

Correlation of cardiotocography abnormalities with position and attitude of the fetal head in labor



Shylabirami Sridharan, MS; Shyamala Guruvare, MD; Chythra R. Rao, MD

BACKGROUND: Fetal distress indicated as the cause for cesarean delivery based on cardiotocography findings most often does not reflect in the newborn assessment. Cardiotocography findings are just the decision indicators for cesarean delivery, in the background of labor abnormalities owing to deflexed head or occipitoposterior position.

OBJECTIVE: This study aimed to investigate the association between cardiotocography findings and the attitude of fetal head and occiput position.

STUDY DESIGN: We conducted a prospective observational study in a tertiary hospital in South India, including 304 women in labor with vertex presentation. Fetal attitude, the position of the head, labor abnormalities, and cardiotocography findings were noted. The chi-square test was applied using MedCalc software (version 19) to investigate the association of cardiotocography findings with the attitude of fetal head and occiput position.

RESULTS: Cardiotocography findings had significant association with occipitoposterior position (relative risk, 1.70; 95% confidence interval, 1.32–2.19) and deflexed attitude of the fetal head (relative risk, 1.44; 95% confidence interval, 1.11–1.87). Among cases with occipitoposterior position, 10 of 42 (24%) had pathologic cardiotocography, and 19 of 42 (45%) had suspicious cardiotocography, whereas among cases with deflexed head position, these proportions were 12 of 61 (20%) and 24 of 61 (40%), respectively.

CONCLUSION: Pathologic and suspicious cardiotocography tracings were more frequent in women with fetal occipitoposterior and deflexed head position. However, the association was not specific to any cardiotocography pattern.

Keywords: deflexed head, occipitoposterior position, prolonged labor

Introduction

Cardiotocography (CTG) provides the pattern of fetal heart rate changes in

From the Departments of Obstetrics and Gynecology, Kasturba Medical College, Manipal, Manipal Academy of Higher Education, Karnataka, India; Community Medicine, Kasturba Medical College, Manipal, Manipal Academy of Higher Education, Karnataka, India

The authors report no conflict of interest.

The authors report no funding for this study.

Informed consent was obtained from all the study participants for inclusion in the study.

Cite this article as: Sridharan S, Guruvare S, Rao CR. Correlation of cardiotocography abnormalities with position and attitude of the fetal head in labor. *Am J Obstet Gynecol Glob Rep* 2022;XX:x.ex–x.ex.

Corresponding author: Shyamala Guruvare, MD. shyamala.g@manipal.edu

2666-5778/\$36.00

© 2022 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

<http://dx.doi.org/10.1016/j.xagr.2022.100112>

response to uterine activity, thereby enabling identification of ongoing and suspected hypoxemic states, which may result in fetal acidosis during labor. Perinatal and neonatal morbidity is associated with abnormal tracings on CTG, denoting fetal acidosis. The sensitivity and specificity of CTG in predicting perinatal morbidity requiring neonatal intensive care unit (NICU) admission are 87% and 66%, respectively, with a high negative predictive value (92%) and low positive predictive value (54%).¹ Abnormal CTG is likely in fetuses with growth restriction and cases of uteroplacental insufficiency. Cord events such as cord compression as in oligohydramnios, labor dystocia, missed cephalopelvic disproportion, meconium-stained liquor,² and improper maternal hydration are the other causes of nonreassuring or abnormal CTGs. Thus, the causes of abnormal CTG differ from case to case, and further intervention is tailor-made.

Very few studies have observed the association of CTG abnormalities with

fetal attitude and head position.³ Correlating the CTG findings with fetal position and attitude may help the obstetrician to substantiate the decision for the actions based on CTG. This study intended to evaluate the association of CTG changes with fetal occiput position and head attitude during labor.

Materials and Methods

The study was approved by the Institutional Ethics Committee (IEC 490/2017). Written informed consent was obtained from all the participants. The prospective observational study was conducted at a tertiary-care hospital in South India, including 304 singleton term pregnancies with vertex presentation in labor.

Pregnancies with severe fetal growth restriction, fetal anomalies, and pre-eclampsia and women who received epidural analgesia were excluded.

We calculated the sample size considering the estimated number of the occipitoposterior (OP) position in labor (26%),⁴ with a 5% margin of error at a

AJOG Global Reports at a Glance

Why was this study conducted?

This study aimed to investigate the correlation between cardiotocography (CTG) findings in labor and the attitude and position of the fetal head.

Key findings

CTG abnormalities were more frequent among fetuses in occipitoposterior (OP) position and deflexed head in labor.

What does this add to what is known?

