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Original Research Article

Intrapartum category II cardiotocography and its association with mode of delivery and perinatal outcomes in term pregnancy: a prospective observational study

Kasthuri Chinnasamy^{1*}, Saradha Jagannathan²

¹Department of Obstetrics and Gynaecology, Dr. Kasthuri Maternity Clinic, Tiruchirappalli, Tamil Nadu, India

²Department of Obstetrics and Gynaecology, Sri Ramakrishna Hospital, Coimbatore, Tamil Nadu, India

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*Correspondence:

Dr. Kasthuri Chinnasamy,

E-mail: kasthuriarivasan@gmail.com

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ABSTRACT

Background: Intrapartum cardiotocography (CTG) is widely used for foetal surveillance. However, Category II CTG has variable patterns and uncertain significance, often leading to operative delivery in pregnant women. This study aimed to assess the association between intrapartum Category II CTG, mode of delivery, and perinatal outcomes in term pregnancies.

Methods: This prospective observational study was conducted at the Department of Obstetrics and Gynaecology, Sri Ramakrishna Hospital, Coimbatore, between December 2019 and August 2020. A total of 103 consecutive term pregnant women with intrapartum Category II CTG were included. The mode of delivery and perinatal outcomes were analysed in relation to parity, modified Bishop score, CTG duration, and CTG pattern type.

Results: Among the study population, 55.3% underwent emergency caesarean section, while 44.7% delivered vaginally, including 31.1% by operative vaginal delivery and 13.6% by normal vaginal delivery. All women with unfavourable modified Bishop scores underwent emergency caesarean section (100%). With favourable Bishop scores, operative vaginal delivery was common in both primigravida (42.6%) and multigravida (40.9%) groups. The duration of category II CTG differed according to parity ($p=0.041$) but was not associated with neonatal outcomes. NICU admission occurred in 37.9% of neonates, most frequently with reduced variability (66.7%) and foetal tachycardia (55.6%) ($p=0.027$). Most NICU stays were less than 24 h (60.5%).

Conclusions: Intrapartum Category II CTG is associated with higher operative delivery rates; however, perinatal outcomes are generally favourable and depend more on CTG pattern type than on duration. Careful intrapartum reassessment may help reduce unnecessary caesarean sections.

Keywords: Fetal heart rate monitoring, Caesarean section, Fetal monitoring, Labor, Obstetric, Neonatal morbidity, Pregnancy

INTRODUCTION

Advances in ultrasound, handheld doppler devices, and foetal heart rate monitoring have established cardiotocography (CTG) as the primary intrapartum surveillance tool for assessing foetal well-being during labour.^{1,2} In 2015, the International federation of

gynecology and obstetrics (FIGO) promoted the largest international consensus on intrapartum foetal monitoring to standardise terminology, interpretation, and clinical outcomes.³ Continuous electronic foetal heart rate monitoring during labour reduces perinatal mortality and morbidity. Intrapartum foetal monitoring is essential for identifying foetuses at risk of hypoxic injury due to

uteroplacental insufficiency. Foetal distress occurs when foetal physiology is altered by hypoxia, increasing the risk of perinatal morbidity and mortality.⁴

Currently, CTG is widely used by obstetricians to monitor labour and make early decisions regarding the mode of delivery to improve perinatal outcomes and reduce labour dystocia. Among the three-tier CTG classification systems, category II tracings represent an intermediate group with heterogeneous patterns and variable clinical significance. The American college of obstetricians and gynaecologists (ACOG) 2010 guidelines are commonly used to predict foetal acidemia; however, Category II tracings demonstrate limited reliability, low sensitivity, and high specificity.⁵

Differences in guideline structures, along with a lack of clarity and complexity in definitions, may lead to inter-observer variability and differences in the predictive value of CTG interpretation. This issue is most evident in the management of intrapartum Category II CTG patterns, where uniform decision-making remains challenging. The decision regarding the mode of delivery depends on the stage of labour, and when the modified Bishop score is favourable (≥ 6), the expected time to delivery after the onset of Category II CTG can influence the decision to proceed with emergency caesarean section or continue with expectant vaginal delivery. Intrapartum foetal heart rate monitoring aims to detect early signs of foetal hypoxia.^{6,7}

