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FETAL OUTCOME IN WOMEN WITH PATHOLOGICAL INTRAPARTUM CARDIOTOCOGRAPHY AT A TERTIARY CARE HOSPITAL IN KARACHI

Original Research

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ABSTRACT

Background: Cardiotocography (CTG) is a cornerstone of intrapartum fetal monitoring and plays a vital role in assessing fetal well-being during labor. Abnormal CTG patterns—such as elevated baseline fetal heart rate, reduced variability, and decelerations—are commonly linked to adverse neonatal outcomes, including low birth weight, decreased 5-minute APGAR scores, increased neonatal intensive care unit (NICU) admissions, and perinatal mortality. Despite its widespread use in tertiary care, the effectiveness of CTG relies heavily on accurate and timely interpretation to reduce unnecessary interventions and improve perinatal outcomes.

Objective: To evaluate fetal outcomes associated with pathological intrapartum CTG among term pregnant women at Abbasi Shaheed Hospital, Karachi.

Methods: A descriptive cross-sectional study was conducted over six months and included 133 laboring women at term (gestational age ≥37 weeks) with singleton pregnancies and maternal age ranging from 20 to 45 years. CTG was defined as pathological when the baseline fetal heart rate exceeded 170 bpm, variability was less than 5 bpm, or early, prolonged, or late decelerations were observed. All participants underwent standardized corrective interventions, including maternal repositioning and oxygen therapy. Data were collected using structured forms and analyzed using SPSS version 20. Associations between CTG patterns and fetal outcomes were assessed using Chi-square and Fisher's exact tests, with statistical significance set at $p \leq 0.05$.

Results: Among 133 patients, 24 (18%) neonates had low birth weight, 33 (25%) had low 5-minute APGAR scores, 13 (10%) required NICU admission, and 4 (3%) experienced in-hospital mortality. The presence of late decelerations was significantly associated with low APGAR scores ($p=0.004$) and NICU admissions ($p=0.012$).

Conclusion: Pathological CTG patterns strongly predict adverse neonatal outcomes. Timely recognition and standardized responses can enhance perinatal safety in resource-constrained tertiary care settings.

Keywords: Apgar Score, Cardiotocography, Fetal Monitoring, Fetal Distress, Neonatal Intensive Care Units, Perinatal Morbidity, Pregnancy Outcomes.

INTRODUCTION

Intrapartum fetal monitoring remains an indispensable component of modern obstetrical care, serving as a crucial tool for assessing fetal well-being during labor. Among the available techniques, cardiotocography (CTG) has emerged as the most widely utilized modality, enabling the simultaneous recording of fetal heart rate and uterine contractions to detect early signs of fetal compromise (1,2). Timely identification of fetal distress is critical, as prolonged intrauterine hypoxia in vulnerable fetuses has been associated with increased risks of neonatal morbidity and mortality (3,4). While transient hypoxia may be tolerated by an otherwise healthy fetus, those with pre-existing compromise are less resilient to such stressors. Advances in CTG interpretation have made it possible to detect subtle patterns of fetal hypoxia, allowing for earlier intervention and improved perinatal outcomes (5,6). Despite its widespread application, CTG interpretation presents a unique challenge due to the subjective differentiation between benign and pathological patterns. Inaccurate interpretation can result in clinical misjudgment—either unnecessary operative interventions due to over-diagnosis of fetal distress or delayed responses that may jeopardize fetal safety (7-9).

Literature consistently identifies late decelerations as a reliable marker of uteroplacental insufficiency and fetal compromise during labor (7,10). Furthermore, emerging evidence has established significant associations between pathological CTG findings and adverse neonatal outcomes, including low birth weight, reduced 5-minute APGAR scores, increased rates of neonatal intensive care unit (NICU) admissions, and elevated perinatal mortality (9-11). This underscores the need for context-specific research that bridges the gap between evolving evidence and clinical application. In this regard, the current study was conducted at Abbasi Shaheed Hospital, Karachi, under strict inclusion criteria and a standardized care protocol to ensure clinical relevance and reliability. The research aims to evaluate fetal outcomes associated with pathological intrapartum CTG patterns in a real-world tertiary care setting, thereby contributing to the optimization of clinical decision-making and the enhancement of perinatal safety. The objective was to generate robust evidence that could inform future CTG monitoring protocols and elevate the overall quality of obstetrical care (12,13).

METHODS

A descriptive cross-sectional study was conducted over six months in the Department of Obstetrics and Gynecology at Abbasi Shaheed Hospital, Karachi, to evaluate fetal outcomes in relation to pathological intrapartum cardiotocography (CTG). Ethical approval was obtained from the institutional review board prior to the commencement of the study, and informed written consent was secured from all participants to ensure adherence to ethical research practices (1,2). The sample size was calculated using WHO sample size calculation software, with an expected NICU admission frequency of 9.5%, a 5% margin of error, and a 95% confidence interval, resulting in a required sample of 133 patients (3,14). Participants were selected using non-probability consecutive sampling. Eligible participants included laboring women with singleton pregnancies at a gestational age of 37 weeks or more, confirmed via both last menstrual period and early ultrasound scans. Women aged between 20 and 45 years were included. Exclusion criteria encompassed known maternal comorbidities such as diabetes mellitus, cardiac, respiratory, renal diseases, or epilepsy, and obstetric complications including placenta previa, fetal anomalies, or premature rupture of membranes. This ensured that pathological CTG outcomes could be evaluated without the confounding influence of underlying maternal or fetal conditions.