The observations of this study may lead to an optimal approach when CTG abnormalities are found with OP position and deflexion of the fetal head in the background. Correlating the CTG findings with fetal position and attitude may help the obstetrician substantiate the decision for the actions based on CTG.

95% confidence level. The estimated sample size was 295.

We recruited women in early labor at cervical dilatation of <4 cm. Maternal body mass index (BMI) was calculated by measuring weight (kg) and height (m) and using the formula $BMI = (\text{weight in kg}) / (\text{height in m})^2$. Transabdominal ultrasonography (using 2–5-MHz curved-array transducer) was performed to identify fetal position. The fetal head position was determined by noting the relative position of the fetal occiput with the maternal pelvis (arrowhead formed by falx cerebri and thalamus in fetal transthalamic plane pointing toward fetal occiput), and by noting the fetal vertebral column to substantiate the findings. We grouped fetal positions under 2 categories: OP and non-OP.

The attitude of the fetal head was documented as flexed or deflexed on the basis of the position of the caput succedaneum relative to bregma (Figure). The attitude was identified as “flexed” when the prominence of the caput was away from bregma and closer to occiput, and as “deflexed” when it was close to bregma. In the absence of caput, the attitude was decided on the basis of observation by the attending clinician during delivery.

The modified World Health Organization (WHO) partograph was used to document labor progress.⁵ We categorized the labor abnormalities as protraction disorders and arrest concerning cervical dilatation and descent of the fetal head. A slower than expected rate of cervical dilatation (1.2 cm/h in primi-

and 1.5 cm/h in multigravidas) in the active phase of labor defined protracted dilatation. Similarly, a head descent at a slower rate than normal defined protracted descent; for clinical purposes, it was considered protracted descent when the station improved minimally with or without caput/molding.⁶ Cervical dilatation remaining the same for >2 hours in the active phase of labor defined arrest of dilatation; fetal head remaining at the same station for >1 hour in the second stage of labor defined arrest of descent.⁷

On the basis of International Federation of Gynecology and Obstetrics (FIGO) consensus guidelines, we categorized the CTG findings as normal, suspicious, and pathologic.⁸ On the basis of the birthweight centiles, the newborns were grouped as average for gestational age (AGA), large for gestational age (LGA), and small for gestational age (SGA) as per WHO classification.⁹

We entered the data in Microsoft Excel 2007 software and summarized it as percentages and proportions. Univariate analysis was done using the chi-square test, with a level of significance set to <.05. Relative risk (RR) with 95% confidence interval (CI) was calculated to determine the association between CTG pointers and fetal variables. Analysis was done using MedCalc statistical software, version 19 (MedCalc Software, Ostend, Belgium).

FIGURE**Attitude of fetal head based on position of caput succedaneum**

A, Deflexion. B, Flexion.

Sridharan. Cardiotocography with fetal head position and attitude. *Am J Obstet Gynecol Glob Rep* 2022.

TABLE 1
Characteristics of the study participants (n=304)

Characteristics	
Age (mean±SD)	30.5±2.6
BMI at term (mean±SD)	26.2±3.9
Parity, n (%)	
Primi	163 (53.6)
Multi	141 (46.3)
Onset of labor, n (%)	
Spontaneous	189 (62.1)
Induced ^a	115 (37.8)

BMI, body mass index; SD, standard deviation.

^a33% were induced for premature rupture of membranes and gestational diabetes mellitus.

Sridharan. *Cardiotocography with fetal head position and attitude. Am J Obstet Gynecol Glob Rep* 2022.

Results

The cross-sectional study included 314 women in labor with vertex presentation. Among these, 10 patients were excluded from analysis for lack of documentation of fetal attitude in 8 cases and loss of CTG traces in 2 cases. Of the remaining 304 women, 163 were primi- and 141 were multigravidas with a mean age of 30.5±2.6 years. We included only term deliveries, of which 12 were postdated pregnancies. BMI at admission for delivery was >30 kg/m² in 115 (38%) and 25 to 29 kg/m² in 148 (48.6%) women.

Over a third (115/304; 38%) of the recruited women had induced labor, for which common indications were prelabor rupture of membranes (39%) and gestational diabetes mellitus (36%). Half of the study group had a cesarean delivery. Two-thirds (69%) of the cesarean

deliveries for fetal distress had CTG abnormalities. The characteristics of study participants are described in [Table 1](#).

In 42 of 304 (13%) women, the fetus was in OP position. Most (243 [80%]) had flexed attitude in labor, and 61 (20%) had a deflexed head; 89 (30%) women had abnormal labor, 28 dilatation disorders, and 61 descent disorders. Nearly half of the women in labor (169 [55%]) had normal CTG, 72 (24%) had suspicious CTG, and 63 (22%) pathologic CTG findings.

