Admission cardiotocography: Its role in predicting foetal outcome in high-risk obstetric patients

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RESEARCH

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Abstract

Background

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.

Aims

The objective of this study was to evaluate the predictive value of the admission cardiotocogram (CTG) in detecting foetal hypoxia at the time of admission in labour and to correlate the results of the admission CTG with the perinatal outcome in high-risk obstetric cases.

Method

This was a prospective observational study conducted in the labour and maternity ward of a hospital in Gangtok, India, during the period 2008 to 2010. The study included high-risk pregnant women, admitted via the emergency or outpatient department with a period of gestation ≥36 weeks, in first stage of labour with foetus in the cephalic presentation. All women were subjected to an admission CTG, which included a 20 minute recording of FHR and uterine contractions.

Results

One hundred and sixty patients were recruited. The majority of women were primigravida in the 21-30 years age group. About 42% patients were postdated pregnancy followed by pregnancy-induced hypertension (PIH) (15.6%) and premature rupture of membranes (PROM) (11.3%) as the major risk factors. The admission CTG were 'reactive' in 77%, 'equivocal' in 14.4% and 'ominous' in 8.7% women. Incidence of foetal distress, moderate-thick meconium stained liquor and neonatal intensive care unit (NICU) admission was significantly more frequent among patients with ominous test results compared with equivocal or reactive test results on admission. Incidence of vaginal delivery was more common when the test was reactive.

Conclusion

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.

Key Words

Cardiotocography, admission test, foetal distress, foetal hypoxia, perinatal outcome.

What this study adds:

1. The admission CTG is a short, usually 20 minute, recording of the FHR immediately after admission to the labour ward.
2. The present study supports the role of admission CTG in high-risk obstetric patients. The test has high specificity, and

appears to have a role in obstetric wards of non-industrialised countries with a heavy workload with a large number of high-risk cases and limited resources to help in 'triaging' foetuses.

3. Future research should work to define the role of admission CTG in patients with specific pregnancy complications. Studies are also required to determine the convenient supplemental diagnostic modalities which can enhance the positive predictive value of an equivocal/abnormal admission test.

Background

Surveillance of the foetus during labour is important to ensure the delivery of a healthy baby in good condition with the minimum of intervention.[1] Although, the vast majority of foetuses cope well during labour, the journey through the birth canal is stressful and the foetus may mount a 'stress response'. Foetuses with utero-placental insufficiency develop hypoxia in labour that may be acute or sub-acute. Some foetuses may be hypoxic prior to entering labour. Foetal monitoring during labour identifies the foetuses at risk of hypoxic damage, so that appropriate intervention could be instituted to optimise perinatal outcome. Such an approach is introduced to prevent neurological injury, including cerebral palsy.[2] For this purpose, electronic foetal monitoring (EFM) has widely been adopted.[3] Although with intermittent auscultation the baseline foetal heart rate (FHR) can be measured, other features of the foetal heart such as baseline variability, accelerations and decelerations are difficult to quantify.[4] Therefore, the use of antepartum and intrapartum cardiotocography (CTG) has increased over the last 15 years. As a consequence some authors attribute a considerable decrease in the overall perinatal mortality to the use of CTG and today CTG is a first line investigation for ante and intrapartum foetal assessment.[5]

Routine electronic monitoring of FHR in labour has become an established obstetric practice in industrialised countries.[6] Economic constraints in many developing parts of the world limit routine and continuous monitoring. In busy labour wards with few monitors, selection of the patients for continuous monitoring is necessary.[7]

Ingemarsson et al[8] described an alternative method of monitoring FHR during labour to pick the women apparently at risk whose foetuses were compromised on admission or were likely to become compromised in labour – Admission test (AT).[4]

The admission CTG is a short, usually 20 minute, recording of the FHR immediately after admission to the labour ward.[9]

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 identifies foetal compromise at an early enough stage to allow intervention.[10] In industrialised countries with good antenatal care, such foetuses may have been picked up by serial ultrasound or doppler scans.

But in non-industrialised countries with inadequate antenatal care, an AT has a role in obstetric units with a heavy workload (>10,000 deliveries/year) with limited resources in 'triaging' foetuses by providing a 'snap-shot' view of foetal well-being at the time of admission in labour.[2]

British guidelines published in 2001[11] do not recommend admission CTG in low-risk women, while Swedish guidelines published the same year[12] recommend the test in all women.

