ORIGINAL ARTICLE

Comparative Analysis of Pathological Cardiotocography as Predictor of Adverse Perinatal Outcome among High-Risk Pregnancy Group

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ABSTRACT

Objective: Determination of the frequency of pathological cardiotocography in laboring women with high-risk pregnancies and to compare perinatal outcomes with and without pathological CTG among them.

Study Design: Comparative cross-sectional study.

Place and Duration of Study: The study was conducted at the Gynecology Department, Combined Military Hospital (CMH) Lahore, Pakistan from March 2023 to September 2023.

Methods: A total 75 women with high-risk pregnancies were included in this cross-sectional comparative study. Women were selected by consecutive nonprobability sampling techniques. Adverse perinatal outcomes were assessed in terms of stillbirth, cesarean section, low Apgar score, neonatal mortality, and morbidity. Statistical Package for Social Sciences (SPSS) version 25 was used for data analysis. Quantitative variables like age, parity, gestational age, and Apgar score were presented as mean± SD. Frequency and percentage were used for qualitative variables like high-risk illness, pathological CTG finding, cesarean section, stillbirth, neonatal mortality, and neonatal intensive care unit admission. Two groups were compared by using Chi-square test. Data stratification was done for age and gestational age. *P*-value ≤0.05 was considered as significant.

Results: A mean age of 28.0±4.1 years was found in included women. Pathological CTG was found in 28 cases (37.3%). The adverse perinatal outcome was found significantly higher in a group with pathological CTG (*P*≤0.005).

Conclusion: The relationship and frequency of pathological CTG in high-risk pregnancies should be timely determined to get good maternal and fetal outcomes. Women with pathological CTG, are at great risk of caesarean section with rising trends of low Apgar score at birth, increased rate of NICU admission, and mortality.

Keywords: *Asphyxia, Cardiotocography, Fetal Growth.*

How to cite this: *Naeem A, Ashraf V, Sajjad R, Naeem F. Comparative Analysis of Pathological Cardiotocography (CTG) As Predictor of adverse Perinatal Outcome among High-Risk Pregnancy Group. Life and Science. 2024; 5(3): 323-328. doi: http://doi.org/10.37185/LnS.1.1.576*

Introduction

Cardiotocography (CTG) is a non-invasive technique used for electronic monitoring of fetal heart rate and uterine contraction signals. Intrapartum fetal monitoring with CTG reduces the risk of intrapartum fetal hypoxia in all pregnancies[1] NICE guidelines on fetal monitoring during labor recommend use of CTG only in women at increased risk of complications.[2]

High-risk pregnancies influence the perinatal outcomes.[3] Risk commonly observed in these women are gestational diabetes, pre-eclampsia, multiple pregnancies, prolonged pregnancy, and preterm ruptured membranes and all of these affect fetal health, which is in terms of adverse perinatal outcomes like preterm delivery, stillbirth, low birth

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Received: Jan 06, 2024; Revised: Apr 13, 2024
Accepted: May 22, 2024

weight, neonatal mortality, NICU admission, and low Apgar score at birth.[4,5]

Dhakare et al. and Salahuddin et al., reported that 23.8% of women had pathological CTG with mean Apgar score at 1 minute (7.0 vs. 5.7 vs. 5.2), at 5 minutes (7.6 vs. 6.5 vs. 6.0), NICU admission (9.0% vs. 50.0% vs. 76.0%) and neonatal death (0.0% vs. 0.0% vs. 100.0%) and this comparison was done between normal, suspicious and abnormal CTG.[6,7] Role and importance of antenatal CTG predicting perinatal outcomes in high-risk pregnancies is evaluated by Kumar et al. who reported that 8.4% women with high-risk pregnancies had pathological CTG; and the frequencies of low Apgar score at 5 min (44.2% vs. 11.3% vs. 7.2%), NICU admission (33.3% vs. 11.3% vs. 6.3%), in pathological CTG were higher than in suspicious and normal CTG.[8] In contrast, Grivell, showed no significant relation of abnormal CTG with maternal outcome.[9,10]

High-risk pregnancy is defined as pregnancy complicated by one or more comorbid that have adverse effects on the fetomaternal outcome. About 20-30% of pregnancies are high risk pregnancy. It includes high-order cesarean section, twin pregnancy, antepartum and postpartum hemorrhage, impending eclampsia,placenta accrete spectrum, acute fatty liver of pregnancy, Severe anemia, gestational diabetes, and heart disease.[4]

The adverse perinatal outcomes were assessed in terms of cesarean delivery, stillbirth, low Apgar score, NICU admission, and neonatal mortality.