More than two-thirds of the newborns were AGA (~69%), and 14% and 17% were LGA and SGA, respectively. Fifteen newborns required active neonatal resuscitation; 99% of newborns had a good 5-minute Apgar score. NICU admission was required for 12 of 304 newborns; 2 newborns required NICU stay for 5 to

7 days because of poor Apgar score and delayed recovery. Although CTG categories correlated with Apgar findings, it was observed that only 13 of 135 (10%) suspicious and pathologic CTG findings co-occurred with Apgar scores ≤7 ([Table 2](#)).

In examining the association of labor abnormalities with fetal position, head attitude, and birthweight, it was found that only fetal position correlated with labor abnormalities, specifically with descent disorders. Among those with OP position, 24 (56%) had descent disorders vs 37 (14%) in the non-OP group ($P=.04$). Furthermore, we observed that women with labor abnormalities were 1.9 times (RR, 1.9; 95% CI, 1.57–2.51) more likely to have CTG abnormalities compared with patients with appropriate labor progress.

Suspicious and pathologic CTG findings were more frequent with OP than with non-OP position, and also more frequent with deflexed head than with flexed head position ([Table 3](#)). OP position was 1.7 times (95% CI, 1.32–2.19) more likely to have abnormal CTG compared with non-OP position; the deflexed head position was associated with 1.4 times (95% CI, 1.11–1.87) increased risk of CTG abnormalities compared with flexed head position.

Analysis of individual CTG components ([Table 4](#)) showed reduced baseline variability as the most common abnormal pattern (34/42 [81%] in OP position, 25/61 [41%] in deflexed head position). Decelerations (variable deceleration) were the second most common finding in the deflexed head position (16/61 [26%]).

TABLE 2
Comparison of neonatal Apgar scores with the cardiotocography categories (n=304)

CTG category	1-min Apgar		P value	5-min Apgar		P value
	≤7	>7		7–9	≥9	
Normal (n=169)	2	167	.0008	168	1	1.000
Suspicious+pathologic (n=135)	13	122		134	1	

Fisher exact test.

CTG, cardiotocography.

Sridharan. *Cardiotocography with fetal head position and attitude. Am J Obstet Gynecol Glob Rep* 2022.

TABLE 3

Comparison of cardiotocography categories with position and attitude of fetal head

CTG categories	Position of fetal head		Attitude of fetal head	
	OP (n=42) n (%)	Non-OP (n=262) n (%)	Deflexed (n=61) n (%)	Flexed (n=243) n (%)
Normal (n=169)	13 (30.9)	156 (59.6)	25 (40.9)	144 (59.2)
Suspicious (n=72)	19 (45.2)	53 (20.2)	24 (39.3)	48 (19.75)
Pathologic (n=63)	10 (23.9)	53 (20.2)	12 (19.6)	51 (20.9)
<i>P</i> value ^a	.001		.004	
Relative risk (95% CI)	1.70 (1.32–2.19)		1.44 (1.11–1.87)	

CI, confidence interval; CTG, cardiotocography; OP, occipitoposterior.

^aChi-square test.

Sridharan. Cardiotocography with fetal head position and attitude. *Am J Obstet Gynecol Glob Rep* 2022.

Comments

CTG monitoring has been standard practice during labor management. CTG abnormalities are often interpreted as fetal distress, leading to cesarean delivery. However, most such CTG abnormalities do not translate to poor Apgar score at birth or poor perinatal outcome.^{10,11} Because literature regarding the association of labor abnormalities with CTG abnormalities is limited, this study was designed to evaluate the association of CTG abnormalities with fetal attitude and head position.

This study observed significantly increased CTG abnormalities in women with OP and deflexed head position. Decreased variability was the most common abnormality, probably indicating

the general trend in CTG. We did not observe any single specific type of abnormal CTG finding associated with deflexed head or OP position, nor did the CTG abnormalities in labor translate to poor perinatal outcomes. This observation may be owing to early decision for cesarean delivery, particularly when labor abnormality was predicted or identified. Schifrin¹⁰ has also reported that despite CTG abnormalities, newborns did not have severe birth asphyxia or neurologic damage. Bogdanovic et al¹¹ observed low Apgar score only in 17 of 45 (46%) of the newborns when CTG was pathologic, and this was among those who completed delivery by vaginal route. They concluded that newborn Apgar scores were better when

the decisions for immediate delivery were taken on the basis of pathologic traces.