The objective of this study was to evaluate the predictive value of the admission CTG in detecting foetal hypoxia at the time of admission in labour and to correlate the results of the admission CTG with the perinatal outcome in high-risk obstetric cases.

Methods

Study design and setting

This study was conducted during the period 2008 to 2010, it was a prospective, single centre observational study at the labour and maternity ward, Department of Obstetrics and Gynecology at Central Referral Hospital (CRH) --- teaching hospital of Sikkim Manipal Institute of Medical Sciences (SMIMS), Gangtok, India. The study was approved by SMIMS ethics committee at the Central Referral Hospital. Written informed consent was obtained from the women who participated in the study.

Inclusion and exclusion criteria

Women were eligible to join the study if they were booked for hospital delivery, had a gestation of ≥36 weeks, were in the first stage of labour (spontaneous onset) with the foetus in a cephalic presentation and the patient had been classified as high risk during the antenatal period or at that visit. The high-risk obstetric cases considered for inclusion were: women with bad obstetric history (BOH), pregnancy with medical disorder (e.g. diabetes, hypertension, renal disease etc), previous history of still birth, pregnancy induced hypertension (PIH)/pre-eclampsia, postdated pregnancy, premature rupture of membranes (PROM), oligo/polyhydramnios, intrauterine growth restriction (IUGR), Rh-ve pregnancy and women with decreased foetal movements. Women who were excluded from the study

were those who had a period of gestation <36 weeks, ultrasonography (USG) confirmed lethal congenital anomaly of the foetus, acute hypoxic states (such as abruption of placenta, cord prolapse, uterine scar rupture etc.), multiple pregnancies, abnormal lie and presentation needing immediate Caesarean section, and patients who were identified for elective LSCS.

Admission test procedure and monitoring

On admission, the women's details and history including age, parity, antenatal care, menstrual, obstetric and medical history were documented. General physical examination was done. Per abdominal and bimanual examination were performed to determine the stage of labour, following which patients were subjected to AT. Corometrics 170 CTG machine was used. A tracing was taken for 20 minutes with the patient in a semilateral position in a separate room beside the first stage labour room. The FHR traces obtained were categorised as reactive, equivocal or ominous as according to the classification proposed by NICE (National Institute of Clinical Excellence – Clinical guideline September 2007).[13]

Following the AT, patients with reactive trace were monitored intermittently by auscultation for one minute every 30 minute in the first stage of labour and every five minutes in the second stage of labour post contraction. Cases with equivocal trace were put on continuous CTG monitoring. In those with ominous tracings, appearance of late, significant variable or prolonged decelerations, delivery was hastened by operative or instrumental intervention depending upon stage of labour. After delivery, the colour of liqor, and Apgar score was determined. Newborns who were distressed and whose Apgar score was <7 at five minutes underwent cord blood pH estimation.[14]

Foetal and neonatal outcome

Foetus/neonate was considered to be in distress if one of the following were present.

1. Ominous FHR changes led to Caesarean section (LSCS) or forceps/ventouse delivery.
2. Presence of moderate – thick meconium stained liqor (MSL).
3. Apgar score at 5 minutes < 7.
4. Umbilical cord arterial blood pH < 7.2.
5. Admission into neonatal intensive care unit (NICU) for birth asphyxia.
6. Neonatal seizures within first 24 hrs to 48 hrs.
7. Incidence of intrapartum/neonatal mortality.

Statistical analysis

Data obtained from the study groups was analysed and statistically verified by nonparametric Chi-square test (x^2 test) with the use of computer software SPSS version 10. Statistic significance was calculated between groups with reactive and ominous; and reactive and equivocal groups where ever possible. A p value of <0.05 was considered to indicate statistical significance.

Results

One hundred and sixty women were recruited. Most women were primigravida in the 21–30 years age group (Table 1). About 42% patients were postdated pregnancy followed by PIH (15.6%) and PROM (11.3%). A few patients had multiple risk factors (Table 2).

