Original Research Article

Role of Admission Cardiotocography (CTG) to Predict Mode of Delivery and Perinatal Outcome

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Abstract

Background During the transition from intrauterine to extrauterine environment, all fetuses are subjected to physiological stress. Admission CTG is a test of fetal well-being that is performed when a woman with a low-risk pregnancy is admitted in early labor. It can be utilized to differentiate between mothers, in whom continuous fetal monitoring is needed and those who can be managed by intermittent auscultation. It is a good predictor of fetal condition on admission and during the next few hours of labor in term fetuses.**Aims and Objective** The objective of this study was to ascertain the efficacy of admission CTG to identify the already compromised or likely to become compromised fetus of an apparently normal pregnancy on admission and to know the efficacy of admission CTG in predicting the mode of delivery& perinatal outcome in term pregnancy at onset of labor.**Material & Method** This was a prospective observational study conducted in department of obstetrics and gynaecology, GMC Bhopal. This study included 400 antenatal women admitted in hospital with term pregnancy in early labor without high risk and Singleton pregnancy with cephalic presentation. All women were subjected to an admission CTG, which included a 20minute recording of fetal heart rate and contractions.**Result** The Majority of women were primigravida in the 20-24 years age group. The admission CTG were reassuring in 84.3%, non reassuring in11.8% and pathological in 4.0%women. Incidence of fetal distress, meconium stained liquor and NICU stay was significantly more frequent among patients with pathological pattern. Spontaneous vaginal delivery commonest mode of delivery in reassuring CTG pattern.**Conclusion** Admission CTG can be used as a simple, economic, non- invasive screening procedure to detect pre-existing fetal hypoxia and plan early intervention to prevent adverse perinatal outcomes in hospital settings with limited resources and heavy patient load.

Keywords: Cardiotocography (CTG) ,Perinatal Outcome, Fetal Distress, Meconium Stained Liquor, Labor admission test (LAT).

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Introduction

The ten centimetre journey from brim to the outlet of pelvis has remained the most dangerous journey in one's life since the evolution of the species. The fetal distress in labor is a common occurrence and a cause of concern for both the patient and her obstetrician. Therefore every fetus deserves intrapartum fetal monitoring. Surveillance of the fetus during labor is important to ensure the delivery of a healthy baby in good condition with the minimum of intervention[1].

Fetal heart rate monitoring initially was started for the detection of fetal hypoxia or fetal acidemia, which can cause multi-organ complication in the newborn. The extreme consequences of this damage can be intrapartum or early neonatal death. The less severity of hypoxia may result in transient or possibly permanent morbidity[2].Labor admission test (LAT) is a test of fetal well-being that is performed when a woman with a low-risk pregnancy is admitted in labor. A recording of fetal heart rate and uterine activity using the cardiotocograph for about 20 minutes on admission to the labor ward is called as labor admission test[3]. It's aim is to assess fetal well-being at the onset of labor and identify those fetuses that may be already hypoxic or may not withstand the stress of uterine contractions which can expose them to hypoxia in labor. Screening for fetal distress is a big challenge for obstetricians. Labor admission test (LAT) by cardiotocography (CTG) can be utilized to differentiate between mothers, in whom continuous fetal monitoring is needed and those who can be managed by intermittent auscultation.Admission test is used to indicate the fetal well-being non-invasively. Thus, taking a short recording of fetal heart rate on admission helps us to determine the ability of the fetus to withstand the stress of labor. It is a dynamic screening test for the state of oxygenation of the fetus on admission of the mother into labor room. It checks the fetal reserve by recording fetal heart rate during the phase of temporary occlusion of the utero-placental blood supply under physiological stress of repeated uterine contractions. The admission CTG, therefore, has two potential roles. It can be used as a screening test in early labor to detect compromised fetuses on admission and to select the women in need of continuous fetal electronic monitoring during labor. Barring acute events like cord prolapse, uterine hyperstimulation, placental abruption and

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meconium aspiration, the admission test is a good predictor of fetal condition at the time of admission and during the next few hours of labor in term fetuses[4].

In developing countries with inadequate antenatal care and limited resources, Intrapartum fetal morbidity and mortality are not uncommon. Hence in present prospective study we tried to ascertain the efficacy of admission CTG to identify the already compromised or likely to become compromised fetus of an apparently normal pregnancy on admission along with predicting the mode of delivery and neonatal outcome in term pregnancy at onset of labor.

The objective of this study was to ascertain the efficacy of admission CTG to identify the already compromised or likely to become compromised fetus of an apparently normal pregnancy on admission and to know the efficacy of admission CTG in predicting the mode of delivery & perinatal outcome in term pregnancy at onset of labor.