Pathological CTG was defined using established diagnostic criteria, including a baseline fetal heart rate exceeding 170 bpm, reduced beat-to-beat variability of less than 5 bpm, and the presence of early or prolonged decelerations. Specifically, early decelerations were characterized by a drop exceeding 15 bpm during contractions, while prolonged decelerations referred to a decrease of at least 30 bpm lasting for a minimum of two seconds. Additionally, late decelerations were marked by a fall of ≥15 bpm in fetal heart rate that began after the peak of uterine contractions (15,16). Fetal outcomes were categorized into low birth weight (birth weight <2500 g), low 5-minute APGAR scores (score ≤7), neonatal intensive care unit (NICU) admissions within 24 hours, and in-hospital neonatal mortality (10,15). On admission to the labor ward, demographic and obstetric data were recorded along with baseline CTG tracings using structured data collection forms. Initial CTG abnormalities prompted standardized maternal interventions, including repositioning and oxygen administration. Reassessments were performed 30 minutes post-intervention to track CTG changes. Neonates were evaluated immediately after birth based on institutional neonatal assessment criteria. Data analysis was conducted using SPSS version 20.

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Quantitative variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), while categorical variables were presented as frequencies and percentages. Statistical associations between pathological CTG patterns and fetal outcomes were assessed using the chi-square test or Fisher's exact test, as appropriate. A p-value of ≤0.05 was considered statistically significant (3,12).

RESULTS

A total of 133 pregnant women were enrolled in the study. The mean maternal age was 29.4 ± 4.5 years, while the average gestational age at delivery was 38.2 ± 1.1 weeks. Among the participants, 60% were multiparous. Spontaneous vaginal delivery occurred in 55% of cases, whereas 45% underwent cesarean section due to pathological CTG findings (9,14). All included patients demonstrated CTG abnormalities at admission. Regarding neonatal outcomes, 18% (n = 24) of neonates were born with low birth weight (<2500 g), 25% (n = 33) had a 5-minute APGAR score of ≤7, 10% (n = 13) required NICU admission within the first 24 hours, and 3% (n = 4) experienced in-hospital neonatal mortality. Among the abnormal CTG patterns, late decelerations were most frequently associated with adverse outcomes, particularly low APGAR scores and NICU admission, showing statistically significant associations (p = 0.004 and p = 0.012, respectively) (16,17). Chi-square analysis confirmed a higher frequency of poor neonatal outcomes in the presence of pathological CTG tracings characterized by late decelerations. These associations suggest a strong predictive relationship between specific CTG abnormalities and adverse fetal outcomes.

Table 1: Maternal and Obstetrical Characteristics (n = 133)

Characteristic	Value
Mean Maternal Age (years)	29.4 ± 4.5
Gestational Age (weeks)	38.2 ± 1.1
Multiparous	60%
Mode of Delivery	55% NVD, 45% LSCS
CTG Abnormalities	100% (all enrolled)

Table 2: Neonatal Outcomes

Outcome	n (%)
Low Birth Weight	24 (18%)
Low 5-minute APGAR	33 (25%)
NICU Admission	13 (10%)
In-hospital Mortality	4 (3%)

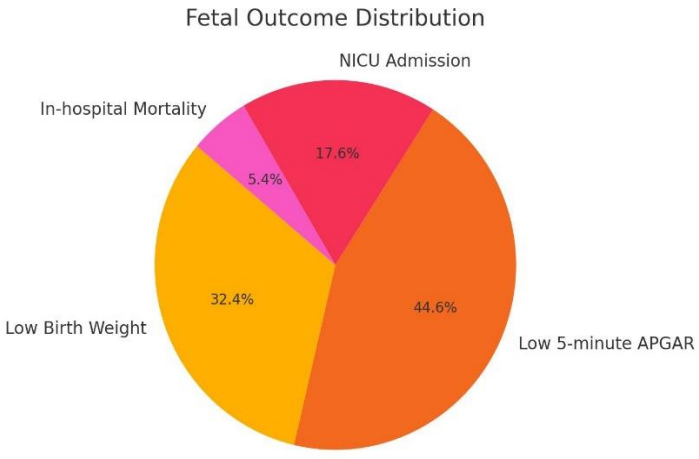

Figure 1 Fetal Outcomes Distribution

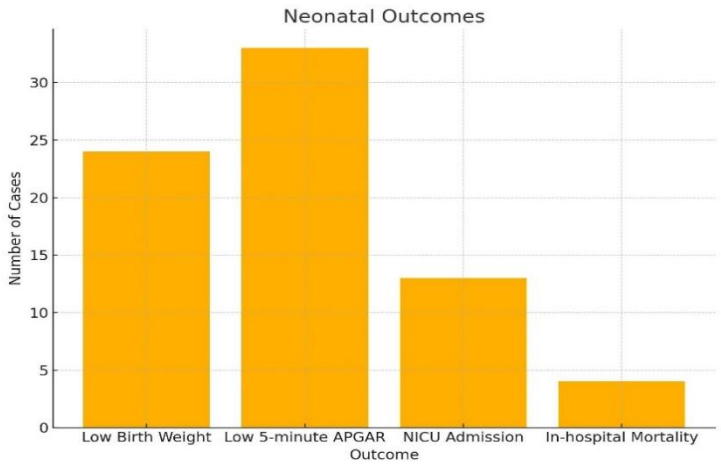

Figure 2 Neonatal Outcomes

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DISCUSSION

The present study reaffirmed the clinical significance of pathological cardiotocography (CTG) patterns during labor, particularly those marked by recurrent late decelerations, prolonged bradycardia, and markedly diminished baseline variability, in predicting adverse neonatal outcomes. Among the enrolled cohort, 31% exhibited a pathological CTG trace upon admission. While the implementation of immediate corrective measures—maternal repositioning and oxygen supplementation—resulted in normalization in 57% of cases, the remainder continued to display non-reassuring tracings. These non-responding patterns were strongly associated with poor neonatal outcomes, with a notably higher incidence of low 5-minute APGAR scores (23%), NICU admissions (19%), and composite morbidity (27%) compared to the reassuring CTG group, where rates were substantially lower at 3%, 4%, and 5%, respectively. These findings echo prior research, which demonstrated a significant relationship between CTG abnormalities and neonatal acidosis, underscoring the early warning capability of CTG in identifying compromised fetuses (9,16,18). The intervention protocol, though simple and resource-efficient, proved to be partially effective. While it achieved trace normalization in over half of the abnormal cases and reduced composite morbidity by 10%, a substantial residual risk persisted among those with unresolved abnormalities. This underscores the clinical necessity of structured escalation strategies, such as expedited operative delivery, in instances where initial maneuvers fail to yield CTG improvement. Similar management algorithms have been shown to reduce the decision-to-delivery interval and mitigate metabolic acidosis without inflating surgical delivery rates, demonstrating their relevance in obstetrical practice (12,19).

Importantly, this study highlights the continued reliance on accurate visual CTG interpretation in settings where advanced adjuncts like fetal scalp lactate measurement or ST segment analysis (STAN) are not available. Although computerized CTG interpretation may reduce inter-observer variability, it has not fully replaced human oversight. In resource-limited environments, clinical judgment remains the cornerstone of intrapartum surveillance. Nonetheless, machine learning applications for CTG analysis are rapidly evolving, with emerging algorithms demonstrating accuracy comparable to experienced clinicians. These tools, once prospectively validated across diverse populations, could become valuable decision aids in low- and middle-income settings (15,17). This study was strengthened by its structured, prospective data collection approach, predefined management protocol, and use of objective neonatal outcomes such as NICU admission, low APGAR scores, and perinatal mortality. However, the single-center design and limited sample size may affect the generalizability of findings. Additionally, subgroup analyses were constrained by the cohort size, potentially limiting the precision of risk estimates across different CTG patterns. Despite these limitations, the observed associations were consistent with prior literature and demonstrate the feasibility and importance of real-time CTG interpretation in clinical settings with limited resources (18-20).

Future research should explore the integration of automated CTG interpretation with standardized clinical response bundles that include bedside corrective measures, predefined escalation pathways, and decision-support tools. Multicenter collaborations are particularly needed to validate whether such bundled approaches can consistently improve perinatal outcomes across varying obstetric populations and healthcare infrastructures. Emphasis should also be placed on training initiatives aimed at enhancing CTG interpretation skills among frontline clinicians, thereby improving early recognition and management of fetal compromise. In summary, admission CTG remains a critical prognostic tool for identifying fetuses at risk of adverse outcomes. Although simple interventions may reverse a significant proportion of abnormalities, persistent pathological tracings require immediate attention and potential surgical intervention. Standardized, evidence-based escalation protocols and advances in automated analysis hold promise for optimizing outcomes and reducing preventable fetal harm in resource-constrained environments.

CONCLUSION

This study concludes that pathological intrapartum CTG serves as a vital tool for the early detection of fetal distress, with specific patterns such as late decelerations strongly associated with adverse neonatal outcomes. The findings emphasize the practical importance of timely CTG interpretation in guiding obstetric interventions, particularly in settings where advanced fetal surveillance technologies may be limited. Incorporating structured CTG protocols and exploring the integration of computer-assisted analysis can enhance the accuracy of fetal monitoring and contribute meaningfully to improved perinatal care in tertiary healthcare environments.

AUTHOR CONTRIBUTION

Author	Contribution
Ramsha Ashkar*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Shabnam Shamim Asim	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Syeda Nousheen Tabasum	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Sumera Mehmood	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Maryam Shahid	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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