Table 1: Demographic and clinical characteristics. Data is expressed as number *(N) and %.*

Age (years)	Reactive N (%)	Equivocal N (%)	Ominous N (%)	Total (n=160)
17-20	15 (71.4)	4 (19.1)	2 (9.5)	21 (13.1)
21-25	56 (82.4)	6 (8.8)	6 (8.8)	68 (42.5)
26-30	38 (76.0)	9 (18.0)	3 (6.0)	50 (31.3)
31-35	8 (66.7)	2 (16.7)	2 (16.7)	12 (7.5)
36-40	6 (66.7)	2 (22.2)	1 (11.1)	9 (5.6)
Parity				
Primi	76 (76.7)	15 (15.2)	8 (8.1)	99 (61.9)
Multi	47 (77.1)	8 (13.1)	6 (9.8)	61 (38.1)
Gestational Age				
37-40 weeks	70 (75.3)	16 (17.2)	7 (7.5)	93 (58.2)
>40 weeks	53 (79.2)	7 (10.4)	7 (10.4)	67 (41.8)

Seventy-seven per cent of admission CTG was 'reactive' of which only 11% were associated with foetal distress. Of the 23 women (14.4%) who had an equivocal trace, nine (39%) babies had foetal distress, whereas 86% of babies born to women with ominous test had foetal distress. It is evident from Tables 3 and 4 that the incidence of foetal distress significantly increased with worsening of admission CTG (p<0.001).

Table 2: Risk factors in the study population

Risk factors	***Number***	***%***
Postdated	67	41.8
PIH	25	15.6
PIH with IUGR	8	5.0
IUGR	10	6.3
PROM	18	11.3
BOH	10	6.3
Oligohydramanios	8	5.0
Diabetes	5	3.1
Rh-ve pregnancy	4	2.5
Others	5	3.1

Table 3: Admission test result and incidence of foetal distress

Results	AT result		Foetal distress	
	Number	%	*Number*	%
Reactive	123	76.9	14	11.3
Equivocal	23	14.4	9	39.1
Ominous	14	8.7	12	85.7

*P value <0.001 (statistical significance was calculated between reactive, equivocal and ominous groups)

Table 4: Incidence of foetal distress (FD) in specific risk factor groups. Data are expressed as number *(N) and %.*

Risk factors	Reactive		Equivocal		Ominous	
	Total	FD N (%)	Total	FD N (%)	Total	FD N (%)
Postdated	52	6(11.5)	11	4(36.4)	4	3(75.0)
PIH	20	2(10.0)	3	1(33.3)	2	2(100)
PIH with IUGR	5	1(20.0)	1	1(100)	2	2(100)
IUGR	7	1(14.3)	2	1(50)	1	1(100)
PROM	14	1(7.1)	3	1(33.3)	1	-
BOH	8	1(12.5)	1	1(100)	1	1(100)
Oligohydramanio	6	1(16.7)	1	-	1	1(100)
Diabetes	4	-	-	-	1	1(100)
Rh-ve pregnancy	3	1(33.3)	1	-	-	-
Others	4	-	-	-	1	1(100)

About 72% patients with an ominous test had moderate-thick MSL, compared to 39% and 9% in the equivocal and reactive AT group respectively (p<0.001). Fifty seven per cent of babies born to patients with ominous AT had NICU admissions compared to 26% and 6.5% of those babies born to patients with equivocal and reactive AT respectively (p<0.001).

As seen from Table 5 the incidence of birth asphyxia was greater in the nonreactive test group compared to the reactive group when the babies were assessed by Apgar score <7 at 5 minute and/ cord blood PH<7.2. There were no intrapartum/neonatal deaths among babies born to mothers with reactive AT, whereas there were two neonatal deaths due to birth asphyxia in babies born to mothers with equivocal and ominous AT (one in each group).

Table 5: Correlation of foetal/neonatal outcomes with AT

	Reactive (*n*=123)		Equivocal (*n*=23)		Ominous (*n*=14)	
	n	%	*n*	%	*n*	%
Mod-thick MSL	11	8.9	9	39.1	10	71.4
Apgar score at 5 min <7	8	6.5	6	26.1	9	64.3
NICU admission	8	6.5	6	26.1	8	57.1
Cord blood Ph<7.2	5	4.1	4	17.4	8	57.1
Neonatal death	0	-	1	4.3	1	7.1

***** P value <0.001 (statistical significance was calculated between reactive, equivocal and ominous groups)

Table 6: Mode of delivery with the results of the Admission test and occurrence of foetal distress (FD)

Mode of delivery	**Reactive (*n*=123)**	**Equivocal (*n*=23)**	**Ominous (*n*=14)**
Spontaneous Vaginal Delivery	**65 (52.8%)**	**12(52.2%)**	**2 (14.3%)**
With FD	4 (6.2%)	4 (33.3%)	-
Without FD	61 (93.8%)	8 (67.7%)	2 (100%)
Forceps/Ventouse	**14 (11.4%)**	**1 (4.3%)**	**1 (7.1%)**
With FD	4 (28.6%)	1 (100%)	1 (100%)
Without FD	10 (71.4%)	-	-
LSCS	**44 (35.8%)**	**10 (43.5%)**	**11(78.6%)**
With FD	6 (13.6%)	4 (40%)	11 (100%)
Without FD	38 (86.4%)	6 (60%)	-

