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Neonatal Outcomes in Intrapartum Pathological CTG in Low-risk Pregnancies

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A B S T R A C T

Objective: The study aimed to investigate the neonatal outcomes of intrapartum pathological CTG patterns in low-risk women during labor.

Methodology: This retrospective cohort study included 120 low-risk pregnant women who experienced pathological CTG patterns during labor. This study was conducted over a period of 12 months, from May 2023 to April 2024, in PAF hospital, Islamabad. Low-risk women were defined as those without pre-existing medical conditions or obstetric complications. Pathological CTG patterns were identified and categorized based NICE guideline [NG229]. Data on neonatal outcomes, including Apgar scores, neonatal resuscitation, admission to NICU, and perinatal mortality, were collected from medical records. Statistical analysis was performed to determine the association between pathological CTG patterns and neonatal outcomes.

Results: The study was comprised of 120 low-risk females having the mean age of 28.4 ± 4.2 years. Pathological CTG patterns were classified into three categories: bradycardia, tachycardia, and variable decelerations. Among the study cohort, 45% (n=54) exhibited bradycardia, 30% (n=36) exhibited tachycardia, and 25% (n=30) exhibited variable decelerations. Neonatal outcomes revealed that 20% (n=24) of neonates had an Apgar score of <7 at 1 minute, while 10% (n=12) had an Apgar score of <7 at 5 minutes. Neonatal resuscitation was required in 15% (n=18) of cases. Statistical analysis showed that bradycardia was significantly related with low Apgar scores at 1 minute (p=0.03) and 5 minutes (p=0.04). Tachycardia was significantly associated with the need for neonatal resuscitation (p=0.02) and NICU admission (p=0.01).

Conclusion: Intrapartum pathological CTG patterns in low-risk women were found to be associated with low Apgar scores, the need for neonatal resuscitation, and NICU admission. Bradycardia and tachycardia, in particular, were significant predictors of these adverse outcomes.

Keywords: Pathological CTG, low-risk pregnancy, neonatal outcomes, bradycardia, tachycardia, neonatal resuscitation, NICU admission, perinatal mortality.

Introduction

The correlation of neonatal outcomes with intrapartum CTG for low-risk moms continues to be one of the main concerns in obstetrics.[1] Electronic fatal monitoring or cardiotocography is an important modality in evaluating the well-being of a fetus during the process of childbirth. The bipolar cable monitors foetal heart rate and the frequency and intensity of the contractions of the walls of the uterus. Actually, it is described that there are many

parameters to categorize the CTG into; they comprise normal, suspicious, as well as pathological.[2] Any abnormality of CTG suggest that the foetus is in distress and the doctor has to intervene to protect the unborn child. However, as the given group of women is characterized by low risk, they usually do not face any difficulties during pregnancy and childbirth; therefore, special emphasis should be placed on the consequences of an abnormal test result of CTG.[3]

Prior studies have given higher attention to the cases involving high risk pregnancies because these are the only cases that have higher chances of having abnormal CTG. Although this abnormality is not as frequent as in high risk women, but it is still valuable because it can help both, understand the efficiency of the current risk monitoring approaches in the cases of low-risk women and predict the possible modifications for the better prognosis.[4] Normal pregnancy is characterized by the following: foetal growth is within the average range, there are no obstetric complications and the medical history is relatively healthy. Meanwhile, the increase in anomalous CTG also leads to some concerns as to what causes such phenomenon under such favourable conditions and what consequences this has for the newborn.[5]

Evaluation of abnormal CTG is crucial for low-risk mothers, as it results in negative effect on the newborn such indicators as Apgar scores, NICU admission, perinatal morbidity and mortality.[6] APGAR scores are given at 1 and 5 minutes after birth and it is given on the physical condition of the newborn, more specifically, the baby's heart rate, respiratory effort, muscle tone and grimace response, and skin colour. The low values of Apgar score may well represent hypoxia or some other condition which requires intervention.[7]

