



CATEGORY II CARDIOTOCOGRAPHY AND NEONATAL OUTCOMES: AN OBSERVATIONAL STUDY

Obstetrics & Gynaecology

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ABSTRACT

Background: Category II cardiotocography (CTG) is commonly encountered during labour and represents an indeterminate fetal heart rate pattern associated with variable neonatal outcomes. **Objective:** To correlate Category II cardiotocography findings with neonatal outcomes. **Methods:** This observational descriptive study was conducted in the Department of Obstetrics and Gynaecology at Rohilkhand Medical College and Hospital, Bareilly, over 12 months from April 2024 to April 2025. A total of 90 pregnant women between 34 and 42 weeks of gestation with Category II CTG tracings were included. Neonatal outcomes including APGAR score, fetal distress based on umbilical cord blood pH, NICU admission, and mode of delivery were assessed. Statistical analysis was performed using SPSS version 23, and $p < 0.05$ was considered significant. **Results:** Most women belonged to the age group of 21–30 years, and 65.6% were multigravida. Lower segment caesarean section was the most common mode of delivery (66.7%). APGAR score < 7 was observed in 12.2% neonates at 1 minute and 3.3% at 5 minutes. NICU admission was required in 30% neonates, while fetal distress was present in 31.1% cases. Fetal distress was significantly higher when CTG-to-delivery interval exceeded 1 hour (50.0% vs 18.5%; $p = 0.015$). Delayed delivery was also significantly associated with NICU admission ($p = 0.013$). **Conclusion:** Category II cardiotocography was associated with increased fetal distress and neonatal morbidity in the present study. A longer interval between detection of Category II CTG and delivery was significantly related to higher rates of fetal acidemia and NICU admission. Most neonates had satisfactory APGAR scores, but adverse outcomes were more common when delivery was delayed. Timely monitoring and intervention can improve neonatal outcomes.

KEYWORDS

Category II Cardiotocography; Fetal Distress; Neonatal Outcome; Nicu Admission; Apgar Score

INTRODUCTION

Cardiotocography (CTG) is an important method of intrapartum fetal monitoring used to assess fetal wellbeing during labour. It records fetal heart rate and uterine contractions and helps in the early detection of fetal hypoxia and fetal distress.^[1,2] Early identification of compromised fetuses can reduce the risk of birth asphyxia, low APGAR scores, neonatal intensive care unit (NICU) admission, and long-term neurological complications.^[3,4]

The fetal heart rate is regulated by the autonomic nervous system, and changes in variability, accelerations, and decelerations reflect fetal oxygenation and response to labour stress.^[5] Based on fetal heart rate patterns, CTG tracings are classified into Category I, II, and III. Category I represents normal findings, while Category III indicates abnormal patterns requiring urgent intervention. Category II CTG includes indeterminate patterns that are neither clearly normal nor abnormal and therefore often create difficulty in clinical decision-making.^[4,6]

Category II tracings are commonly seen during labour and may include reduced variability, recurrent variable decelerations, late decelerations, or absence of accelerations.^[7] Studies have shown that persistent Category II patterns are associated with increased risk of fetal distress, operative delivery, low APGAR scores, neonatal acidemia, and NICU admission.^[8,9] However, not all Category II tracings result in adverse neonatal outcomes, making careful monitoring and timely intervention essential.^[10,11]

Standardized management, including maternal repositioning, intravenous fluids, reduction of uterotonic agents, and timely delivery when required, can improve neonatal outcomes in these patients.^[12,13] Since Category II CTG remains the most common and challenging fetal heart rate pattern during labour,^[14,15] this study was conducted to evaluate its association with neonatal outcomes and fetal distress.

Aim and Objectives

Aim:

- To correlate Category II Cardiotocography findings with neonatal outcomes.

Objectives:

- To assess the outcomes of category II Cardiotocography.
- To estimate the incidence of fetal distress.
- To determine the correlation between outcomes of category II cardiotocography and incidence of fetal distress.

Material and Methods

Study Design

This was an observational descriptive study.

Study Setting

The study was conducted in the Pre-Labour Room of the Department of Obstetrics and Gynaecology at Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India.

Study Duration

The study was conducted over a period of 12 months from 6 April 2024 to 6 April 2025 after obtaining approval from the Institutional Ethics Committee.

Study Population

Pregnant women admitted to the Department of Obstetrics and Gynaecology with gestational age between 34 and 42 weeks and showing Category II cardiotocography tracings were included in the study.

