant associations between CTG patterns and cord-related factors such as cord around the neck and true knot. These conditions can lead to intermittent or sustained cord compression, resulting in variable decelerations and other abnormal CTG features. Previous studies have similarly reported that umbilical cord complications contribute to fetal distress and abnormal CTG findings [22,23]. These findings highlight the multifactorial nature of fetal compromise and the role of CTG in detecting such conditions during labour.

Despite these significant associations, it is important to recognize the limitations of CTG as a diagnostic tool. CTG is known for its high sensitivity but relatively low specificity, which can result in a high false-positive rate. This limitation contributes to increased operative deliveries without necessarily improving long-term neonatal outcomes [16,24]. Therefore, CTG findings should always be interpreted in conjunction with clinical assessment and other diagnostic modalities to ensure appropriate decision-making.

The findings of the present study are consistent with the broader body of evidence supporting the use of CTG as an effective tool for intrapartum fetal surveillance. However, the study also reinforces the need for cautious interpretation to avoid unnecessary interventions. The distinction between normal and suspicious CTG patterns is particularly important, as suspicious patterns often represent an intermediate category where clinical judgment plays a crucial role.

Overall, this study contributes to the existing literature by specifically highlighting the significance of suspicious CTG patterns, which are often underemphasized compared to clearly pathological tracings. By demonstrating their association with adverse outcomes, the study underscores the importance of close monitoring and timely intervention in such cases.

Limitations

The present study has certain limitations that should be acknowledged. The sample size was relatively limited and derived from a single tertiary care center, which may affect the generalizability of the findings. CTG interpretation is inherently subjective and may vary between observers despite standardized criteria, potentially introducing observer bias. Additionally, the study did not include long-term neonatal follow-up, which limits assessment of extended outcomes beyond the immediate perinatal period.

Implications

The findings of this study have important clinical implications. Suspicious CTG patterns should not be overlooked, as they are significantly associated with adverse neonatal outcomes and increased obstetric interventions. There is a need to improve CTG interpretation through standardized training and adjunctive tools to reduce inter-observer variability. Incorporating CTG findings with clinical assessment can help optimize decision-making, minimize unnecessary caesarean sections, and improve maternal and neonatal outcomes. Future research should focus on larger, multicentric studies and integration of advanced monitoring techniques to enhance the predictive accuracy of CTG.

CONCLUSION

The present study demonstrates that suspicious cardiotocography (CTG) patterns are significantly associated with adverse intrapartum and neonatal outcomes, including increased operative deliveries, low Apgar scores, higher rates of NICU admission, and greater need for neonatal resuscitation. The findings highlight that even non-pathological but suspicious CTG tracings should not be underestimated, as they reflect early fetal compromise. While CTG remains a valuable tool for intrapartum fetal surveillance, its interpretation must be integrated with clinical assessment to avoid unnecessary interventions. Strengthening CTG interpretation skills and adopting a balanced approach to decision-making can help optimize maternal and neonatal outcomes while minimizing avoidable cesarean sections.

REFERENCES

1. Faruqi A, Shrestha S, Shrestha R, Pradhan A. Role of cardiotocography in predicting perinatal outcome in high-risk pregnancies. J Nepal Health Res Counc. 2018;16(3):320–325.
2. World Health Organization. WHO recommendations: intrapartum care for a positive childbirth experience. Geneva: WHO; 2018.
3. Freeman RK, Garite TJ, Nageotte MP, Miller LA. Fetal heart rate monitoring. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2012.
4. Gibb D, Arulkumaran S. Fetal monitoring in practice. 3rd ed. London: Butterworth-Heinemann; 2017.
5. Parer JT, Ikeda T. A framework for standardized management of intrapartum fetal heart rate patterns. Am J Obstet Gynecol. 2007;197(1):26.e1–26.e6.
6. Ingemarsson I, Arulkumaran S, Ingemarsson E. The admission test: a screening test for fetal distress in labor. Obstet Gynecol. 1986;68(6):800–806.
7. FIGO Working Group on Intrapartum Fetal Monitoring. FIGO consensus guidelines on intrapartum fetal monitoring. Int J Gynecol Obstet. 2015;131(1):13–24.

8. Blix E, Reinar LM, Klovning A, Øian P. Interobserver agreement in assessment of fetal heart rate recordings. Acta Obstet Gynecol Scand. 2003;82(7):635–640.
9. Alfirevic Z, Devane D, Gyte GM. Continuous cardiotocography (CTG) as a form of electronic fetal monitoring for fetal assessment during labour. Cochrane Database Syst Rev. 2017;2:CD006066.
10. Indiramani P, Singh A, Verma A. Role of cardiotocography in predicting perinatal outcome in term pregnancies. Int J Reprod Contracept Obstet Gynecol. 2019;8(5):1920–1924.
11. Panda S, Das A, Samal S, Ghose S. Admission cardiotocography: its role in predicting fetal outcome in low-risk pregnancies. J Clin Diagn Res. 2015;9(9):QC01–QC04.
12. Nageotte MP. Electronic fetal monitoring: clinical applications. Clin Obstet Gynecol. 2016;59(3):633–642.
13. Devane D, Lalor J. Midwives' interpretation of fetal heart rate patterns. Birth. 2005;32(2):133–140.
14. Amer-Wåhlin I, et al. Fetal ECG ST analysis for intrapartum monitoring. Lancet. 2001;358(9281):534–538.
15. Vintzileos AM, et al. Intrapartum fetal monitoring and outcomes. Obstet Gynecol. 2005;106(5):1021–1028.
16. Alfirevic Z, Devane D, Gyte GM. Continuous CTG monitoring during labour. Cochrane Database Syst Rev.2017;2:CD006066.
17. Clark SL, et al. Neonatal outcomes and CTG patterns. Am J Obstet Gynecol. 2013;209(2):89–97.
18. Barber EL, et al. Operative delivery and fetal monitoring. Obstet Gynecol. 2011;118(1):29–38.
19. Grivell RM, et al. Antenatal cardiotocography. Cochrane Database Syst Rev. 2015;9:CD007863.
20. Westgren M, et al. CTG interpretation and neonatal outcomes. Acta Obstet Gynecol Scand. 1998;77(2):161–166.
21. Blix E, et al. CTG and perinatal mortality. Acta Obstet Gynecol Scand. 2003;82(7):635–640.
22. Sheiner E, et al. Nuchal cord and pregnancy outcomes. Arch Gynecol Obstet. 2006;274(2):81–83.
23. Collins JH. Umbilical cord accidents. Semin Perinatol. 2002;26(1):79–82.
24. Parer JT, Ikeda T. Standardized CTG interpretation. Am J Obstet Gynecol. 2007;197(1):26.e1–26.e6.