Prolonged Category II CTG tracing during the final two hours of labour has been associated with increased perinatal morbidity.⁷ Despite this, Category II CTG is frequently used as an isolated indication for emergency caesarean sections, even in the absence of confirmed foetal acidemia, resulting in potentially avoidable primary caesarean deliveries.^{8,9}

Understanding the physiological basis of foetal heart rate changes across different stages of labour, along with maternal parity and cervical favourability, is important for guiding appropriate clinical decisions and reducing unnecessary surgical interventions. Therefore, this study aimed to assess the incidence of emergency caesarean sections in intrapartum Category II CTG patterns and to evaluate the association between Category II CTG, parity, modified Bishop score, mode of delivery, and perinatal outcomes in term pregnancies.

METHODS

This prospective observational study was conducted on 103 antenatal patients at the Department of Obstetrics and Gynaecology, Sri Ramakrishna Hospital, Coimbatore, for eight months from December 2019 to August 2020 in term gestational age patients admitted for delivery. Written informed consent was obtained from all participants, and institutional ethical committee approval was obtained (EC/2019/1908/CR/45).

Inclusion criteria

All primigravida and multigravida, singleton pregnancies, cephalic presentations, and gestational ages 37-40 weeks in the active phase of labour were included.

Exclusion criteria

Anomalous foetuses, multiple pregnancies, non-cephalic presentation, elective caesarean sections, an interval between CTG tracing and caesarean birth of <20 minutes, and preterm deliveries were excluded.

Methodology

A detailed history of antenatal checkups, including early and recent ultrasounds, was obtained to rule out foetal anomalies. All women admitted for delivery were managed with routine care. Patients in the active phase of labour were monitored using continuous CTG in the lateral position. Women who developed Category II CTG tracings during labour were included based on the National institute of child health and human development (NICHD) 2008 classification, adapted by ACOG 2013. Category II CTG patterns, like variable decelerations, foetal tachycardia, reduced variability, bradycardia, early and late decelerations, were identified according to NICHD definitions.

In a term pregnancy, foetal heart rate monitoring was performed every 2 h during the latent phase, with 30 min CTG recording, and continuous CTG was performed in the active phase. Foetal well-being was assessed based on the maternal and foetal factors. The consultant and investigator assessed Category II CTG together to reduce the observer variation. The time of onset of Category II CTG and the stage of labour were recorded. Intrauterine resuscitation was performed, and oxytocin was stopped if required. Meconium-stained liquor during labour was also recorded. Clinical reassessment was performed based on the modified Bishop score and labour progression. The duration of Category II CTG, mode of delivery, Apgar score at 5 min, Neonatal intensive care unit (NICU) admission and duration of stay, and neonatal complications were also recorded. The primary outcome was the mode of delivery (vaginal, assisted vaginal, or emergency caesarean section). Secondary outcomes included Apgar score at 5 min, NICU admission, duration of NICU stay, and neonatal complications.

Statistical analysis

Data were entered in MS Excel and analysed using SPSS v29. Categorical variables were expressed as frequencies and percentages. Intergroup comparisons of categorical variables were performed using Pearson's chi-square test. Statistical significance was set at $p < 0.05$. No missing data were found for the primary outcome variables. No multivariate analysis was performed.

RESULTS

During the study period, 103 women who developed intrapartum Category II CTG and met the inclusion criteria were included in the final analysis; no participants were excluded after enrolment. Most participants were aged <30 years and primigravida. Among pregnant women with intrapartum Category II CTG, 55.3% underwent emergency caesarean section, while 44.7% delivered vaginally, of which 31.1% were operative vaginal deliveries and 13.6% were normal vaginal deliveries.

Maternal age was not significantly associated with the mode of delivery ($p=0.699$) or parity ($p=0.4$). Emergency caesarean section was the most common mode of delivery (Table 1). In primigravida women with a favourable modified Bishop score, 22.2% had normal vaginal delivery, 42.6% had operative vaginal delivery, and 35.2% underwent emergency caesarean section, whereas all primigravida women with an unfavourable Bishop score underwent emergency caesarean section (100%; $p<0.0001$).

