Volume 3, Issue 4, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

ABNORMAL CARDIOTOCOGRAPHY AND FETAL OUTCOME

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DOI: https://doi.org/10.5281/zenodo.23474206

Keywords

Cardiotocography; Fetal outcome; Apgar score; Neonatal intensive care; Perinatal mortality; Emergency caesarean section

Article History

Received: 01 May 2025

Accepted: 15 June 2025

Published: 30 June 2025

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Abstract

Background: *Abnormal cardiotocography (CTG) in labour may indicate fetal hypoxia, but local data on its fetal consequences are scarce.*

Objective: *To determine fetal outcomes in women with abnormal CTG at term at a tertiary care facility in Hyderabad.*

Methods: *This descriptive cross-sectional study was conducted in the Department of Obstetrics and Gynaecology, Bilawal Medical College, Liaquat University of Medical and Health Sciences, Jamshoro, over six months from May 2024 to November 2024. A total of 110 women aged 18-45 years with singleton pregnancies at 37-42 weeks and an abnormal CTG were enrolled by non-probability consecutive sampling. Women with growth restriction, associated medical or obstetric disorders, severe oligohydramnios, abruptio placentae or fetal malformation were excluded. Outcomes were 5-minute Apgar score below 7, neonatal intensive care unit (NICU) admission, emergency caesarean section for fetal compromise and perinatal mortality. Data were analysed in SPSS 24. Outcomes were stratified by age and parity using the chi-square or Fisher's exact test ($p \leq 0.05$).*

Results: *Mean maternal age was 27.05 ± 4.25 years and mean gestational age was 38.82 ± 1.07 weeks. Of the women, 51.8% were primiparous. Reduced baseline variability was the commonest abnormality (40.0%). Emergency caesarean section was performed in 82 women (74.5%). The mean 5-minute Apgar score was 6.82 ± 1.42, and 37 newborns (33.6%) scored below 7. NICU admission was required for 38 newborns (34.5%), and perinatal mortality occurred in 9 (8.2%). Age group and parity were not significantly associated with low Apgar score, NICU admission or perinatal mortality (all $p > 0.05$).*

Conclusion: *Abnormal CTG at term was associated with frequent emergency caesarean section, low Apgar scores, NICU admission and a notable perinatal mortality. Prompt recognition and timely response to pathological traces are essential. Larger multicentre studies with control groups and cord blood gas analysis are needed.*

INTRODUCTION

Stillbirth remains a major and largely preventable global health problem. In 2019, an estimated 2.0 million babies were stillborn at 28 weeks of gestation or later, a global rate of 13.9 per 1000 total births. The annual rate of reduction in stillbirth since 2000 (2.3%) has lagged behind that of neonatal mortality (2.9%) [1,2]. Approximately 98% of stillbirths occur in low- and middle-income countries, and better

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

care at birth could prevent an estimated 1.3 million intrapartum stillbirths worldwide [3]. Intrapartum hypoxia is central to these losses and, in survivors, may result in acidaemia and neurological injury. A systematic review of 51 studies found that low arterial cord pH was strongly associated with neonatal death, hypoxic-ischaemic encephalopathy and cerebral palsy [4]. In a cohort of 51,519 term births, however, most neonates with neurological morbidity had a normal cord pH, indicating that acidaemia does not explain all adverse outcomes [5]. Cardiotocography (CTG) records the fetal heart rate in relation to uterine contractions and is used in labour to identify fetuses that may be short of oxygen. Pooled trial evidence shows that continuous CTG reduces neonatal seizures, with no clear difference in cerebral palsy or infant mortality, but increases caesarean and instrumental vaginal births [6]. Interpretation is therefore guided by consensus frameworks such as the FIGO guidelines [7] and by the NICE guideline. NICE advises continuous CTG when intrapartum risk factors develop and stresses that traces be interpreted together with maternal, fetal and labour factors [8]. Fetal outcome after an abnormal trace is commonly judged by the Apgar score, neonatal intensive care unit (NICU) admission, mode of delivery and perinatal death. The Apgar score, however, describes the newborn's condition at a single point in time. It cannot by itself be taken as evidence of asphyxia or as a predictor of individual neonatal mortality [9]. Regional studies report varying findings. A cross-sectional study from Rawalpindi found low Apgar scores to be frequent among women with pathological CTG [10]. A prospective Indian cohort correlated non-reassuring CTG with cord blood pH and early neonatal outcome [11]. Another Indian study found that admission CTG gave no neonatal benefit in low-risk women but increased obstetric intervention [12]. Local data on the fetal consequences of abnormal CTG remain scarce.