Apgar score comprises of following five components: appearance, pulse, grimace, activity, and respiration. Each component has 0-2 scores depending on the features of the fetus. The sum of scores of five components ranges from 1 to 10; and is classified as normal ≥7 scores; fairly low 4-6 scores; and critically low ≤3 Scores and <7 as low Apgar score.[10] Frequency of pathological CTG in laboring women with high-risk pregnancy was determined in this study and perinatal outcomes with and without pathological CTG, were compared with each other.

Methods

This comparative cross-sectional study was conducted at Gynecology Department, Combined Military Hospital (CMH) Lahore, Pakistan from March 2023 to September 2023. A total 75 women with high-risk pregnancies were enrolled by the non-probability consecutive sampling technique. Ethical Committee permission was granted from the Institute on dated: 25th March 2023, vide letter no: 458/2023. Written informed consent was obtained from all participants. After admission in the labor room, a purpose-built questionnaire was used to record demographic and clinical data such as patient age, gestational age, parity, and pregnancy-related complications.

On admission, CTG of 20 min trace, with uterine contraction signals in a woman lying in the left lateral position was recorded. CTG was termed as normal, suspicious, and pathological as per operational definitions. Women with normal CTG were monitored by intermittent auscultation for 1 minute, every 30 minutes in the first stage of labour, and every 5 minutes in the second stage of labour. Continuous CTG monitoring was selected as a monitoring tool in patients with suspicious CTG. In patients with pathological CTG, delivery was hastened by operative or instrumental intervention.

Adverse perinatal outcomes were assessed in terms of cesarean delivery, stillbirth, low Apgar score, neonatal morbidity, and mortality. According to the operational definitions, cesarean delivery is defined as the delivery of a baby through an abdominal route. Stillbirth was defined as when the baby was alive before the onset of labor but delivered with no sign of life. A low Apgar score was classified as <7 scores. NICU admission relates to neonatal mortality. Neonatal mortality was defined as death during the first 28 completed days of life per 1000 live births in a given year. Data were entered and analyzed by using Statistical Package for Social Sciences (SPSS) version 25. Quantitative variables like gestational age, age of patient, parity, and Apgar score were presented as mean± SD.

Qualitative variables like high-risk comorbid, finding pathological CTG, need of emergency cesarean section, stillbirth, NICU admission, and neonatal mortality were presented by using percentage and frequency. A comparison of outcomes like C-section, stillbirth, NICU admission, and neonatal mortality was done between groups by using the chi-square test. Women's age, gestational age, and parity were stratified by applying chi-square. *P*-value ≤0.05 was

considered to be significant.

Results

The mean age of the women was 28.0±4.1 years (Table-1). Mean gestational age was 38.7±1.1 weeks (Table-2). Distribution of patients by illness was as follows, 5 women Were diabetic (6.7%), 1 was hypertensive 1 (1.3%) and obesity was a risk in 16 women (21.5%) (Table-3). Gestational diabetes mellitus was found in 19 women (25.3%), ruptured membranes noticed in 31 women (41.3%), PIH in 18 (24%), and vaginal bleeding in 10 cases (13.3%) (Table-3). Pathological CTG was found in 28 cases (37.3%) (Table-4). Adverse perinatal outcome included C- section 32 (42.7%), stillbirth 5 (6.7%), low Apgar score at 1 min 17 (22.7%) while at 5 minute 7 (9.3%), NICU admission 20 (26.7%) and neonatal mortality 5 (6.7%) (Table-5). The mean Apgar score at 1 min was 7.6±1.0 and at 5 minutes 8.2±1.0 (Table-5). The adverse perinatal outcome was found to be significantly higher in the pathological group