Sample Size

The sample size was calculated using the formula: $n = 4pq / L^2$, where n = sample size, p = prevalence (5.9%), $q = 100 - p$ (94.1), and L = absolute error (5%).^[16] The calculated sample size was 88.8, and after rounding up, it was 90.

Inclusion Criteria

- Pregnant women between 34 and 42 weeks of gestation
- Patients showing Category II CTG tracings during labour

Exclusion Criteria

- Suspected or diagnosed fetal malformations
- High-risk pregnancies such as gestational diabetes mellitus
- Hypertensive disorders of pregnancy
- Intrauterine growth restriction (IUGR)

Methodology

After obtaining written informed consent, detailed history, general examination, and obstetric examination were performed. Maternal height and weight were recorded. CTG monitoring was done using an ultrasound transducer placed over the maternal abdomen. A 20-minute tracing was obtained and evaluated for baseline fetal heart rate, variability, accelerations, and decelerations. CTG tracings were categorized into Category I, II, or III. Women with Category II CTG

tracings were further assessed for neonatal outcomes including APGAR score, fetal distress, NICU admission, and mode of delivery.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 23. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. A p-value <0.05 was considered statistically significant.

Ethical Considerations

Ethical clearance was obtained from the Institutional Ethics Committee of Rohilkhand Medical College and Hospital, Bareilly. Written informed consent was obtained from all participants.

RESULTS

A total of 90 pregnant women with Category II cardiotocography (CTG) tracings were included in the study.

Table 1 shows the baseline characteristics of the study population. The majority of antenatal women belonged to the age group of 21–25 years (37.8%), followed by 26–30 years (34.4%) and 31–35 years (23.3%). Women aged 18–20 years and 36–40 years each constituted 2.2% of the study population. The mean maternal age was 27.3 ± 4.20 years. Most participants were multigravida (65.6%), while primigravida women accounted for 34.4% of the cases. A majority of the women were from rural areas (73.3%), whereas 26.7% belonged to urban areas.

Table 1: Baseline Characteristics of the Study Population

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	18–20	2	2.2
	21–25	34	37.8
	26–30	31	34.4
	31–35	21	23.3
	36–40	2	2.2
	Total	90	100
Mean Age (years)	27.3 ± 4.20		
Obstetric History	Primigravida	31	34.4
	Multigravida	59	65.6
	Total	90	100.0
Residence	Rural	66	73.3
	Urban	24	26.7
	Total	90	100.0

Table 2 demonstrates the distribution of mode of delivery among the study participants. Lower segment caesarean section (LSCS) was the most common mode of delivery and was performed in 60 women (66.7%). Vaginal delivery occurred in 18 women (20.0%), while instrumental delivery was required in 12 women (13.3%). These findings suggest that Category II CTG was associated with a high rate of operative delivery, particularly LSCS.

Table 2: Distribution of Antenatal Women According to Mode of Delivery

Mode of Delivery	Frequency (n)	Percentage (%)
Instrumental Delivery	12	13.3
Lower Segment Caesarean Section (LSCS)	60	66.7
Vaginal Delivery (VD)	18	20.0
Total	90	100.0

Table 3 presents neonatal outcomes in the study population. At 1 minute, 11 neonates (12.2%) had APGAR scores <7, whereas 79 neonates (87.8%) had APGAR scores ≥7. At 5 minutes, only 3 neonates (3.3%) had APGAR scores <7, while 87 neonates (96.7%) had reassuring APGAR scores ≥7, indicating improvement in neonatal condition after initial resuscitative measures. NICU admission was required in 27 neonates (30.0%), while 63 neonates (70.0%) did not require NICU care. Fetal distress based on umbilical cord blood pH <7.2 was observed in 28 neonates (31.1%), whereas 62 neonates (68.9%) had normal cord blood pH.

Table 3: Neonatal Outcomes in the Study Population

Variable	Category	Frequency (n)	Percentage (%)
Apgar Score (1 min)	< 7	11	12.2
	≥ 7	79	87.8
	Total	90	100.0

Apgar Score (5 min)	< 7	3	3.3
	≥ 7	87	96.7
	Total	90	100.0
NICU Admission	No	63	70.0
	Yes	27	30.0
	Total	90	100.0
Fetal Distress (Based on Umbilical Cord pH)	Present (pH < 7.2)	28	31.1
	Absent (pH ≥ 7.2)	62	68.9
	Total	90	100.0

Table 4 shows the distribution of Category II CTG-to-delivery interval. Among the 90 women, 54 (60.0%) delivered within 1 hour of detection of Category II CTG, whereas 36 women (40.0%) delivered after more than 1 hour.