This study therefore aims to determine fetal outcome, in terms of low Apgar score, NICU admission, caesarean section for fetal compromise and perinatal mortality, in women with abnormal CTG presenting to a tertiary care facility in Hyderabad, so that strategies to reduce complications can be devised.

Methodology

This descriptive cross-sectional study was conducted in the Department of Obstetrics and Gynaecology, Bilawal Medical College, Liaquat University of Medical and Health Sciences, Jamshoro, over six months from May 2024 to November 2024, after the approval of synopsis from College of Physicians and Surgeons Pakistan. The sample size was calculated with the WHO sample size calculator, using an anticipated perinatal mortality of 16.5% [11] among women with abnormal CTG, an absolute precision of 7% and a 95% confidence level. This gave 110 women, who were recruited by non-probability consecutive sampling. Women aged 18 to 45 years were included if they have a singleton pregnancy of 37 to 42 weeks of gestation (dated from the last menstrual period and confirmed by first-trimester ultrasound measurement), any fetal presentation and an abnormal CTG. An abnormal CTG was defined as the presence of one or more of the following: baseline variability below 5 bpm lasting 40 minutes; a baseline fetal heart rate above 180 bpm or below 60 bpm persisting for more than 60 seconds; or prolonged bradycardia lasting two to three minutes. Women were excluded if they have intrauterine growth restriction, associated medical or obstetric disorders (gestational diabetes, obstetric cholestasis, hypertension or pre-eclampsia), severe oligohydramnios (amniotic fluid index below 5) or abruptio placentae, or if the fetus has a known gross congenital malformation. The study was begin after approval from the Ethical Review Committee of Bilawal Medical College, Kotri. Eligible women were enrolled after the purpose, procedures, risks and benefits were explained and written informed consent was obtained. Demographic and obstetric data, including age, gestational age and parity, were recorded. Height was measured in metres on a wall-mounted scale without shoes or headgear. Weight was measured on an electronic scale in light clothing, and body mass index (BMI) was calculated as weight in kilograms divided by height in metres squared. All women were observed until delivery, and further management followed the standard protocols. Mode of delivery was noted. Fetal outcomes were defined as follows: Apgar score below 7, assessed by a paediatrician at 5

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ISSN: (e) 3007-1607 (p) 3007-1593

minutes after birth; NICU admission, at the discretion of the consultant paediatrician; perinatal mortality, defined as absence of signs of life such as cardiac activity; and caesarean section performed because of fetal compromise. All data was recorded on a structured proforma. Data was entered and analysed in SPSS version 24.0 (IBM Corp., Armonk, NY, USA). Normality was assessed with the Kolmogorov–Smirnov test. Mean ± SD or median (interquartile range), as appropriate, was calculated for age, gestational age, height, weight, BMI and Apgar score. Frequencies and percentages were calculated for parity, emergency caesarean section, Apgar score below 7, NICU admission and perinatal mortality. Effect modifiers (age, parity and BMI) was stratified, and post-stratification comparison was done use the chi-square or Fisher exact test, with a p value of 0.05 or less considered significant.