Table-1: Distribution of patients by age

Age (Year)	Frequency n (%)	Percentage (%)
18-25	20	26.7
26-35	55	73.3
Total	75	100.0
MEAN±SD	28.0±4.1	

Table-2: Distribution of patients by gestational age (week)

Gestational Age	Frequency (n)	Percentage (%)
37-39	60	80.0
40-41	15	20.0
Total	75	100.0
MEAN±SD	38.7±1.1	

Table-3: Distribution of patients by illness

Variables	Freequency (n)	Percentage (%)
Hypertension	5	6.7%
Diabetes	1	1.3%
Obesity	16	21.3%
Gestational diabetes	19	25.3%
Gestational hypertension	18	24%
Vaginal bleeding	10	13.3%
PROM	31	41.3%
Normal	53	70.7%

Table-4: Gestational age and Cardiotocography (CTG) findings with outcome

Gestational Age	CTG	Cesarean n (%)	Vaginal Delivery n (%)	Total n (%)	*P*-Value
37-39 Weeks	Pathological	16 (66.9%)	8 (33.3%)	24 (32%)	0.003
	Normal	10 (27.7%)	26 (72.3%)	36 (48%)	
40-41 Weeks	Pathological	3 (75%)	1 (25%)	4 (5.3%)	0.095
	Normal	3 (27.3%)	8 (72.7%)	11 (14.6%)	

Table-5: Frequency of adverse perinatal outcome

Outcome	Frequency (n)	Percentage (%)
Cesarean Section	32	42.7
Stillbirth	5	6.7
Low Apgar Score At 1 Minute	17	22.7
Low Apgar Score At 5 Minutes	7	9.3
NICU Admission	20	26.7
Neonatal Mortality	5	6.7

(*P*<0.005). (Table-6).

Discussion

Table-6: Comparison of adverse perinatal outcome

Outcome	CTG Findings		Total	Chi-Square/ *P*-Value
	Pathological n (%)	Normal n (%)	n (%)	
Cesarean Section				
Yes	19 (59.3%)	13 (40.6%)	32 (100%)	χ^2=11.590
No	9 (20.9%)	34 (79.1%)	43 (100%)	*P*=0.001
Total	28 (37.3%)	47 (62.7%)	75 (100%)	
Still -Birth				
Yes	5 (100%)	0	5 (100%)	χ^2=8.992
No	23 (32.9%)	47 (67.1%)	70 (100%)	*P*=0.003
Total	28 (37.3%)	47 (62.7%)	75 (100%)	
NICU Admission				
Yes	12 (60%)	8 (40%)	20 (100%)	χ^2=5.989
No	16 (29.1%)	39 (70.1%)	55 (100%)	*P*=0.014
Total	28 (37.3%)	47 (62.7%)	75 (100%)	
Neonatal Mortality				
Yes	5 (100%)	0	5 (100%)	χ^2=8.992
No	23 (32.9%)	47 (67.1%)	70 (100%)	*P*=0.003
Total	28 (37.3%)	47 (62.7%)	75 (100%)	

Fetal surveillance during labour is directly related to the delivery of a healthy baby with minimal intervention.[11] Majority of fetuses cope well during labour. However the journey of birth is stressful and the fetus may mount a 'stress response'. Fetuses with uteroplacental insufficiency result in hypoxia during the process which can be acute or sub-acute. Some fetuses may become hypoxic before the onset of labour. Strict fetal monitoring during labour help in the identification of fetuses who are at risk of hypoxic damage, so that appropriate intervention is implemented to optimize perinatal outcomes. This approach is introduced basically to prevent neurological injury, including cerebral palsy.[12] For this objective, electronic fetal monitoring (EFM) has been adopted widely.[13]

With intermittent auscultation, the baseline fetal heart rate (FHR) can be measured, but other features of the CTG such as baseline variability, accelerations, and decelerations are difficult to quantify.[14] Therefore, the use of antepartum and intrapartum cardiotocography (CTG) has increased over the period. As a consequence, the use of CTG has direct attribution to a considerable decrease in overall perinatal mortality and morbidity which has made it as the first line of investigation for antenatal and intrapartum fetal surveillance.[15]

Abnormal CTG is consistently seen in patients who are already labelled as to be high-risk pregnancies, however finding abnormal CTG even in low-risk pregnancies is also around 7.8%.[16] which is `considerably lower than that observed in the high-risk pregnancy group that is 22.8%, the fact is that fetuses with abnormal CTG have a 2.3 times higher chance to develop neurological fatal implications like cerebral palsy than those fetuses with normal CTG.[17] The perinatal death is even higher among pregnancies showing abnormal CTG and they have a 6.7 times higher rate of death than the fetuses born with the reassuring CTG trace.

The mean age of the patients in the study was 28.0±4.1 years. Most of the patients 73.3% were between 26-35 years of age. This was comparable to the observations made in the study by Chan who concluded that among five thousand patients, 51.94% of patients belonged to this age between 26-35 years.[18]

A study by Sheikh et al. emphasized neonatal outcomes with the Apgar score of the babies born with abnormal CTG's.[4] Apgar score of less than 7 at one minute was documented in 64.15% of the cases. Apgar score after five minutes, stayed at less than 7 in

18.86% of the cases, while the rest showed Apgar either improved or remained at 7.

Our study shows that the frequency of pathological cardiotocography among high-risk pregnancies, was 37.3% while 22.7% of babies born to these mothers had low Apgar scores of <7 at 1 minute and 9.3% had low Apgar score at 5 minutes. Cardiotocograph was interpreted to depict intrapartum hypoxia, which is usually implicated as the cause for low birth Apgar score.[19,20]

CTG is an important monitoring tool for high-risk pregnancies having impaired fetal growth as discussed as an objective in study by Grivell RM et al. who also emphasized the use of CTG for fetal surveillance and for good outcome.[21]

The main reason for fetal compromise is fetal asphyxia due to inadequate oxygen supply, certain cases of fetal asphyxia have been reported despite reassuring intrapartum CTG which aims to look forward to improving fetal surveillance in the antenatal and intrapartum period.[22,23]

Upper limit of normal uterine contractions are defined as five contractions in 10 minutes each lasting for 30 seconds according to international standards, and severe uterine contractions are responsible for more than 75% of cases of fetal asphyxia compromise and lead to abnormal CTG.[24,25]

A study done by Kumar et al. reported that 8.4% of women with high-risk pregnancies in labor having strong uterine contractions, had pathological CTG; and the frequencies NICU admission (33.3% vs. 11.3% vs. 6.3%), and neonatal death (7.4% vs. 4.2% vs. 0.5%) in pathological CTG were higher than in suspicious and normal CTG.[8]

In the current study, when a comparison of adverse perinatal outcomes was made between pathological vs normal CTG, the results were as follows: cesarean section (59.3% vs 40.6%; *P*=0.001), stillbirth/ neonatal mortality 100% vs 0%; *P*=0.003), NICU admission (60% vs 40%; *P*=0.014).

The study by Salahuddin N et el. Showed frequencies of C/section (42.0% vs. 76.7%), low Apgar score at 1 min (9.7% vs. 18.9%), and at 5 min (4.8% vs. 13.3%), stillbirth (2.4% vs. 4.4%), and neonatal death (4.1% vs. 13.9%) in normal CTG were significantly lower than suspicious and pathological CTG.[7]

Our study is a single centre. There is a need for a randomized controlled trial study on this subject. More studies should be carried out with the aim to improve antenatal and intrapartum fetal monitoring.

Conclusion

Finding pathological CTG in high risk pregnancies is alarming leading to cesarean sections, poor Apgar score at birth, and rise in mortality. Therefore, routine use of CTG is highly recommended for screening and monitoring of high-risk pregnancies which will help in the timely evaluation of fetal compromise during labour. It also facilitates taking timely appropriate measures to avoid neonatal morbidity and mortality and to restore financial resources.

Acknowledgment: None

Conflict of Interest: The authors declare no conflict of interest

Grant Support and Financial Disclosure: None

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Authors Contribution

AN: Idea conception, data collection
VA: Idea conception, data collection, data analysis and interpretation
RA: Data collection, data analysis and interpretation, manuscript writing or proofreading
FN: Manuscript writing or proofreading