Bellussi et al³ studied the role of ultrasound in identifying flexion and deflexion of the fetal head in OP positions in labor. They reported abnormal CTG findings in 36% (15 of 42) of cases with OP position, and in 35% and 50% of cases with flexed and deflexed attitudes, respectively, but the definition and classification of CTG abnormality were not specified. The reporting of CTG abnormalities was reduced because the authors combined the OP and deflexion results, unlike the present study where we analyzed the observations of CTG abnormalities in OP and deflexion separately.

TABLE 4

Individual cardiotocography components in occipitoposterior and deflexed head position

CTG components ^a	OP position (n=42)			Deflexed head (n=61)		
	n (%)	RR (95%CI)	<i>P</i> value	n (%)	RR (95% CI)	<i>P</i> value
Baseline tachycardia	12 (28.5)	7.4 3.45–16.22	<.001	14(22.9)	6.9 3.06–15.86	<.001
Reduced baseline variability	34 (81)	5.8 4.20–8.25	<.001	25(40.9)	2.6 1.75–3.92	<.001
Variable decelerations	6 (14.2)	0.9 0.43–2.13	.92	13(21.3)	1.7 0.98–3.22	.05
Late decelerations	4 (9.5)	2.4 0.82–7.59	.10	3 (4.9)	1.0 0.31–3.77	.89

CI, confidence interval; CTG, cardiotocography; OP, occipitoposterior; RR, relative risk.

^aSeveral women had >1 abnormal CTG pattern.

Sridharan. Cardiotocography with fetal head position and attitude. *Am J Obstet Gynecol Glob Rep* 2022.

There is a possibility of observer bias in documenting fetal attitude; however, the risk of bias could be minimal because we recruited the cases when the trained investigator was on labor room duties, and the same investigator made all the observations. The study's cross-sectional design limited the elimination of other confounding factors.

CTG abnormalities must mandate reassessing labor progress to rule out OP positions and head deflexion that may lead to progress delays. The recently introduced "Labour Care Guide" by WHO also includes documentation of fetal head position.¹²

The observations of this study are helpful for counseling women in labor and their anxious relatives. This could aid in explaining the progress of labor, plans for further labor management, and keeping patients prepared for probable cesarean delivery. In addition, it can assist in more comprehensive documentation of indications for cesarean delivery.

A cohort design with a larger sample size would be desirable to substantiate the findings further. ■

REFERENCES

1. Sultana J, Chowdhury TA, Begum K, Khan MH. Comparison of normal and abnormal cardiotocography with pregnancy outcomes and early neonatal outcomes. *Mymensingh Med J* 2009;18:S103–7.
2. Odongo BE, Ndavi PM, Gachuno OW, Sequeira E. Cardiotocography and perinatal outcome in women with and without meconium stained liquor. *East Afr Med J* 2010;87:199–204.
3. Bellussi F, Ghi T, Youssef A, et al. Intrapartum ultrasound to differentiate flexion and deflexion in occipito posterior rotation. *Fetal Diagn Ther* 2017;42:249–56.
4. Akmal ET, Tsoi E, Howard R, Osei E, Nicolaides KH. Investigation of occipitoposterior delivery by intrapartum sonography. *Ultrasound Obstet Gynecol* 2004;24:425–8.
5. Kwast BE, Poovan P, Vera E, Kohls E. The modified WHO partograph: do we need a latent phase? *Afr J Midwif Womens Health* 2008;2:143–8.
6. ACOG technical bulletin. Dystocia and the augmentation of labor. Number 218–December 1995 (replaces no. 137, December 1989, and no. 157, July 1991). American College of Obstetricians and Gynecologists. *Int J Gynaecol Obstet* 1995;53:73–80. PMID: 8737311.
7. Dalal AR, Purandare AC. The partograph in childbirth: an absolute essentiality or a mere exercise? *J Obstet Gynaecol India* 2018;68:3–14.
8. Ayres-de-Campos D, Spong CY, Chandrharan E. FIGO Intrapartum Fetal Monitoring Expert Consensus Panel. FIGO consensus guidelines on intrapartum fetal monitoring: cardiotocography. *Int J Gynaecol Obstet* 2015; 131:13–24.
9. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards based on length/height, weight and age. *Acta Paediatr Suppl* 2006;450:76–85.
10. Schifrin BS. The CTG and the timing and mechanism of fetal neurological injuries. *Best Pract Res Clin Obstet Gynaecol* 2004;18:437–56.
11. Bogdanovic G, Babovic A, Rizvanovic M, Ljuca D, Grgic G, Djuranovic–Milicic J. Cardiotocography in the prognosis of perinatal outcome. *Med Arch* 2014;68:102–5.
12. WHO recommendations: intrapartum care for a positive childbirth experience. Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO