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Clinical study of cardiotocography admission test in labour as a predictor of fetal outcome at a tertiary care center.

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INTRODUCTION

Intrapartum fetal surveillance is important to ensure the delivery of a healthy baby in good condition with the minimum of intervention.[1] Unexpected complications may occur during labor, even in patients without prior evidence of risk, so maternity hospitals need to ensure the presence of trained staff, as well as appropriate facilities and equipment for an expedite delivery (in particular emergency cesarean delivery).

The admission cardiotocography test is a short continuous electronic FHR recording for 20 minutes, along with the simultaneous recording of the uterine activity done immediately on admission to the labour room.[2,3] Admission test is a 'Natural contraction stress test' that can assess the ability of fetus to withstand the functional stress of uterine contractions and helps to identify those cases at risk. It is a dynamic screening test for the state of oxygenation of the fetus on admission of the mother into labour room.

The fetuses which are already at risk and those which are likely to have problems in labour may be identified by the Admission Test and need careful continuous monitoring.[4] The Admission CTG can be used as a screening test in early labour to detect compromised fetuses on admission and to select the women in need of continuous fetal electronic monitoring during labour.[5,6]Our institute caters large number of pregnant women, with approximate 20,000 deliveries per year. In order to improve fetal outcome, we undertook present study of cardiotocography admission test in labour as a predictor of fetal outcome at a tertiary care center.

MATERIAL AND METHODS

Present study was single-center, prospective, observational study, conducted in department of obstetrics & gynaecology, at Government medical college & hospital, Aurangabad, Maharashtra, India. Study duration was of 6 months (April 2021 to September 2021). Study was approved by institutional ethical committee.

Inclusion criteria

- Pregnant women with >37 weeks of gestation, spontaneous/ induced labour, singleton fetus, underwent admission test, delivered at our hospital within 24 hours of the admission test, willing to participate
- High risk pregnancies such as post-dated, HDP (hypertensive disorders of pregnancy), IUGR (intrauterine growth restriction), Oligohydramnios (AFI < 5), diabetes mellites/gestational diabetes mellites, underwent admission test, delivered at our hospital within 24 hours of the admission test, willing to participate.

Exclusion criteria

- Women with a period of gestation ≤37 weeks.
- Congenital anomaly confirmed by ultrasonography (USG).
- Acute hypoxic states (placental abruption, cord prolapse, abnormal lie and needing emergency caesarean section, urgent LSCS for fetal hypoxia (lower segment caesarean section).
- multiple pregnancies, previous LSCS, any H/o uterine surgery
- Underwent LSCS for maternal request

Study was explained & a written informed consent was taken from patient. Patient was placed in the left lateral position using pillows under one of her hips, The transducer was applied to the patient with elastic adjustable retaining strap that encircles the abdomen after applying an adequate amount of ultrasound coupling gel over the transducer face. Uterine activity was measured by external tocodynamometry where transducer was placed over the uterine fundus and held in place by a belt. FHR for 20 minutes period was recorded, if the patient perceived low fetal movements with acceleration of > 15 beats lasting for 15 sec then the test is stopped. If no movement was recorded the test was continued for another 20 minutes period or baby can be stimulated by vibro acoustic stimulation.

Variables evaluated were baseline fetal heart rate, variability of foetal heart rate, presence or absence of accelerations, presence or absence of decelerations.

The admission test tracings were typed into (i) Reactive (ii) Suspicious (iii) Pathological . Depending on the type of tracings, the mode of management varies.

Table 1: Pathological classification proposed by NICE.[6]

Description	Baseline (beats/ minute)	Baseline variability (beats/minute)	Declarations
Reassuring	110 to 160	5 to 25	None or early Variable decelerations with no concerning characteristics for < 90 minutes
Non-reassuring	100 - 109 **OR** 161- 180	< 5 for 30- 50 minutes **OR**> 25 for 15-25 minutes	Variable decelerations with no concerning characteristics for ≥ 90 minutes **OR** Variable decelerations with any concerning characteristics in up to 50% of contractions for ≥ 30 minutes **OR** Variable decelerations with any concerning characteristics in over 50% of contractions for < 30 minutes **OR** Late decelerations in over 50% of contractions for < 30 minutes, with no maternal or fetal clinical risk factors such as vaginal bleeding or significant meconium
Abnormal	< 100 **OR** > 180	< 5 for > 50 minutes **OR**> 25 for > 25 minutes **OR**Sinusoidal pattern	Variable decelerations with any concerning characteristics in over 50% of contractions for 30 minutes (or less if any maternal or fetal clinical risk factors) **OR** Late decelerations for 30 minutes (or less if any maternal or fetal clinical risk factors) **OR** Acute bradycardia, **OR** a single prolonged deceleration lasting 3 minutes or more

The FHR tracing was classified as normal, suspicious or pathological as according to the classification proposed by NICE (National institute of clinical excellence) guidelines 2017.

Table 2: Definition of CTG tracings (NICE guidelines 2017).[6]

Category	**Definition**
Normal	An FHR trace in which features are classified as reassuring.
Suspicious	An FHR trace with 1 no reassuring feature AND 2 reassuring

	features.
Pathological	An FHR trace with 1 abnormal feature OR 2 no reassuring features.

Patients with a normal reactive test were monitored by intermittent auscultation for 1 minute, every 30 minutes in the 1st stage of labour and every 5 minutes in the second stage of labour. Those with suspicious tracings were placed on continuous CTG monitoring. In patients with a pathological tracing delivery was hastened by operative, instrumental intervention depending upon the stage of labour. Perinatal outcome was assessed in terms of the colour of the liquor, APGAR score, NICU admission and perinatal mortality.

The neonatal outcome measures assessed were development of fetal distress during labour, Apgar score 5 minutes after birth, whether baby needed any resuscitation, admission to neonatal intensive care unit (NICU) and incidence of intrapartum still birth / neonatal mortality. Maternal outcomes assessed were mode of delivery, complications during delivery. Placenta was examined for infarcts and other anomalies. Mother and baby were followed till discharge.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Statistical analysis was done by descriptive statistics.

RESULTS

During study period (Aprilto September 2021) total 4562 admission tests were performed in labour room. After applying inclusion & exclusion criteria total 800 pregnant women were included in present study. Majority of pregnant women were from ≤ 25 years age group (44.25 %), followed by 26-30 years age group (39 %). Parity wise majority were 1 or 2 para (44. 88 %) & 40.25 % were nulliparous. 39-40 weeks gestational age pregnant women were (49.38 %) more as compared to 37-39 weeks gestational age (36 %). Admission test interpretation was normal in majority of cases (75.25 %), while suspicious tracing was noted in 143 (17.88 %) cases & pathological tracing in 55 (6.88 %) cases.

Table 3- General characteristics

Parameter	No. of patients	Percentage (%)
Maternal age		
≤ 25	354	44.25%
26-30	312	39.00%
31-35	112	14.00%
>35	22	2.75%
Parity		
0	322	40.25%
1-2	359	44.88%
≥ 3	119	14.88%
Gestational age		
37-39 weeks	288	36.00%
39-40 weeks	395	49.38%
41-42 weeks	117	14.63%
Admission test interpretation		
Normal Tracing	602	75.25 %
Suspicious Tracing	143	17.88 %
Pathological Tracing	55	6.88 %

In 602 pregnant women with normal admission test, 35 (5.81 %) later developed fetal distress. Majority were delivered vaginally (86.71 %), while 21 by instrumental delivery & 59 by LSCS. Among 59 cases of LSCS, fetal distress was indication in 16 cases while 43 cases were due to reasons other than fetal distress. 22 neonates (3.65 %) required NICU admission.

In present study, 143 pregnant women had suspicious admission test, 77 (53.85 %) later developed fetal distress. Majority were delivered LSCS (54.47 %), while 48 (33.57 %) vaginally & 27 by instrumental delivery. Among 78 cases of LSCS, fetal distress was indication in 45 cases while 23 cases were due to reasons other than fetal distress. 38 neonates (26.57 %) required NICU admission. Among 55 cases with pathological admission test, all underwent emergency LSCS due to fetal distress. 26 neonates (47.27 %) required NICU admission.

Table 4. Maternal and Foetal Outcome

Outcome	Normal Tracing (n=602)	Suspicious Tracing (n=143)	Pathological Tracing (n=55)
Foetal distress	35 (5.81 %)	77 (53.85 %)	55 (100 %)
Mode of delivery			
Vaginal delivery	522 (86.71 %)	48 (33.57 %)	0
Instrumental delivery			
With foetal distress	8 (1.33 %)	21 (14.69 %)	0
Without foetal distress	13 (2.16 %)	6 (4.2 %)	0
LSCS			
With foetal distress	16 (2.66 %)	45 (31.47 %)	55 (100 %)
Without foetal distress	43 (7.14 %)	23 (16.08 %)	0
Neonatal outcome			
Apgar score (at 1 minute)	554 (92.03 %)	89 (62.24 %)	25 (45.45 %)
>7	48 (7.97 %)	54 (37.76 %)	30 (54.55 %)
≤ 7			
Apgar score (at 5 minute)			
>7	583 (96.84 %)	107 (74.83 %)	33 (60 %)
≤ 7	19 (3.16 %)	36 (25.17 %)	22 (40 %)
NICU admission	22 (3.65 %)	38 (26.57 %)	26 (47.27 %)

Neonatal follow-up was kept till discharge. Neonates of 22 mothers (3.65 %) with normal admission test required NICU admission. In that group 12 (54.55 %) neonates required mechanical ventilation. Morbidities noted were birth asphyxia (4.55 %), neonatal jaundice (50 %) &septicemia (4.55 %). All neonates were discharged without any complications. No incidence of hypoxic ischemic encephalopathy (HIE), still birth or early neonatal death noted.

Among mothers with suspicious admission test, all 38 (100 %) neonates admitted in NICU required resuscitation, 29 (76.32 %) required mechanical ventilation. Morbidities noted were birth asphyxia (84.21 %), neonatal jaundice (42.11 %), meconium aspiration syndrome (5.26 %), aspiration pneumonia (2.63 %), ssepticemia(10.53 %) &hypoxic ischemic encephalopathy (HIE) (2.63 %). Early Neonatal death was noted in 1 (2.63 %) case, remaining 37 (97.37 %) cases were discharged without any complications.

26 neonates of mothers with Pathological admission test required NICU admission, all required resuscitation before admission while 20 (76.92 %) neonates required mechanical ventilation. Morbidities noted were birth asphyxia 26 (100 %), neonatal jaundice 14 (53.85 %), meconium aspiration syndrome 5 (19.23 %), aspiration pneumonia 7 (26.92 %),

septicemia 13 (50 %), hypoxic ischemic encephalopathy (HIE) 3 (11.54 %). In this group we noted 2 (7.69 %) still births & 3 (10.54 %) early neonatal deaths. 18 (69.23 %) neonates were discharged without any complications.

Table 5: Distribution of study participants according to CTG tracings and NICU admission

CTG tracings	Normal Tracing (n=22)	Suspicious Tracing (n=38)	Pathological Tracing (n=26)
Required resuscitation	22 (100 %)	38 (100 %)	26 (100 %)
Required mechanical ventilation	12 (54.55 %)	29 (76.32 %)	20 (76.92 %)
Discharged Without Any complications	22 (100 %)	37 (97.37 %)	18 (69.23 %)
Birth asphyxia	1 (4.55 %)	32 (84.21 %)	26 (100 %)
Neonatal Jaundice	11 (50 %)	16 (42.11 %)	14 (53.85 %)
Meconium Aspiration Syndrome	0	2 (5.26 %)	5 (19.23 %)
Aspiration Pneumonia	0	1 (2.63 %)	7 (26.92 %)
Septicemia	1 (4.55 %)	4 (10.53 %)	13 (50 %)
Hypoxic ischemic Encephalopathy (HIE)	0	1 (2.63 %)	3 11.54 %)
Still birth	0	0	2 (7.69 %)
Early Neonatal death	0	1 (2.63 %)	3 (10.54 %)

DISCUSSION

Cardiotocography (CTG) is one form of fetal assessment that simultaneously records fetal heart rate (FHR), fetal movements and uterine contraction patterns to investigate hypoxia. It assesses the placental reserve by checking the response of the fetal heart during the phase of temporary occlusion of the utero-placental blood supply under physiological stress of repeated uterine contractions. [7] It thereby assesses the ability of the fetus to withstand the process of labour. CTG analysis contains evaluation of basic CTG features (baseline, variability, accelerations, decelerations, and contractions) followed by overall CTG classification.

Fetal morbidity and mortality are greater in high-risk women, such as those with prolonged pregnancy, intrauterine growth restriction, hypertension, diabetes or other risk factors. However, it is interesting to note that in pregnancies that proceeded to term, morbidity and mortality due to intrapartum events occurred with similar frequency in those categorized as low risk compared with high risk based on traditional classification.[8] Most clinical guidelines that subsequently emerged recommended continuous CTG in labor for women at high risk and intermittent auscultation for those considered at low risk.[9]

In present study, 24.75 % patients had abnormal admission test. In a similar study by Shrestha et al.[10] among the 125 pregnant mothers who were included in the study, 10% had abnormal admission test. In a study by Panda et al.,[11] out of 100 cases, 86% had normal admission test and 14% had abnormal admission test. Increased incidence in present study is due to inclusion of high risk patients as well.

Thobbi VA et al.,[12] studied 400 pregnant women, there were 328 patients (82%) with normal admission test, 37 patients (9.3%) with suspicious admission test, 35 patients (8.8%)

with pathological admission test and a total of18% patients had abnormal admission test. The incidence of fetal distress (100% vs. 31.6%), caesarean section rate (100% vs. 6.1%), low Apgar score at 5' (50% vs. 26.1%), NICU admission (50% vs. 26.1%) was higher in pathological admission test group than in normal admission test. Similar findings were noted in present study. The sensitivity and specificity of NST in predicting fetal distress was 61.6% and 94.5% respectively, while the overall diagnostic accuracy was 86.4%.

Thimmappa S et al., [13] studied 200 low risk pregnant women in labour. 164 (82%), 20 (10%) and 16 (8%) had normal, suspicious and pathological admission test result respectively. The incidence of fetal distress (100% Vs 7.92%), caesarean section rate (100% Vs 7.3%), low Apgar score at 5' (50% Vs 4.87%), NICU admission (50% Vs 4.87%) was higher in pathological AT group than in normal AT group. Similar findings were noted in present study. Sensitivity, Specificity, PPV, NPV and overall diagnostic accuracy was 54.45%, 92%, 69%, 93% and 83% respectively.

Dashora S[14] studied 100 women, 74% had normal/reactive CTG tracings, 10% had equivocal/suspicious CTG tracings and 16% had abnormal/nonreactive CTG. Around 75% women were in the age group 21-30 years and 60% were multigravida. Women with suspicious and abnormal CTG tracings on admission tests showed higher rates of instrumental and operative deliveries. Neonates born of mothers showing suspicious and abnormal CTG showed lower Apgar scores at 1 and 5 minutes and also subsequent NICU admission. Similar findings were noted in present study.

Kumar A et al., [15] studied 340 high risk pregnant women , with a period of gestation of ≥37 weeks, underwent . admission CTG of a 20-minute recording of FHR and uterine contractions. The admission CTG was reactive in 69.4% of all patients, equivocal in 22.2% and pathological in 8.4% of the 340 recruited patients. A total of 37.5% of the patients were post-dated followed by 20.6% of pregnancy included hypertensive patients. The neonatal outcomes in terms of fetal distress, meconium stained liquor, NICU admission were considerably higher in pathological test. . Similar findings were noted in present study. The specificity of the test was 53.3%, and the negative predictive was 86.49%. They concluded that admission CTG is a simple, useful screening test and serves as a non-invasive tool in forecasting the adverse fetal outcomes in high risk pregnancies.

Reasons for the high rates of CTG misinterpretation include: difficulties in pattern recognition, difficulty interpreting the CTG in the clinical context, poor interobserver agreement on the classification of CTG cases, setting the recording rate at 3 cm/minute instead of the standard 1 cm/minute, and It is important to confirm that the external fetal monitor is actually recording fetal heart rate and not maternal heart rate (transmitted from a maternal vessel, such as the aorta or uterine artery).

Health professionals who provide intrapartum care have a responsibility to ensure that they undertake that care with an understanding of the relevant maternal and fetal pathophysiology and understand the available fetal surveillance options.[16]

Admission test is a good screening test because it is a simple test, noninvasive, easily performed and interpreted, having high acceptability by pregnant mothers, can be repeated at any time and high validity.[17,18] But, CTG monitoring should never be regarded as a substitute for good clinical observation and judgement, or as an excuse for leaving the mother unattended during labor.

CONCLUSION

The admission test is a short period of fetal heart rate monitoring in relation to uterine activity at the onset of labor to identify fetuses at risk of distress in labor & prevents unnecessary delay in intervention. The admission test cardiotocography is a simple, non-invasive, inexpensive & reliable test to detect fetal distress at onset of labour and to predict adverse fetal outcome in high-risk pregnancies.

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