Table 4: Distribution of Category II CTG to Delivery Time

CTG to Delivery Time	Frequency (n)	Percentage (%)
≤ 1 Hour	54	60.0
> 1 Hour	36	40.0
Total	90	100.0

Table 5 demonstrates the incidence of fetal distress in the study population. Fetal distress, defined by umbilical cord blood pH <7.2, was present in 28 neonates (31.1%), while 62 neonates (68.9%) did not show biochemical evidence of fetal distress.

Table 5: Incidence of Fetal Distress in the Study Population

Fetal Distress (Based on Umbilical Cord pH)	Frequency (n)	Percentage (%)
Present (pH < 7.2)	28	31.1
Absent (pH ≥ 7.2)	62	68.9
Total	90	100.0

Table 6 shows the association between Category II CTG-to-delivery interval and incidence of fetal distress. Among women delivered within 1 hour, fetal distress was present in 10 neonates (18.5%) and absent in 44 neonates (81.5%). In contrast, when delivery occurred after more than 1 hour, fetal distress increased markedly and was present in 18 neonates (50.0%), while only 18 neonates (50.0%) had normal cord blood pH. The association was statistically significant ($\chi^2 = 5.87$, $df = 1$, $p = 0.015$). These findings indicate that prolonged CTG-to-delivery interval was significantly associated with increased incidence of fetal distress.

Table 6: Association Between Category II CTG-to-Delivery Time and Incidence of Fetal Distress

CTG-to-Delivery Time (minutes)	Fetal Distress Present (pH < 7.2)	Fetal Distress Absent (pH ≥ 7.2)	Total	p-value
≤ 1 hour (n = 54)	10 (18.5%)	44 (81.5%)	54	0.015
> 1 hour (n = 36)	18 (50.0%)	18 (50.0%)	36	
Total (n = 90)	28 (31.1%)	62 (68.9%)	90	

($\chi^2 = 5.87$, $df = 1$, $p = 0.015$)

Table 7 demonstrates the association between NICU admission and CTG-to-delivery interval. Among women delivered within 1 hour, only 10 neonates required NICU admission, whereas 44 neonates did not require NICU care. However, when delivery occurred after more than 1 hour, NICU admission increased substantially, with 17 neonates requiring NICU care and only 19 neonates not requiring admission. Statistical analysis showed a significant association between delayed delivery and NICU admission ($\chi^2 = 8.64$, $df = 1$, $p = 0.013$). These findings suggest that delay in delivery following Category II CTG may adversely affect neonatal outcome and increase the need for intensive neonatal care.

Table 7: Association Between NICU Admission and Category II CTG-to-Delivery Time

NICU Admission	≤ 1 Hour	> 1 Hour	Total
Yes	10	17	27
No	44	19	63
Total	54	36	90

Chi-Square Test Results: $\chi^2 = 8.64$, $df = 1$, $p = 0.013$

Figure 1 illustrates the distribution of antenatal women according to period of gestation. The majority of women were between 37 and 39 weeks of gestation (62.3%). Maximum participants belonged to 38

weeks of gestation (26.7%), followed by 37 weeks (18.9%) and 39 weeks (16.7%). Women at 35 weeks and 36 weeks constituted 8.9% and 13.3% respectively, while only 2.2% women were at 41 weeks of gestation.

Fig 1. Distribution of Antenatal Women According to Period of Gestation (POG)

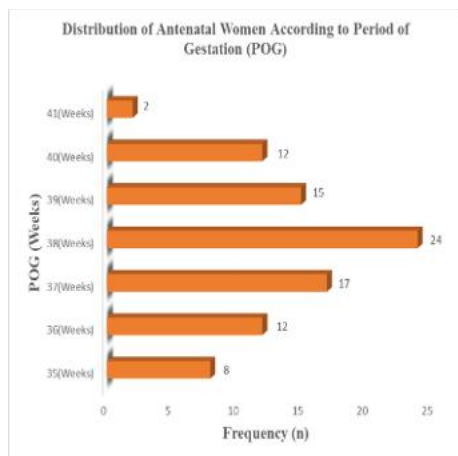


Figure 2 demonstrates the association between mode of delivery and APGAR score at 1 minute. Among neonates with APGAR score <7, the majority were delivered by LSCS (9 out of 11; 81.8%), whereas only 1 neonate each belonged to instrumental and vaginal delivery groups. Among neonates with APGAR score ≥ 7 , 51 were delivered by LSCS, 17 by vaginal delivery, and 11 by instrumental delivery. However, the association between mode of delivery and APGAR score at 1 minute was not statistically significant ($\chi^2 = 1.35$, $df = 2$, $p = 0.510$).

Fig 2. Association Between Mode of Delivery and Apgar Score at 1 Minute

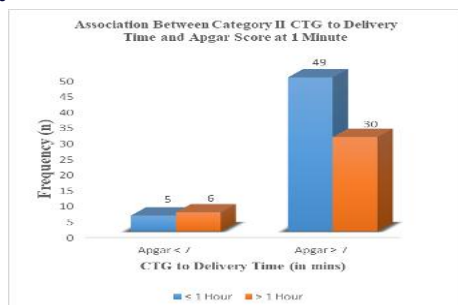


Figure 3 shows the association between Category II CTG-to-delivery interval and APGAR score at 1 minute. Among women delivered within 1 hour, 49 neonates (90.7%) had APGAR scores ≥ 7 , while 5 neonates (9.3%) had APGAR scores <7. In contrast, when delivery occurred after more than 1 hour, APGAR scores <7 increased to 6 neonates (16.7%), whereas 30 neonates (83.3%) had reassuring APGAR scores. These findings suggest that delayed delivery following Category II CTG may be associated with poorer immediate neonatal condition.

Fig 3. Association Between Category II CTG to Delivery Time and Apgar Score at 1 Minute

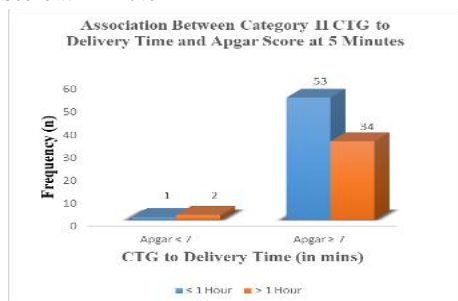
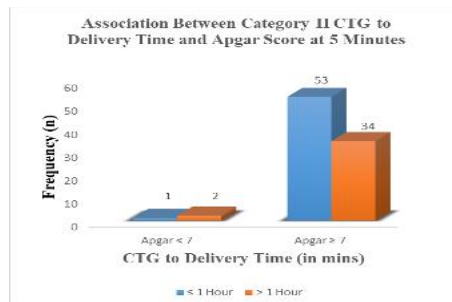


Figure 4 demonstrates the association between Category II CTG-to-delivery interval and APGAR score at 5 minutes. Among women

delivered within 1 hour, only 1 neonate (1.8%) had APGAR score <7, while 53 neonates (98.2%) had APGAR scores ≥ 7 . When delivery occurred after more than 1 hour, 2 neonates (5.6%) had APGAR scores <7 and 34 neonates (94.4%) had APGAR scores ≥ 7 . Although low APGAR scores were slightly higher in the delayed delivery group, the overall number of neonates with poor 5-minute APGAR scores remained low.

Fig 4. Association Between Category II CTG to Delivery Time and Apgar Score at 5 Minutes



DISCUSSION

The study was conducted to evaluate the relationship between Category II cardiotocography (CTG) patterns and neonatal outcomes. Category II CTG is commonly encountered during labour and often creates uncertainty regarding fetal wellbeing because these patterns are neither clearly reassuring nor clearly abnormal. The findings of the present study showed that persistent Category II CTG, especially when associated with delayed delivery, was linked with increased fetal distress and poorer neonatal outcome.

In the present study, most women belonged to the age group of 21–30 years, with a mean age of 27.3 ± 4.20 years (Table 1). Similar age distribution was reported by Kumari et al.^[3] and Anushuya M Chandiran et al.^[17], where most women belonged to the young reproductive age group. Multigravida women formed the majority of the study population, which was comparable to the findings of Nagpal et al.^[18] Most women in the present study were from rural areas, reflecting the patient population commonly attending tertiary care hospitals in this region.

Lower segment caesarean section was the most common mode of delivery in the present study and was performed in 66.7% of women (Table 2). Vaginal delivery occurred in 20% of cases, while 13.3% required instrumental delivery. Similar findings were reported by Anushuya M Chandiran et al.^[17], who also observed a high rate of LSCS among women with abnormal CTG patterns. Weissbach et al.^[4] similarly reported increased operative delivery in women with suspicious fetal heart rate tracings. The higher LSCS rate in the present study suggests that Category II CTG frequently influences the decision for expedited delivery because of concern regarding fetal compromise. The neonatal outcomes observed in the present study were satisfactory in most neonates, although evidence of fetal compromise was present in a significant number of cases (Table 3). At 1 minute, 12.2% neonates had APGAR scores below 7, whereas by 5 minutes only 3.3% continued to have low APGAR scores. This finding indicates that many neonates improved after immediate neonatal resuscitative measures. Similar findings were observed by Suci et al.^[5], Nagpal et al.^[18] and Bhavya HU et al.^[19], where most neonates with Category II CTG recovered well within the first few minutes after birth.

NICU admission was required in 30% of neonates in the present study. Similar NICU admission rates were reported by Suci et al.^[5] and Anushuya M Chandiran et al.^[17] Nagpal et al.^[18] and Bera et al.^[20] also reported increased NICU admission among neonates with suspicious or pathological CTG patterns. These findings suggest that Category II CTG is associated with increased neonatal observation and intensive care requirement.

Fetal distress based on umbilical cord blood pH <7.2 was present in 31.1% of neonates (Table 5). Similar associations between abnormal CTG findings and fetal acidemia were reported by Weissbach et al.^[4] and Mushtaq et al.^[16] reported lower rates of severe acidemia compared with the present study. The relatively higher incidence of fetal distress observed in the present study may be due to prolonged fetal hypoxia or delayed intrapartum referral in some patients.

The present study also showed that most women delivered within 1 hour after recognition of Category II CTG, while 40% delivered after more than 1 hour (Table 4). Similar observations were reported by Weissbach et al.^[4] and Anushuya M Chandiran et al.^[17], who emphasized the importance of timely delivery following persistent abnormal CTG patterns.

An important finding of the present study was the significant association between CTG-to-delivery interval and fetal distress (Table 6). Fetal distress was observed in only 18.5% neonates delivered within 1 hour, whereas it increased to 50% when delivery occurred after more than 1 hour. This association was statistically significant ($p = 0.015$). Similar findings were reported by Weissbach et al.^[4], who observed worsening neonatal acid-base status with prolonged exposure to abnormal fetal heart rate patterns. Westerhuis et al.^[21] also demonstrated that delayed response to persistent abnormal CTG increases the risk of intrapartum hypoxia and metabolic acidosis.

A statistically significant association was also observed between CTG-to-delivery interval and NICU admission (Table 7). NICU admission was more frequent in neonates delivered after more than 1 hour compared with those delivered within 1 hour ($p = 0.013$). Similar findings were reported by Weissbach et al.^[4], who also documented higher NICU admission rates with delayed delivery following abnormal CTG detection. These findings support the importance of early decision-making and timely delivery in women with persistent Category II CTG patterns.

Figure 1 demonstrated that most women belonged to the term gestational age group, mainly between 37 and 39 weeks of gestation. Similar gestational age distribution was reported by Weissbach et al.^[4], Suci et al.^[5] and Zahan et al.^[22] in their CTG-based studies.

Figure 2 showed that lower APGAR scores at 1 minute were more commonly seen in neonates delivered by LSCS, although the association was not statistically significant. Similar findings were reported by Weissbach et al.^[4] and Anushuya M Chandiran et al.^[17], suggesting that neonatal condition depends more on fetal compromise than on the route of delivery itself.

Figures 3 and 4 demonstrated that delayed delivery following Category II CTG was associated with increased frequency of low APGAR scores at both 1 minute and 5 minutes. Similar observations were reported by Weissbach et al.^[4], who showed worsening neonatal condition with prolonged abnormal CTG exposure. However, Tomich et al.^[23] reported no significant association between CTG category and 5-minute APGAR score in low-risk pregnancies.

Overall, the present study demonstrates that Category II CTG is associated with adverse neonatal outcomes, particularly when timely delivery is delayed. Careful monitoring, prompt recognition of persistent abnormal patterns, and timely obstetric intervention are important in reducing fetal distress and improving neonatal outcome.

CONCLUSION

Category II cardiotocography was associated with increased fetal distress and neonatal morbidity in the present study. A longer interval between detection of Category II CTG and delivery was significantly related to higher rates of fetal acidemia and NICU admission. Most neonates had satisfactory APGAR scores, but adverse outcomes were more common when delivery was delayed. The findings suggest that Category II CTG requires close intrapartum monitoring and timely clinical intervention. Early identification of persistent abnormal fetal heart rate patterns and prompt decision-making can help improve neonatal outcome and reduce complications related to fetal compromise during labour.

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