Table 1: Comparison of the age group with the mode of delivery and parity.

Variables	Category	Age group (years)		P value
		<30 N (%)	>30 N (%)	
Mode of delivery	NVD	13 (14.8)	1 (6.7)	0.699
	AVD	27 (30.7)	5 (33.3)	
	LSCS	48 (54.5)	9 (60)	
Parity	Primi	61 (69.3)	12 (80)	0.4
	Multi	27 (30.7)	3 (20)	

Table 2: Comparison of the modified Bishop score with the mode of delivery.

Modified Bishop score	Category	Mode of delivery			P value
		NVD N (%)	AVD N (%)	LSCS N (%)	
Primi	Favourable	12 (22.2)	23 (42.6)	19 (35.2)	<0.0001
	Unfavourable	0	0	19 (100)	
Multi	Favourable	2 (9.1)	9 (40.9)	11 (50)	0.043
	Unfavourable	0	0	8 (100)	

Table 3: Comparison of the mode of delivery with the onset of labour.

Onset of labour		Mode of delivery			P value
		NVD N (%)	AVD N (%)	LSCS N (%)	
Primi gravida	Spontaneous	6 (18.2)	11 (33.3)	16 (48.5)	0.851
	Induced	6 (15)	12 (30)	22 (55)	
Multi gravida	Spontaneous	0	6 (46.2)	7 (53.8)	0.146
	Induced	2 (11.8)	3 (17.6)	12 (70.6)	

Table 4: Comparison of parity with duration of category II CTG.

Parity	CAT II time from onset to delivery (minutes)		P value
	<60 N (%)	>60 N (%)	
Primi	58 (79.5)	15 (20.5)	0.041
Multi	18 (60)	12 (40)	

Table 5: Comparison of CAT II CTG types with NICU admissions.

CAT II CTG type	Admission to NICU		P value
	No N (%)	Yes N (%)	
Variable deceleration	14 (48.3)	15 (51.7)	0.027
Foetal tachycardia	8 (44.4)	10 (55.6)	
Reduced variability	1 (33.3)	2 (66.7)	
Persistent early deceleration	18 (81.8)	4 (18.2)	
Late deceleration	17 (81)	4 (19)	
Bradycardia	6 (60)	4 (40)	

Table 6: Duration of stay at NICU and complications.

Variables	Category	Frequency (N)	Percent (%)
Duration of stay at NICU	<24 hrs	23	60.5
	>24 hrs	15	39.5
Complications	Severe birth asphyxia	1	2.7
	Neonatal seizures	1	2.7
	Respiratory distress	16	43.2
	Transient tachypnoea of the newborn	10	27.0
	Delayed transition	3	8.1
	Sepsis screening	6	16.2

Among multigravida women with a favourable Bishop score, 9.1% had normal vaginal delivery, 40.9% had operative vaginal delivery, and 50.0% underwent emergency caesarean section, while all multigravida women with an unfavourable Bishop score underwent emergency caesarean section (100%; $p=0.043$) (Table 2).

The onset of labour, either spontaneous or induced, had no significant association with the mode of delivery in Category II CTG ($p=0.503$). Cross-tabulation of primi and multi in the mode of onset of labour also showed no significant association ($p=0.851$ for primi, $p=0.146$ for multi) (Table 3). Among primigravida women with intrapartum Category II CTG, 58 were delivered within 60 min (79.5%), while 15 were delivered after >60 min (20.5%). In multigravida women, 18 cases were delivered within 60 min (60%), and 12 cases required >60 min to deliver (40%). The difference in time from the onset of Category II CTG to delivery between primigravida and multigravida women was significant ($p=0.041$) (Table 4).

NICU admission was most frequent among neonates with reduced variability (2, 66.7%), followed by those with foetal tachycardia (10, 55.6%) and variable decelerations (15, 51.7%). Persistent early decelerations 4 (18.2%) and late decelerations 4 (19%) showed lower NICU admission rates.

The association between Category II CTG type and NICU admission was significant ($p=0.027$) (Table 5). Among neonates admitted to the NICU, 23 had a stay of <24 h (60.5%), while 15 required >24 h of NICU stay (39.5%). The most common neonatal complication was respiratory distress 16 (43.2%), followed by transient tachypnoea of the newborn 10 (27.0%) and sepsis screening 6 (16.2%). Delayed transition was noted in three neonates (8.1%), while neonatal seizures and severe asphyxia were observed in one neonate each (2.7%) (Table 6).

DISCUSSION

This study demonstrates that intrapartum Category II CTG is associated with a high rate of emergency caesarean sections, although vaginal delivery remains feasible in a significant proportion of cases. Parity appeared to influence delivery outcomes in women with intrapartum

Category II CTG. Similarly, Simpson et al reported that multigravida women with a favourable cervical status had higher chances of vaginal delivery and emphasised cautious decision-making to avoid unnecessary caesarean sections, particularly when foetal compromise was not evident.¹⁰ Their study highlighted that labour progression differed significantly between primigravida and multigravida women, consistent with the parity-related observations in our study.

The mode of onset of labour did not independently influence the mode of delivery in the presence of intrapartum Category II CTG. Pevzner et al reported that induction of labour was associated with higher rates of CTG abnormalities but did not significantly increase adverse neonatal outcomes, and operative delivery rates were influenced more by CTG interpretation than induction itself.¹¹ Their findings support our observation that induction alone should not determine the delivery mode in Category II CTG. The duration of exposure to Category II CTG varied according to parity, suggesting differences in labour dynamics between primigravida and multigravida women. Similarly, Weissbach et al reported that prolonged exposure to Category II CTG did not increase adverse neonatal outcomes, and neonatal acidaemia was more closely related to specific CTG patterns rather than duration alone.

They found that reduced variability and tachycardia were strong predictors of neonatal compromise.⁷ Specific Category II CTG patterns were more strongly associated with adverse neonatal indicators than Category II classification alone. Similarly, Gupta et al reported that 75.7% of neonates with nonreactive CTG required NICU admission compared to 22.8% with reactive CTG ($p<0.001$).¹² Michaeli et al also found a significant association between decreased variability and bradycardia and neonatal hypoxic-ischaemic encephalopathy ($p<0.001$).¹³ Holzmann et al reported that 20-25% of foetuses with late or severe variable decelerations combined with tachycardia had elevated lactate levels at fetal blood sampling.¹⁴

Meconium-stained liquor was significantly associated with Category II CTG patterns and adverse neonatal outcomes. Similarly, Xu et al reported that prolonged

decelerations, variable decelerations, and foetal tachycardia were significantly associated with meconium-stained amniotic fluid and adverse neonatal outcomes.¹⁵ Frey et al found that 21.3% of cases with meconium-stained liquor showed Category II CTG patterns, supporting the association observed in our study.¹⁶

These findings suggest that many Category II CTG patterns may represent transient or non-progressive physiological changes rather than established foetal compromise. Therefore, Category II CTG alone should not be an indication for emergency caesarean section. Careful reassessment of labour progress, CTG pattern type, cervical status, and foetal physiology is essential to reduce unnecessary operative delivery while preventing neonatal morbidity.

Strengths

The strengths of this study include its prospective design, use of standardised NICHD criteria for CTG interpretation, and systematic intrapartum assessment by trained obstetricians, which minimised the observer variability.

Limitations

This study was conducted at a single centre with a limited sample size. High-risk pregnancies were not analysed separately, and long-term neonatal outcomes, including detailed NICU management and follow-up, were not assessed.

CONCLUSION

Intrapartum Category II CTG is associated with an increased chance of operative delivery, with the final mode of delivery influenced by parity, modified Bishop score, and labour progression. In this study, perinatal outcomes in Category II CTG were favourable and appeared to depend more on specific CTG patterns than on the duration of tracing.

Patterns such as reduced variability and foetal tachycardia warrant closer monitoring, as they are associated with a higher neonatal risk. Category II CTG by itself should not be taken as a definite indication for emergency caesarean section. Regular clinical reassessment of labour progress and foetal status can help avoid unnecessary operative interventions.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee (EC/2019/1908/CR/45)

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