Results

A total of 110 pregnant women presenting with abnormal cardiotocography (CTG) traces at term (37 to 42 weeks of gestation) were evaluated to determine associated fetal outcomes.

The mean maternal age of the participants was 27.05 ±4.25 years (ranging from 18.0 to 41.2 years). The majority of women were aged between 25 and 35 years (n = 75, 68.2%), followed by those aged under 25 years (n = 32, 29.1%) and over 35 years (n = 3, 2.7%). Regarding parity, 57 women (51.8%) were primiparous and 53 (48.2%) were multiparous. The mean gestational age at delivery was 38.82 ±1.07 weeks. Anthropometric evaluation revealed a mean maternal body mass index (BMI) of 26.48 ±3.99 kg/m^2 with 42 participants (38.2%) having a normal BMI, 49 (44.5%) classified as overweight, and 19 (17.3%) classified as obese.

Analysis of the intrapartum CTG traces demonstrated that reduced baseline variability of less than 5 bpm lasting over 40 minutes was the most frequent abnormality, observed in 44 cases (40.0%). Severe baseline bradycardia or tachycardia persisting for more than 60 seconds occurred in 30 cases (27.3%), prolonged bradycardia lasting 2 to 3 minutes in 23 cases (20.9%), and mixed or combined abnormality patterns in 13 cases (11.8%). Due to fetal compromise, the vast majority of participants underwent an emergency caesarean section (n = 82, 74.5%). Spontaneous vaginal delivery occurred in 17 cases (15.5%) and instrumental vaginal delivery in 11 cases (10.0%).

The mean 5-minute Apgar score among newborns was 6.82 ±1.42. A low 5-minute Apgar score of less than 7 was recorded in 37 newborns (33.6%). Neonatal intensive care unit (NICU) admission was required for 38 newborns (34.5%). Perinatal mortality was documented in 9 cases (8.2%).

Post-stratification analysis using chi-square and Fisher's exact tests evaluated the influence of maternal age groups and parity on adverse fetal outcomes (low Apgar score, NICU admission, and perinatal mortality).

The incidence of low Apgar scores was 28.1% (n = 9) in mothers <25 years, 34.7% (n = 26) in those 25-35 years, and 66.7% (n = 2) in those >35 years (p = 0.380). NICU admissions across these age strata were 34.4%, 34.7%, and 33.3% respectively (p = 0.999), while perinatal mortality rates were 9.4%, 8.0%, and 0.0% (p = 0.847). None of the age-stratified differences reached statistical significance.

Primiparous women recorded a low Apgar rate of 35.1% (n = 20) compared to 32.1% (n = 17) in multiparous women (p = 0.895). NICU admissions were comparable between primiparous (35.1%) and multiparous (34.0%) participants (p = 0.939). Perinatal mortality was observed in 10.5% (n = 6) of primiparous versus 5.7% (n = 3) of multiparous births, showing no statistically significant association (p = 0.418).

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (N = 110)

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Baseline Characteristic	Frequency (n) / Mean ± SD	Percentage (%) / Range
Maternal Age (years)	27.05 ± 4.25	18.0 – 41.2
<25 years	32	29.1%
25 – 35 years	75	68.2%
>35 years	3	2.7%
Parity		
Primiparous (1)	57	51.8%
Multiparous (≥2)	53	48.2%
Gestational Age (weeks)	38.82 ± 1.07	37.0 – 41.6
Anthropometric Measures		
Height (m)	1.56 ± 0.06	1.42 – 1.71
Weight (kg)	64.8 ± 8.2	48.0 – 87.5
BMI (kg/m²)	26.48 ± 3.99	18.5 – 38.2
BMI Categories		
Normal (<25.0 kg/m²)	42	38.2%
Overweight (25.0–29.9 kg/m²)	49	44.5%
Obese (≥30.0 kg/m²)	19	17.3%

Table 2: Pattern of CTG Abnormalities and Mode of Delivery (N = 110)

Clinical Parameter / Variable	Frequency (n)	Percentage (%)
CTG Abnormality Pattern		
Baseline variability <5 bpm (>40 mins)	44	40.0%
Severe Bradycardia / Tachycardia (>60s)	30	27.3%
Prolonged Bradycardia (2–3 mins)	23	20.9%
Mixed / Combined Abnormalities	13	11.8%
Mode of Delivery		
Emergency Caesarean Section (Fetal Compromise)	82	74.5%
Spontaneous Vaginal Delivery	17	15.5%

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Instrumental Vaginal Delivery	11	10.0%

Table 3: Primary Fetal Outcomes among Women with Abnormal CTG (N = 110)

Fetal Outcome Parameter	Frequency (n) / Mean ± SD	Percentage (%)
5-Minute Apgar Score (Mean ± SD)	6.82 ± 1.42	–
Low Apgar Score (<7 at 5 minutes)	37	33.6%
NICU Admission	38	34.5%
Emergency CS for Fetal Compromise	82	74.5%
Perinatal Mortality	9	8.2%

Table 4: Stratification of Fetal Outcomes by Maternal Age Groups and Parity (N = 110)

Stratification Variable	Low Apgar (<7) n (%)	NICU Admission n (%)	Perinatal Mortality n (%)	Statistical Test	p-value
Maternal Age Groups					
<25 years (n = 32)	9 (28.1%)	11 (34.4%)	3 (9.4%)	χ^2 = 1.93 (Apgar)	0.38 (NS)
25–35 years (n = 75)	26 (34.7%)	26 (34.7%)	6 (8.0%)	χ^2 = 0.01 (NICU)	0.99 (NS)
>35 years (n = 3)	2 (66.7%)	1 (33.3%)	0 (0.0%)	Fisher's (PNM)	0.84 (NS)
Parity Status					
Primiparous (n = 57)	20 (35.1%)	20 (35.1%)	6 (10.5%)	χ^2 = 0.113 (Apgar)	0.89 (NS)
Multiparous (n = 53)	17 (32.1%)	18 (34.0%)	3 (5.7%)	χ^2 = 0.015 (NICU)	0.93 (NS)
				χ^2 = 0.860 (PNM)	0.41 (NS)

Discussion

Abnormal intrapartum cardiotocography (CTG) at term was associated with a considerable burden of adverse fetal outcomes in this cohort of 110 women. Three-quarters of the women (74.5%) required emergency caesarean section for fetal compromise. About one-third of newborns had a 5-minute Apgar score below 7 (33.6%) or needed NICU admission (34.5%), and perinatal mortality was 8.2%. Neither maternal age nor parity significantly influenced these outcomes.

The emergency caesarean rate is high. A Pakistani study of pathological CTG at term reported a similarly high operative delivery burden [10]. This fits the trial evidence that

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continuous CTG increases caesarean and instrumental births without a clear reduction in cerebral palsy or infant mortality [6]. It also fits the argument that the FIGO guidelines, which have been in use for decades, may over-classify traces as abnormal and favour intervention [13]. Others have contended that electronic fetal monitoring has not reduced cerebral palsy despite higher caesarean rates [14]. Caesarean rates are also rising globally, so an operative delivery after an abnormal trace cannot be judged in isolation [15]. Because this study had no comparison group and no cord blood gas results, we cannot say how many of these operations avoided harm and how many were unnecessary.

A low 5-minute Apgar score in 33.6% of newborns is clinically important. Low 5-minute scores are strongly associated with neonatal mortality [16] and with later cerebral palsy and epilepsy [17]. The mean Apgar score of 6.82 shows that many babies were only mildly depressed rather than severely compromised. The Apgar score reflects a single time point and should not by itself be equated with asphyxia [9]. A Pakistani study of pathological CTG also found frequent low Apgar scores [10]. An Indian cohort linked non-reassuring CTG to lower cord pH and poorer early neonatal outcome [11]. Our results are consistent with these, although the lack of cord pH data prevents us from confirming acidaemia in our low-Apgar babies.

The NICU admission rate of 34.5% needs cautious interpretation. In this study admission was left to the consultant paediatrician's discretion, so it reflects local thresholds and bed availability as well as true neonatal illness. The ability of CTG abnormalities to predict neonatal acidaemia is limited [18]. Even with electronic monitoring, a substantial proportion of neonatal metabolic acidaemia is not prevented [19]. Cord pH is strongly associated with neonatal death and neurological morbidity [4], but most babies with serious neurological morbidity may have a normal pH [5]. Abnormal CTG, low Apgar score and NICU admission should therefore be viewed as complementary but imperfect markers of compromise.

Perinatal mortality of 8.2% was lower than the 16.5% we anticipated when calculating the sample size, but it remains high and exceeds what is expected in term pregnancies in well-resourced settings. Most stillbirths occur in low- and middle-income countries, and many intrapartum deaths could be prevented by better care at birth [1,3]. Population-based data from urban Pakistan show that neonatal mortality is substantial and linked to modifiable risk factors and delays in care [20]. Our finding therefore supports the broader argument that improving intrapartum care is a priority for newborn survival [21]. In our study, perinatal deaths were not analysed by timing, cause or time from CTG abnormality to delivery. We cannot judge how much delay in recognition, transfer or operating theatre access contributed.

Reduced baseline variability was the commonest abnormality (40.0%). This is clinically meaningful, since persistently reduced variability together with decelerations or tachycardia may signal long-standing, accumulating hypoxia [22]. The FIGO consensus identifies such patterns as suspicious or pathological [7], and NICE advises that they be interpreted with maternal, fetal and labour factors [8]. CTG interpretation is subjective, and inter-observer variation in the assessment of traces is well documented [23]. Because the traces here were classified by treating teams, some misclassification is possible. Admission CTG may increase intervention without improving neonatal outcome in low-risk women [12]. Our findings therefore support targeted rather than indiscriminate CTG use, with careful interpretation and prompt action when traces are truly pathological.

We found no statistically significant difference in outcomes by age group or parity. Although low Apgar scores were more frequent in women over 35 years (66.7%), only three women were in that group, so the estimate is unreliable. Primiparous women had higher perinatal mortality than multiparous women (10.5% versus 5.7%), but this was not significant. Maternal obesity and advanced maternal age are recognised risk factors for fetal death and adverse perinatal outcomes [24,25]. Nearly two-thirds of our participants were overweight or obese, yet BMI was not analysed against outcomes, and the study was not powered for these comparisons. These stratified findings should be viewed as exploratory.

This study has several strengths. It used predefined CTG criteria, standardised outcome definitions, assessment of the Apgar score by a

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ISSN: (e) 3007-1607 (p) 3007-1593

paediatrician, and a sample size calculated for the primary outcome. It also addresses a gap in local data. Its limitations should be acknowledged. It was a single-centre study with consecutive non-probability sampling, which limits generalisability. There was no control group of women with normal CTG, so relative risks could not be estimated. Cord blood gas analysis was not available. Women with growth restriction, hypertensive disorders, diabetes, cholestasis, severe oligohydramnios and abruption were excluded, so the results apply only to otherwise uncomplicated term pregnancies. Short-term outcomes only were assessed, and neonatal follow-up beyond the perinatal period was not done.

Conclusion

Abnormal CTG at term in otherwise low-risk women was associated with frequent emergency caesarean section, low Apgar scores, NICU admission and a notable perinatal mortality. Clinicians should respond promptly to pathological traces. Larger multicentre studies with comparison groups, cord blood gas analysis and longer neonatal follow-up are needed to clarify the prognostic value of abnormal CTG and to guide strategies that reduce unnecessary intervention while preventing avoidable perinatal loss.

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