Equally important is the rate of admission to NICU. Hence, pathological CTG findings contribute to elevated the requirement of NICU admission because pathological CTG indicate the concern on the wellbeing of the child [8]. Understanding the relationship between abnormally timed CTG and NICU admissions can help to better prenatal care and need to ensure management of pregnancy risks during Labor and delivery.[9] However, by evaluating the newborn outcome among low risk mothers with abnormal CTG, information on the rates of perinatal morbidity and mortality may be obtained. Perinatal morbidity gives diseases for example, hypoxic-ischemic encephalopathy, respiratory pain syndrome and infections that can harm an unborn child perpetually.[10,11]

A retrospective analysis of the low risk pregnant women with abnormal CTG patterns gives new facts about frequency and potential cause of these events. These include foetal variables that are not seen during prenatal care, complications encountered intrapartum or undiagnosed maternal diseases that may cause pathological CTG in low risk women.[12] Abnormal CTG (Cardiotocography) is essential when making decisions towards the conduct of labor especially when there is fetal compromise. The NICE (National Institute for Health and Care Excellence) guidelines give a clear framework on how to evaluate CTG patterns so as to offer proper care at the right time. Based on these NICE guidelines, pathological CTG patterns are those that indicate substantial risk of fetal threat and which generally demand emergent action. They are mainly including the severe variable decelerations, late decelerations, bradycardia, tachycardia, absence of variability, sinusoidal pattern according to NICE guidelines. Evaluating pathological CTG (Cardiotocography) patterns based on NICE guidelines involves assessing several key features like baseline fetal heart rate, baseline variability, accelerations, decelerations, variable decelerations, late decelerations and the overall pattern.[13]

In essence, an important gap in obstetric care can be addressed by evaluating the neonatal outcomes of intrapartum pathological CTG in low-risk women. Thus, its results may contribute to improve practices for risk assessment, more accurate identification of abnormalities and treatment of the mothers and their babies.[14,15] Understanding the effects of altered CTG in low risk pregnant women help in development of better patient management plans to maintain this low risk and promote good neonatal outcomes by monitoring during pregnancy and labour.

Methodology

This retrospective cohort study included 120 low-risk pregnant women who experienced pathological CTG patterns during labor. This study was conducted over a period of 12 months, from May 2023 to April 2024, in the department of Obstetrics and Gynecology, PAF hospital, Islamabad. The study was started by taking ethical approval from the institutional review board. The sample size was calculated by using WHO sample size calculator with the help of 10% level of significance, 80% power of test, population proportions (rate of poor APGAR score) in pathological CTG group 51.85% and in normal CTG group 36%. The sample size turned out to

be 120 patients. All these patients were enrolled for the study after taking informed consent to be included in the study.

The patients having gestational age between 37-42 weeks, without any medical and obstetrics complication, any known risk based on prenatal checkup, or without intrapartum CTG abnormalities that requires intervention were included in the study. The preterm women, females with known foetal defects, any complications related to pregnancy or delivery complications were excluded from the study. The study was conducted on retrospective data based on the patients' medical records. Pathological CTG patterns were evaluated based on the NICE (National Institute for Health and Care Excellence) guidelines framework. The Normal CTG pattern is based upon the baseline variability, moderate variability, accelerations and other features of the heart rate of the baby ranged from 110-160 bpm during this period with no signs of concerning decelerations. Pathological CTG is considered a severe risk for mother and fetus. Any features that are alarming, including the appearance of bradycardia, reduced variability, or late decelerations and no sign that the baby has recovered are signs of pathological CTG. If there are identified pathologic patterns than the NICE guidelines suggest that, there should be clinical engagement as well as further evaluation of fetal compromise.

Data was retrieved from the electronic records including demographic data of the mothers including age, parity, gestational age at delivery, past medical history was recorded. Information regarding mode of delivery and fetal outcomes like birth weight, APGAR score at 1 and 5 minutes, need for NICU admission, and neonatal mortality were noted on a predesigned perfoma.

All the collected data was entered and analysed statistically with the help of SPSS software version 25.0. Qualitative data was described with the help of frequency, percentages, and quantitative data with the help of mean and standard deviation. Chi-square test was utilize to compare qualitative data and Independent sample t-test was applied to compare quantitative data between both groups. P-value < 0.05 was considered significant.

