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Original Article

Labour Admission Test - A low cost alternative to predict foetal distress and neonatal outcomes

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Abstract

Background and Objectives: The aim of various antepartum and intrapartum monitoring methods is to detect foetal hypoxia at the earliest and to prevent subsequent damage. Cardiotocography (CTG) is one of them. Routine and continuous EFM in labour is not possible in developing countries with limited resources and manpower. Objective of the study was to evaluate the role of CTG as admission test (AT) to predict foetal outcome in low and high-risk group.
Methods: The study population consisted of 100 low risk and 100 high risk patients at term in labour admitted at WCH Hospital attached to J.J.M Medical College, Davangere. Patients were subjected to admission CTG for 20 minutes. The trace thus obtained was classified as normal, suspicious and pathological AT as per NICE 2017 Guidelines on Intrapartum Care.
Results: Among the study group of 200 cases, including low and high-risk groups, 156 (95 & 61) cases had normal AT, 29 (5 & 24) cases had suspicious and 15 high risk cases had Pathological AT. The incidence of foetal distress, caesarean rate, Apgar score at 5 minutes less than 7, NICU admission was higher in pathological AT group than in normal AT. A statistical analysis comparing normal and abnormal (suspicious + pathological) AT showed high specificity 83.82% and high negative predictive value 92.95%. However, LAT was found to have low sensitivity 59.26% and low positive predictive value 36.36%.
Conclusion: CTG as LAT is a simple, non-invasive, low cost test with high specificity and NP, that can be used to triage patients at the outset, thereby utilizing the limited equipment and staff effectively in resource poor labour wards.
Keywords: Labour Admission Test, Cardiotocography, Perinatal Outcome, Electronic Fetal Monitoring

Introduction

Surveillance of the foetus during labour is vital to ensure delivery of a healthy baby with minimal intervention.[1] Routine electronic monitoring of foetal heart rate (FHR) in labour has become an established obstetric practice in developed countries.[2] However, in developing countries with inadequate antenatal care, overburdened hospitals (>10,000 deliveries/year), and labour wards with few monitors due to resource constraints, selection of the patients for continuous monitoring is necessary.[3] Ingermessan et al, described an alternative method of monitoring FHR during labour to choose women at risk whose foetuses were apparently compromised on admission or were likely to become compromised in labour – Admission test (AT).[4,5]

The admission cardiotocography (CTG) is a short, usually 20 min, recording of the FHR immediately after admission to the labour ward.[5] The main justification for admission CTG is that the uterine contractions of labour put stress on the placental circulation; an abnormal tracing indicates a deficiency and hence identify foetal compromise at an early enough stage to allow intervention.[6] It can be used as a screening test in early labour to select the women in need of continuous foetal electronic

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monitoring during labour.[7] Barring acute events like cord prolapse, uterine hyperstimulation, placental abruption, meconium aspiration, the admission test is a good predictor of foetal condition at the time of admission and during the next few hours of labour in term foetuses.[5]

The objectives of the present study were to determine the sensitivity and specificity of CTG as an AT for intrapartum foetal distress, assess the predictive value of CTG patterns and correlation with perinatal outcome, and mode of delivery in relation to AT.

Materials and methods

Study design and population

This was a prospective observational study in a cohort of 200 women of term gestation (≥37 weeks) - 100 each in low risk and high risk, in the 1st stage of labour (spontaneous in onset), with a singleton foetus in cephalic presentation; between April 1, 2018 and March 31, 2019.

Pregnant women with no maternal or foetal complications were categorized as low risk. Pregnant women with bad obstetric history (BOH), medical disorder (Diabetes, Hypertension, Renal disorders), severe anemia, pregnancy-induced hypertension (PIH), post-dated pregnancy, premature rupture of membranes (PROM), oligohydramnios, polyhydramnios, intrauterine growth restriction (IUGR), Rh negative pregnancy, or previous LSCS were categorized as high risk. Pregnant women with non-cephalic presentations, multiple gestation, intrauterine fetal demise, ultrasound confirmed lethal congenital anomaly of the foetus, acute hypoxic states (such as abruption, cord prolapse, uterine scar rupture), or those identified for elective LSCS were excluded.

General setting

The study was conducted in the labour ward in Women and Children's Hospital (WCH) attached to J.J.M Medical College, Davangere, India.

Specific setting

Data variables including information regarding demographic details and clinical characteristics were collected. This was followed by a thorough general physical examination, systemic and obstetric examination. The AT was carried out with the help of the available CTG machine - "**EDAN F3 Fetal Monitor**". This monitor uses a Doppler ultrasound transducer to detect the movement of cardiac structures.

a. **FHR Monitoring:** The transducer sends sound waves into maternal abdomen in the direction of the foetal heart. These sound wave signals are altered by a moving structure (which is the foetal heart structures and blood flowing through it) according to the Doppler shift principle and received by the transducer in its altered form. The monitor analyses the time interval between 2 consecutive echoes (beats) and processes it to compute the FHR in beats per minute (bpm). Thus, the FHR displayed on the screen is a processed one and not the actual heart rate.
b. **Uterine Activity Monitoring:** The toco-transducer detects the uterine activity by sensing the changes in tension on the abdomen. Absolute intrauterine pressure cannot be measured by this method, which can be done with the help of an intrauterine catheter. However, this method reliably assesses the timing, duration and relative strengths of contractions**.**
c. **Interpretation:** The AT tracings were analyzed for baseline FHR, beat to beat variability, accelerations, and decelerations (early, late and variable). The tracings were interpreted as Normal, Suspicious or Pathological as per NICE 2017 guidelines on Intrapartum care.[8] Labour outcome was assessed with respect to incidence of foetal distress, operative/instrumental deliveries, meconium stained liquor, APGAR scores at 1 minute and 5 minutes and new-born intensive care unit (NICU) admission.

Statistical analysis

Data entered in the study proforma was extracted into a Microsoft Excel spreadsheet (Microsoft Excel for Macintosh, version 16.0 (Microsoft Corporation, Redmond, Washington). Continuous variables were summarized as mean (SD) or median (interquartile range) depending on the distribution of the data. Categorical variables were expressed as proportions. Data analysis was done using IBM SPSS statistics for Macintosh, version 26 (Chicago, IBM Corporation 1989, 2019). A Pearson Chi-square ($\chi 2$) test was used for association between two categorical variables. Results were considered to be statistically significant if p-value was <0.05.

Ethics approval

The study protocol was submitted to the Institutional Ethics Committee and approved. A written informed consent was sought prior to participation in the study.

Results

Of the 200 cases, 162(78.3%) belonged to the age group between 21 to 30 years, followed by 29 (14%) between 31 to 40 years. Of the 200 cases, 113

(56.5%) were multigravida, 86(43%) were primigravidae, and 1(0.5%) was grand multipara. Table 1 shows the incidence of various antenatal complications in the 100 high risk women.

AT and Neonatal outcomes:

Of the 200 cases analysed, 156 had normal AT. Of these, 95 were categorised as low risk and 61 as high risk. Of the 29 cases who had a suspicious AT, five were categorised as low risk and 24 as high risk. All the 15 cases who had a pathological AT belonged to high risk category. There were no pathological AT in low risk group. The incidence of fetal distress in different AT groups in high risk and low risk women is shown in Table 2. The predictive value of AT and foetal outcomes in low and high risk groups is shown in Table 3. The mode of delivery in different AT groups in low risk and high-risk women is compared in Table 4. Perinatal outcomes in different AT groups are shown in Table 5. Incidence of thick MSAF in low and high risk women is shown in Table 6.

Table 1: Incidence of antenatal complications in the 100 high risk women.

Risk Factors	Patients (n=100)
BOH	6
Diabetes	1
GDM	3
IUGR	6
Oligohydramnios	5
PIH	20
PHI+ IUGR	5
Post-dated	37
Previous LSCS	2
PROM	10
Rh negative	3
Severe Anaemia	2

Table 2: Incidence of foetal distress in different AT groups in high risk and low risk women.

AT	Low risk (N)	High risk (N)	Total	%
Normal	3(95)	8(61)	11(156)	7.1
Suspicious	1(5)	8(25)	9(30)	31
Pathological	0	7(15)	7(15)	46.7

Table 3: Predictive value of LAT and foetal outcomes in low risk and High risk group.

	Low Risk Value (95% CI)	High Risk Value (95%CI)
Sensitivity *	25%(17.4% to 67.4%)	65.2%(45.7% to 84.6%)
Specificity	95.8%(91.8% to 99.8%)	68.8%(58.4% to 79.1%)
Positive Predictive Value	20%(15% to 55%)	38.4%(23.2% to 53.7%)
Negative Predictive Value	96.8%(93.3% to 100.3%)	86.8%(78.4% to 95.3%)

***Suspicious and pathological results on AT were groped into one category as abnormal AT to compute the sensitivity and specificity of the test.**

Table 4: Mode of delivery in different AT groups in low risk and high-risk women.

AT	FTVD		Vacuum		Forceps		LSCS	
	Low risk N(%)	High risk N(%)	Low risk N(%)	High risk N(%)	Low risk N(%)	High risk N(%)	Low risk N(%)	High risk N(%)
Normal	92(56)	53(34)	0	0	0	0	3(2)	8(5)
Suspicious	1(3)	10(34)	1(3)	3(10)	1(3)	3(10)	2(7)	8(28)
Pathological	0	0	4(27)	0	1(7)	0	0	10(67)

Table 5: Perinatal outcomes in different AT groups.

Perinatal outcome	Normal		Suspicious		Pathological	
	N=156	%	N=29	%	N=15	%
Thick MSAF	11	7.1	9	31	12	80
Apagr<7 at 5 minutes	10.4	6.4	9	31	7	46.7
NICU Admission	12	7.7	9	31	7	46.7

Table 6: Incidence of MSAF in Low and High Risk Women

AT	Low Risk		High Risk	
	N	%	N	%
Normal	3	3.15	8	13.11
Suspicious	1	20	8	33.33
Pathological	0	0	12	80

Table 7: Sensitivity and specificity of AT to detect foetal distress in different studies.

Study group	Sensitivity*	Specificity*	PPV	NPV
Rahman et al[6]	63%	91%	55%	93%
V Bhartiya et al[13]	53.1%	75%	34.7%	86.5%
Shailesh et al[19]	60%	90.9%	48.4%	94.1%
Kumar et al[20]	53.13%	75%	34.7%	85.5%
Present study	59.26%	83.82%	36.36%	92.95%

***Suspicious and pathological results on admission test were grouped in to one category as abnormal AT to compute the sensitivity and specificity of the test.**

Discussion

Intrapartum complications can arise very quickly and unexpectedly in both high and low risk pregnancy.[9] In 1989, American College of Obstetricians and Gynaecologists (ACOG) indicated that foetuses of labouring women could be assessed by EFM or by intermittent auscultation (IA) of fetal heart tones.[10] Although a Cochrane review recommends that high-risk women should be monitored by continuous EFM,[7] this may not be possible in developing countries where a large number of high-risk pregnancies are catered for in crowded settings, with inadequate health care personnel and limited equipment. Reliance on auscultation alone is often ineffective.[6] Admission CTG acts a natural contraction stress test (CST) to the foetus and can be used to detect intrauterine hypoxia already present when a woman first presents in labour, and it may have some predictive value for adverse foetal outcomes that may develop during labour. Patients can be allocated to either continuous EFM or IA alone.

In the present study, the proportion of patients with a reactive AT, suspicious AT, and pathological AT were comparable to results in similar studies.[5,6,11-13] The shortcomings of a single AT in predicting foetal distress in the setting of protracted labour and problems of cord have been described in several studies.[5,12-15] Foetal distress was present in 11 (7.05%) patients with a normal AT in the present study. Of these, 7 developed thick meconium-stained amniotic fluid (MSAF) after 6-8 hours of admission.

Hence, in cases where AT to delivery interval is expected to be more than six hours, it may be prudent to repeat CTG to detect possible foetal distress.

The incidence of foetal distress was higher in the pathological trace group, and in women categorized as high risk in the present study **Table 2**. Underlying antenatal risk factors reduce the capacity of a foetus to cope with the stress of labour.[16] This principle forms the basis for the evidence, on which the Royal College of Obstetricians and Gynaecologists (RCOG) and other regulatory bodies recommend that continuous EFM and admission CTG should be offered to women with risk factors.

When comparing predictive value of AT in high risk and low risk groups in this study, the sensitivity and positive predictive value was lesser in low risk group. Therefore AT in low risk women could lead to unnecessary operative delivery. The same has been documented in different studies and that is the reason why a Cochrane review published in 2017, advices against Admission CTG in low risk women[20].

The sensitivity and specificity of AT to detect foetal distress in labouring women was 59.3% and 83.9% respectively in the present study. The Positive Predictive Value (PPV) was 36.36% and Negative Predictive Value (NPV) was 92.9%. These findings are consistent with those reported in several other studies Table 6.[6,11,17,18]

An abnormal FHR tracing is a sensitive indicator that distress exists, but the intrinsic predictive value of such a tracing is disappointingly low because of the large number of false positive results.[19] Due to the high specificity and NPV of the AT, when a test is negative, a clinician can be sure that adverse foetal outcomes will be infrequent for the next few hours (5-6 hours) of labour and the patients can be confined to monitoring by IA. Thus, AT helps in triaging patients and optimising usage of limited labour room equipment and expertise.

The rate of LSCS and instrumental delivery for foetal distress was more in pathological group than suspicious or normal group in the present study. The correlation between mode of delivery and AT was statistically significant ($p < 0.001$). Similar results were reported in several other studies.[6,11,15,17]

A higher incidence of LSCS for foetal distress was observed in high risk patients (25%) compared to low risk patients (2%) in the present study. This is probably the result of misclassification of more foetuses as suspicious or pathological AT (high false positives). Also, an abnormal AT is usually followed by continuous EFM; this can again lead to unnecessary obstetric interventions.

The incidence of low APGAR score (<7 at 5 minutes), thick MSAF and NICU admissions were higher in the pathological trace group, and in women categorized as high risk in the present study. Similar foetal outcomes were reported noted in several other studies.[6,11,12,15]

Conclusions

- Admission CTG as AT has low sensitivity, high specificity, low PPV and high NPV.
- Antenatal risk factors play an important in the pathophysiology of foetal hypoxia as evidenced by higher incidence of foetal distress in women with these conditions.
- AT or admission CTG can be used to triage patients to optimize the usage of limited equipment and workforce in resource constrained labour wards.
- The possibility of higher rates of surgical intervention in the absence of significant improvement in neonatal outcome should be borne in mind while basing decisions on AT in low risk women.

Scope for improvement

Further studies are required to define an optimal time interval to repeat CTG to detect foetal distress and to minimize the false negatives. Future research should emphasize on defining the role of AT in patients with specific pregnancy complications. Studies are also required to determine the convenient supplemental diagnostic modalities, which can enhance the PPV of an equivocal/abnormal AT.

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