Material & Methods

This prospective study ―Role of admission cardiotocography (CTG) to predict mode of delivery and perinatal outcome was undertaken in Department of obstetrics and gynaecology in Sultania Zanana Hospital, Gandhi Medical College, BHOPAL from December 2018 to December 2019 after seeking authorization from Dean, GMC, Bhopal and Head of the department, department of obstetrics and gynaecology SZH, Bhopal. 400 patients admitted in hospital were included as per following criteria:

Criteria for Selection of Cases

Inclusion Criteria

- Antenatal women admitted in sultania zanana hospital with term pregnancy in early labor with no medical and obstetrics high risk.
- Singleton pregnancy with cephalic presentation.

Exclusion Criteria

- Multiple gestation
- Antepartum hemorrhage (APH)
- Pregnancy induced hypertension (PIH)
- Oligohydramnios
- Intra-uterine growth restriction (IUGR)
- Gestational diabetes mellitus (GDM)

After included in the study, the patients were explained about the procedure and informed consent was obtained. The pregnant mother was asked to empty her bladder and all the procedure, what to expect during the procedure and what is expected of her were explained to her. She is placed in the semi fowler's position. The foetal heart rate and the activity of the uterine muscle are detected by two transducers placed on the mother's abdomen (one above the foetal heart, to monitor heart rate and the other at the fundus of the uterus to measure frequency of contractions).The patient is asked to press the event marker every time she perceives foetal movement. Presence of spontaneous foetal heart rate accelerations with foetal movement is an indicator of foetal well-being.

Non stress test (NST) Variables to be evaluated are

- Baseline foetal heart rate
- Variability of foetal heart rate
- Presence or absence of accelerations
- Presence or absence of decelerations

CTG tracing will be interpreted as per RCOG CRITERIA for interpretation of CTG.

After which CTG tracing were typed into

- Normal / reassuring
- Suspicious / equivocal
- Abnormal / pathological.

Patient can be divided into low and high observational group depending upon the tracings.

Low observational group – Normal tracing

High observational group - Suspicious + Pathological tracing

If the admission test tracings are normal and not in immediate labor, she is transferred to antenatal ward. If the tracings are pathological, she is transferred to labor ward and further management is decided based on individual condition. The admission CTG will be used to know the correlation of cardiotocography to mode of delivery and perinatal outcomes such as APGAR score, Need of resuscitation, admission into neonatal intensive care unit (NICU) and duration of stay in NICU.

Observation Chart

Table 1: Showing Distribution of Patients in Different Age Group

Age Group (Years)	Frequency	Percent
20-24	248	62.0
25-29	108	27.0
30-34	36	9.0
>35	8	2.0
Total	400	100.0

Table 2: Showing Distribution of Patients According To Their Booking Status

Booking status	Frequency	Percent
Booked	276	69.0
Unbooked	124	31.0
Total	400	100.0

Table 3: Showing Patterns of Ctg

CTG Pattern	Frequency	Percent
Re-Assuring	337	84.3
Non-Reassuring	47	11.8
Pathological	16	4.0
Total	400	100.0

Table 4: Comparing Ctg Patterns With Mode of Delivery

CTG Pattern	Spontaneous Vaginal delivery		Ventouse assisted delivery		LSCS		Total		P value
	N	%	N	%	N	%	N	%	
Re-Assuring	264	78.33	0	0	73	21.66	337	84.2	<0.001
Non-Reassuring	23	48.93	0	0	24	51.06	47	11.8	
Pathological	0	0	0	0	16	100	16	4	

Table 5: Showing Correlation of Indication of Lscs And Ctg Patterns

Indication	Re-assuring (n=73)	Non-reassuring (n=24)	Pathological (n=16)	Total
Fetal distress	23 (5.75)	22 (5.50)	13 (3.25)	58
Cephalo pelvic disproportion	34(8.5)	2(0.5)	1(0.25)	37
Deep transverse arrest	10 (2.5)	0 (0)	0 (0)	10
Face presentation	3 (0.75)	0 (0)	0 (0)	03
Abruption with fetal distress	0 (0)	0 (0)	2 (0.5)	02
Persistent occipito posterior	2 (0.5)	0 (0)	0 (0)	02
Non progress of labor	1 (0.25)	0 (0)	0 (0)	01
Total	73	24	16	113

Table 6: Diagnostic Parameters of Admission Test (Sensitivity, Specificity, Positive Predictive Value and Negative Predictive Value

Parameters	Percentage
Sensitivity	63.4
Specificity	96.8
PPV	83.7
NPV	85.6

Table 7: Comparing Cardiotocography Reading With Apgar Score

CTG Pattern	APGAR score		Total	P value
	<7	>7		
Re-Assuring	22 (6.5%)	315 (93.5%)	337 (100%)	<0.001
Non-Reassuring	17 (36.2%)	30 (63.8%)	47 (100%)	
Pathological	11 (68.8%)	5 (31.2%)	16 (100%)	
Total	5 (12.5%)	350 (87.5%)	400 (100%)	

Table 8: Comparing Ctg Patterns With Need For Neonatal Resuscitation

CTG pattern	Need for neonatal Resuscitation		Total	P value
	No	Yes		
Re-Assuring	324 (96.1)	13 (3.9)	337 (100)	<0.001
Non-Reassuring	32 (68.1)	15 (31.9)	47 (100)	
Pathological	6 (37.4)	10 (62.5)	16 (100)	
Total	362 (90.5)	38 (9.5)	400 (100)	

Table 9: Comparing Ctg Patterns With Nicu Admission

CTG pattern	Admission in NICU		Total	P-value
	No	Yes		
Re-Assuring	324 (96.1)	13 (3.9)	337 (100)	<0.001
Non-Reassuring	35 (74.5)	12 (25.5)	47 (100)	
Pathological	7 (43.8)	9 (56.2)	16 (100)	
Total	366 (91.5)	34 (8.5)	400 (100)	

Table 10: Showing Neonatal Outcome Among Nicu Admissions (N=34)

Total no of NICU admission	Back to Mother	Neonatal death	P value
34	30	04	<0.001

Results

Total 400 patients were enrolled in the study , It was found that majority of the patients were in the age group between 20-24 years 62% followed by 25-29 years 27%.There were 9% patients in the age group of 30-34 years whereas 2% patients had age more than 35 years .Among 400 pregnancies, majority were booked 69% followed by 31% unbooked cases.

It was found that on CTG, majority of the women found to have re-assuring pattern of admission test 84.3% followed by non-reassuring 11.8% and pathological 4% pattern. Table records the comparison of CTG Patterns with mode of delivery. It was found that out of 337 women with re-assuring pattern, 78.33% had Spontaneous Vaginal delivery whereas 21.66% had LSCS. Out of 47 women with non-reassuring pattern, majority had LSCS (51.06%) whereas out of 16 patients with pathological CTG pattern, all undergone LSCS (100%).

As seen from Table , most common indication for LSCS in Re-assuring (n=73) group was Cephalo pelvic disproportion 8.5% followed by fetal distress 5.75%, Deep transverse arrest 2.5% and Face presentation 0.75%. In non-reassuring (n=24) most common indication for LSCS was Fetal distress 5.50% followed by Cephalo pelvic disproportion 0.50% similarly in Pathological (n=16) pattern group most common indication was Fetal distress 3.25% followed by Cephalo pelvic disproportion 0.25%. Table shows the diagnostic parameters of admission test (sensitivity, specificity, positive predictive value and negative predictive value. It was found that Sensitivity, Specificity, PPV and NPV was admission test was 63.4%, 96.8%, 83.7% and 85.6% respectively.

Table shows the comparing cardiotocography reading with APGAR score. It was found that majority of the women in Re-assuring group had APGAR score >7 (93.5%) followed by (6.5%) women who had APGAR score <7. Similarly in non- reassuring majority had APGAR score >7 (63.8%) followed by (36.2%) women who had APGAR score <7. Whereas in Pathological pattern group majority had APGAR score <7 (68.8%) followed by APGAR score >7 in (31.2%) women. Table shows the comparing CTG patterns with need for neonatal resuscitation. It was found that in Re-assuring group 13 (3.9%) had the Need of Resuscitation whereas in non-reassuring group, 15 (31.9%) had Need of Resuscitation and in Pathological pattern group 10 (62.5%) had Need of Resuscitation.

Table shows the comparing CTG patterns with NICU admission. It was found that in Re-assuring group 13 (3.9%) neonates had Admission in NICU whereas in non- reassuring group, 12 (25.5%) had Admission in NICU whereas in Pathological pattern group 9 (56.2%) had Admission in NICU. Table shows neonatal outcome

among NICU admissions (n=34). It was found that out of 34 babies who were admitted in NICU, majority (n=30) were back to mother where 4 neonates died in NICU.

Statistical Analysis

The collected data was compiled using MS EXCEL and was analysed using SPSS version 20 (IBM, USA). Data was presented in form of tables, percentage and proportion. Descriptive statistics were calculated using Analytical statistical methods like chi-square test with 95% CI were done. Differences at p value < 0.05 were considered statically significant.Frequency and percentage were calculated & statistical test (Chi Square) was applied wherever applicable; p<0.05 was taken as statistically significant.

Discussion

Routine and continuous electronic monitoring of foetal heart rate (FHR) in labour has become an established obstetric practice in high-risk pregnancies in industrialised countries. However, the same may not be possible in non-industrialised countries where antenatal care is inadequate with a large number of high-risk pregnancies being delivered in crowded settings and inadequate health care provider to patient ratios.The admission CTG therefore has two potential roles. It can be used as a screening test in early labor to detect compromised fetuses on admission and to select the women in need of continuous electronic fetal monitoring during labor. A short tracing of FHR on admission in labor ward may thus detect fetal intrauterine hypoxia already present on admission and may have some predictive value for hypoxia that may develop during labor. Based on this assumption 20 minute EFM on admission has been used as labor admission test.

Present study was conducted to evaluate the efficacy of admission CTG in predicting the mode of delivery in term pregnancy at onset of labor and perinatal outcome. Majority of the patients were in the age group between 20-24 years (62%) followed by 25-29 years (27%), 9% patients in the age group of 30-34 years whereas 2% patients had age more than 35 years. This was compared to a study conducted by Kansal TJ et al, where most of the females were between 20-30 years of age (81%), while only 4.8% were above 30 years of age[5].Similar result were also observed in Rahman H et al study, where the majority of women (73.8%) were in the 21-30 years age group.[1] In Thobbi VA et al study most of the females were between 20-30 years of age (85%) while only 3% were above 30 years of age[6].

According to NICE guidelines 2001, CTG traces were divided into re-assuring, non-reassuring and Pathological. Present study shows that as per 20 minute admission CTG patterns, 84.3% women showed re-assuring pattern 11.8% showed non-reassuring traces and only 4% had a pathological pattern. The incidence of admission test in the present study was comparable to the study by Kamal Buckshee et al, where majority of the women found to have re-assuring pattern of admission test 85% followed by non-reassuring 11% and 4% pathological pattern[7]. These results were also comparable to the other studies conducted by Ingemarsson et al and Hegde A et al. Ingemarsson conducted a study on admission test with 130 patients where tracings were: 86.9% re-assuring, 7.4% belonged to non-reassuring group and 0.6% belonged to pathological pattern[8]. According to CTG tracing done in the patients of Hegde A et al study, 84.5% had re-assuring CTG, 9.5% had non-reassuring and 6% had pathological CTG[9]. Joshi H et al in their study observed that 67% had re-assuring CTG, 21% had non- reassuring and 12% had Pathological CTG[10].

Table 11: Comparison of Patterns of Ctg With Other Studies

Study group	No of patients	Re-assuring	Non-reassuring	Pathological
Ingemarsson (1986)	130	86.9%	8.5%	4.6%
Kamal Buckshee (1999)	100	85%	11.0%	4.0%
Aparna Hedge (2001)	200	84.5%	9.5%	6.0%
Present study	400	84.3%	11.8%	4.0%

Assessment of fetal wellbeing in labor ward by admission CTG helps us to look for already prevailing high risk factors vigilantly and also new factors that have recently appeared. In present study on comparing CTG Patterns with mode of delivery, out of 337 women with re-assuring pattern, 78.33% had Spontaneous Vaginal delivery whereas 21.66% had LSCS. Out of 47 women with non- reassuring pattern, majority had LSCS (51.06%) whereas out of 16 patients with pathological CTG pattern, all undergone LSCS (100%). This result was comparable to those of Rajalekshmi M et al study, where pathological tracings were associated with increased incidence of LSCS delivery than re-assuring tracings (p<0.05)[11]. In the study conducted by Meena RB et al, 92% patients with re-assuring CTG delivered vaginally and 6.67% delivered by LSCS while 88% patients with pathological or non- reassuring CTG underwent LSCS & 12% delivered vaginally[12]. In Joshi H et al study out of the 67 patients with re-assuring CTG, 58% delivered vaginally, 9% patients underwent instrumental delivery while 22 (32%) were delivered by caesarean section. Of the 21 patients with non- reassuring CTG, 43% delivered vaginally, 5% had instrumental delivery and 52% underwent caesarean section. Among the 9 patients who had pathological CTG, 84% delivered by caesarean section, while 8% delivered vaginally & 8% had instrumental delivery. The incidence of operative deliveries (caesarean sections) was more in the pathological CTG group[10]. Similarly Impey L et al et al in their study found that most of the caesarean deliveries occurred in abnormal CTG group[13].

Present study correlates the indication of LSCS with CTG patterns. It was found that most common indication for LSCS in re-assuring (n=73) group was Cephalo pelvic disproportion (8.5%) followed by fetal distress (5.75%), Deep transverse arrest (2.5%) and Face presentation (0.75%). In non-reassuring (n=24) most common indication for LSCS was Fetal distress (5.50%) followed by Cephalo pelvic disproportion (0.50%) similarly in Pathological (n=16) pattern group most common indication was Fetal distress (3.25%) followed by Cephalo pelvic disproportion (0.25%). While result of Kumar A et al study indicated that LSCS technique with fetal distress were higher in the pathological group and considerably lower in the re-assuring group[14]. Kansal R et al conducted a study on 276 women and reported fetal distress in 139 patients. Only 64 (16.0 %) cases developed fetal distress in the re-assuring admission test group, whereas the percentage increased to 39 (62.9 %) and 36 (97.3 %) in the non- reassuring and pathological groups, respectively[5]. Ingemarsson et al in their study reported rate of fetal distress, 1.3% in re-assuring group, 10% in non-reassuring group and 40% in pathological group[8].

Present study shows the diagnostic parameters of admission test. It was found that Sensitivity, Specificity, positive predictive value and negative predictive value admission test was 63.4%, 96.8%, 83.7% and 85.6% respectively. Similarly, Shruti Prabha et al in their study showed that admission test had 95% specificity and 73.70% Sensitivity[2]. Ingemarsson et al also reported a very high (99.4%) specificity of the admission test. The high specificity of the admission test means that a normal test accurately excludes adverse fetal status at the time of testing. Sensitivity, positive predictive value and negative predictive value of admission test was 23.5%, 40% and 98.7%.[8]

Table 12: Comparing Sensitivity, Specificity, Positive Predictive Value And Negative Predictive Value With Previous Studies

Study group	Sensitivity	Specificity	PPV	NPV
Ingemarsson (1986)	23.5%	99.4%	40.0%	98.7%
Kamal Buckshee (1999)	21.43%	87.50%	40.0%	74.12%
Aparna Hegde (2001)	66.7%	90.0%	38.7%	96.0%
Present study	63.4%	96.8%	83.7%	85.6%

In Kamal Buckshee et al study sensitivity of admission test was 21.43%, specificity was 87.50 %, PPV was 40 %, and NPV was 74.12 %.[7] Hegde A et al showed that admission test CTG has high sensitivity and specificity for predicting fetal distress (66.7 % and 90% respectively). A high NPV (86.49%) enables a clinician to accurately exclude fetal distress in an individual patient. PPV of admission test was 38.7%[9]. The results of previous studies comparable to those of current study.

Admission test by CTG is used to indicate not only the state of oxygenation of the fetus on admission of the mother non- invasively but also checks the fetal reserve by recording FHR during the phase of temporary occlusion of the utero-placental blood supply under physiological stress of repeated uterine contractions. Thus, taking a short recording of fetal heart rate on admission helps us to determine the ability of the fetus to withstand the stress of labor[15].

The objective of the study by Bogdanovic G et al was to examine whether cardiotocography can (CTG) predict asphyxia of the embryo, manifested as hypoxic-ischemic encephalopathy (HIE), and to what extent one can rely on CTG record. Authors concluded that cardiotocography is one of the reliable methods of fetal monitoring in pregnancy and delivery, and that pathological CTG record very likely indicates the possible presence of perinatal asphyxia. Achieving a low degree of correlation between pathological intrapartum cardiotocography findings and long-term outcome of children can be achieved by rapid and adequate obstetric intervention and the relatively short duration of fetal acidosis, and optimal procedures during intensive care of newborns[16].

Various other authors in similar studies like ours have studied admission cardiotocography and elaborated its role in predicting foetal outcome in high-risk obstetric patients. In conclusion of various studies **,**the admission CTG appears to be a simple non-invasive test that can serve as a screening tool in 'triaging' foetuses of high-risk obstetric patients in non-industrialised countries with a heavy workload and limited resources[17,18].

Conclusion

Admission CTG can be used as a simple, economic, non- invasive screening procedure to detect pre-existing fetal hypoxia and plan early intervention to prevent adverse perinatal outcomes in hospital settings with limited resources and heavy patient load. In present study, specificity and PPV are 96.8% and 83.7% respectively.

What This Study Add To Existing Knowledge

The admission CTG is a short, usually 20 minute, recording of the FHR immediately after admission to the labour ward. Admission test has a good predictive value for fetal wellbeing for next few hours of labor in patient without any obstetric and medical high risk so it can be used as screening procedure to detect pre-existing fetal hypoxia and plan early intervention to prevent adverse perinatal outcomes in developing countries like India with limited resources and heavy patient load.

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