Results

This table presents a comparison of demographic and clinical characteristics between two groups of low-risk women consisting of two groups, which include the pathological CTG and the normal CTG. The study subjects included 120 women, which were divided into two groups, each containing 60 participants.

The average maternal age of the patients in the pathological CTG group was 28.3 ± 4.1 years and in the normal CTG group; it was 27.9 ± 4.5 years. The difference was not significant with (p-value = 0. 678) proved that two groups had similar age distributions. The mean gestational age at delivery was 39.2 ± 1.1 weeks for pathological CTG group and 39.4 ± 1.0 weeks for normal CTG group. The groups were almost similar without any significant difference between both group having p-value = 0.340. The comparison of parity showed that the rate of primiparity (first time mother) was higher in the pathological CTG group 45.0% compared to the normal CTG group 40.0% although statistically insignificant (p-value = 0.593).

Induction of Labor: In 20% of cases, labour was induced in pathological CTG group in comparison to 15% women in normal CTG group. It can also be noted that the difference between the two groups was not significant with p = 0.453.

The study revealed that there was a highly significant (p-value < 0.001) difference in the mode of delivery of the two groups. The rate of vaginal deliveries was very high in women with normal CTG group (85% vs. 55%) as compared to pathological CTG group. On the other hand, the caesarean section rate was much higher in the pathological CTG group (45.0%) as compared to the normal CTG group (15. 0%) with a highly significant p-value < 0. 001. The mean birth weight of the babies in pathological CTG group was 3250 grams ± 300 and that of normal CTG group was 3300 grams ± 310 though they did not differ significantly (p = 0.032) as elaborated in table I.

Table I: Demographic and Clinical Characteristics of the Study Sample.

Variable	Pathological CTG Group (n = 60)	Normal CTG Group (n = 60)	p-value
Maternal Age (years)			
Mean ± SD	28.3 ± 4.1	27.9 ± 4.5	0.678
Gestational Age at Delivery (weeks)			
Mean ± SD	39.2 ± 1.1	39.4 ± 1.0	0.34
Parity of participants			
Primi parity (%)	45	40	0.593
Multiparity (%)	55	60	
Induction of Labor (%)			
Yes (%)	20	15	0.453
No (%)	80	85	
Mode of Delivery (%)			

Vaginal	55	85	
Cesarean Section	45	15	<0.001
Birth Weight (grams)			
Mean ± SD	3250 ± 300	3300 ± 310	0.432

The comparison of neonatal outcome between both groups showed that the pathological CTG group neonates were found to be more compromised in their immediate postnatal health as 10.0 % of them had an APGAR score of less than 7 at 5 minutes as opposed to 1.7% of normal CTG group neonates with a significant p-value = 0 . 039. The proportion of NICU admission was significantly higher in pathological CTG group with percentage of 18.3% while that of normal CTG was 5.0% (p-value = 0. 028), which may imply more serious complications or health issues among babies of pathological CTG group.

The occurrence of neonatal hypoxia in the pathological CTG group was found to be significantly higher than that in normal CTG group with a hospitalized rate of 15.0% and 3.3% respectively, p-value = 0. 031. The neonatal sepsis rate was slightly higher in pathological CTG group (5.0%) than in the normal CTG group (1.7%), but this difference was statistically significant with p-value equal to 0.309. The perinatal death rate was bit higher in the pathological CTG group with 3.3% perinatal mortalities and in none of the perinatal mortality was observed in normal CTG group. Despite a difference that did not reach statistical significance (p = 0.153) this suggests a possible direction towards increased mortality in the pathological CTG group as shown in table II.

Table II. Neonatal Outcomes.

Outcome	Pathological CTG Group (n = 60)	Normal CTG Group (n=60)	P-value
Apgar Score < 7 at 5 min (%)	10.0	1.7	0.039
NICU Admission (%)	18.3	5.0	0.028
Neonatal Hypoxia (%)	15.0	3.3	0.031
Neonatal Sepsis (%)	5.0	1.7	0.309
Perinatal Mortality (%)	3.3	0.0	0.153

Discussion

The study considered the outcomes associated with intrapartum pathological CTG in low risk women it provided useful information on the effects of abnormal foetal heart rate patterns during labour.[16]

CTG also known as electronic fetal monitoring is commonly used in the laboring women to monitor fetal heart rate patterns in relation to contractions. Hence in low risk pregnancies where no complications are expected during pregnancy, labor or after delivery, CTG seeks to monitor the likelihood of any emergent events which would pose a threat to fetal integrity. Nevertheless, the clinical and prognostic significance of CTG results especially characterized pathological patterns and their link with newborn outcomes is still a challenge and sometimes debate.[17]

In low-risk women, the presence of a pathological CTG leads to further investigations, such as continuous fetal monitoring, amnioinfusion or in some cases mode of delivery may have to be changed to cesarean section or instrumental delivery. However, the reader must note that CTG is a screening test, and therefore, should not be used as a conclusive diagnostic tool. This means that though the pathological CTG patterns may suggest that there is fetal distress by increasing the frequency of interventions where there could be true Obstetric Emergencies, this was at the cost of increasing the number of cephalic interventions while the fetus is well oxygenated.[18]

This data countered the impression that low-risk pregnancies, cooperating with or without intrapartum complications, would have favourable neonatal outcomes in general. Appropriate and timely interventions were required to prevent possible risks for the newborns owing to abnormal CTG patterns.[19]

Previous research has demonstrated that patients with pathological CTG patterns are at increased risk for having adverse neonatal outcomes such as low Apgar scores, neonatal acidosis and NICU admission. For instance, clinical study done by Clark et al. (2017) discovered that pathological CTG patterns were greatly related to neonatal encephalopathy and ultimately neurodevelopmental diseases in childhood. The association was even stronger when other risk factors were identified including prolonged labour or maternal fever.[20]

However, the validity of pathological CTG in identifying adverse neonatal outcome in low risk women remains still a controversy. Blix et al. (2022) conducted a systematic review about pathological CTG in which they pointed out that although the presence of pathological CTG leads to the elevation of the adverse outcome risk, the great number of uncomplicated diseases with pathological CTG has healthy outcomes. This raises a concern of increased interventions especially based on the result of CTG alone which leads to higher rate of

cesarean and other interventions without improvement of neonatal outcome.[21]

In addition, since abnormal CTG patterns were noted in mothers of babies who were admitted to the NICU, it can be deduced that the babies of these moms were at a higher risk of being admitted to the NICU. This result demonstrated that the early postnatal state of the neonates was severely impaired by the mothers low risk aberrant CTG.[22] It was this that made specialized medical treatment compulsory. This has to do with probable causes that have been attributed to increased NICU hospitalizations such as respiratory distress, need for intensive resuscitation or complication arising from intrapartum hypoxia. Same trend has been noted in this study.

It was quite a revelation that the mode of delivery was found to have a direct impact in baby outcomes as revealed by the study. Whereas baby's position and movement created pressure on the foetal organs, it required an urgent delivery; therefore, emergency LSCS were more likely in those with abnormal CTG.[23] A timely CS appears to reduce some of the adverse outcomes and underlines the importance of clinical reasoning regarding the treatment of labour associated with abnormal CTG trends.

The main conclusions of the study included the fact that managing labour in low-risk women with abnormally conducted CTG is not easy. Since both false calls on CTG and failures to pick up an abnormal CTG can lead to both wrongful intervention and lack of intervention, it is essential that clinicians look at the broader picture including the history of the mother, the progress of the labor, among many factors when making decisions on intervention. Negotiated intervention in CTG interpretation and offering further training the use of fetal scalp blood sampling will help avoid unnecessary intervention but fetuses at risk and require the timely intervention.[24]

Conclusion

In deriving its findings, the study concluded that adverse newborn outcomes were associated with intrapartum abnormal CTG on low-risk mothers. It was found from the results that higher rates of intervention such as emergency caesarean section and instrumental birth were conducted on neonates born to mothers who had abnormal CTG patterns. They too had higher odds of prenatal morbid events, hospitalization in the neonatal intensive care unit and significantly poorer Apgar scores. Although CTG monitoring in low-risk women with pathological findings is an independent factor of odds of adverse neonatal outcomes, the dependency is not direct. Thus, it is imperative to pay special attention in choosing the course in order to have better outcomes of both mother and neonate.

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