***P value <0. 001 (statistical significance was calculated between reactive, equivocal and ominous groups.**

Incidences of vaginal delivery were more common when the test was reactive in compared to operative delivery. On the other hand operative deliveries were more common when the AT was non-reactive compared to the reactive group (p<0.001). An important observation was that those who underwent operative/instrumental delivery in the reactive group, only in 17% (10/58) was the indication foetal distress, among the remaining 83% the most common reason for operative/instrumental delivery was non-progress of labour. In the non-reactive group operative/instrumental delivery was indicated for foetal distress among 74% (17/23) patients (Table 6).

Discussion

Use of electronic FHR monitoring at the time of admission in labour has been employed by some centres to identify foetuses that are at an increased risk of hypoxia.[2] EFM can detect hypoxia early and avoid unnecessary delay in intervention. It is a non-invasive recordable method of foetal monitoring and is a highly logical solution to the undeniable human factors/human lapses of manual foetal monitoring of labour. Uterine contractions serve as a functional stress to the foetus; a short tracing of FHR on admission to the labour ward may thus detect foetal intrauterine hypoxia already present on admission and also help identify those who are risk of developing hypoxia during labour.[8]

The admission CTG therefore has two potential roles. It can be used as a screening test in early labour to detect compromised foetuses on admission and to select the women in need of continuous EFM during labour.[15]

Use of EFM is controversial. For example Impey et al[16] believe that neonatal outcome is not significantly improved by the use of admission CTG as compared to intermittent FHR auscultation during labour. Thacker et al[17] also feel that the use of EFM is of limited effectiveness and carries an increased risk of interventions. According to them increased information at admission will not necessarily lead to better clinical outcomes. This may be true in developed countries when the majority of the population is provided with comprehensive antenatal care, and receives personal attention during labour. Although a Cochrane review recommends that continuous EFM be limited to high-risk pregnancies,[18] this may not be possible in developing 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.

In the present study, 11.3% (14/123) babies from mothers in the reactive AT group, 39.1% (9/23) of babies from the equivocal group, and 85.7% (12/14) babies from the ominous group showed evidence of foetal distress. Sandhu et al[19] also reported similar rates (i.e. 15% in reactive, 55% in equivocal and 73% in ominous test group) of foetal distress in high-risk obstetric patients in their study. Ingemarsson et al[8] observed development of foetal distress in 1.3% of the reactive group, 10% of the equivocal group and in 40% of the ominous group babies.

Libiran et al[20] reported 6.5% risk of foetal asphyxia in the reactive group, and 50% risk in the ominous group's babies when measured by Apgar score and/umbilical cord blood pH. In the present study we also observed women with reactive AT who had low risk (4.1%) of developing intrapartum foetal hypoxia and significantly high risk in the ominous group (57%) when assessed by Apgar score and/cord blood pH <7.2.

Table 7: Sensitivity and specificity of AT

	Present study	Ingemarsson et al. (1984-85)
Sensitivity	60.0%	23.5%
Specificity	94.8%	99.4%
Positive predictive value	56.8%	40.0%
Negative predictive value	88.6%	98.7%
False negatives	40.0%	76.5%
False positives	13.9%	1.3%

In Table 7 it is seen that AT has high specificity (95%) and low false positivity. Thus the present study supports the role of admission CTG in high-risk obstetric patients. The results are supported by those reported by Ingemarsson et al (see Table 7).[8]

Fourteen patients with reactive AT had foetal distress in labour. It was found that in all of them AT to delivery interval was more than six hours. Therefore AT may not predict foetal distress after several hours of labour with other influencing factors like problems of cord, prolonged labour etc. which may become operational as labour progress.[8] So in cases where admission test-delivery interval is expected to be more than six hours it is good to repeat CTG to detect foetal distress.

Conclusion

The admission CTG is a simple non-invasive test that can serve as a screening tool in high-risk obstetric patients to detect foetal distress already present or likely to develop and prevent unnecessary delay in intervention. As the test has high specificity, it has a role in obstetric wards of non-industrialised countries with a heavy workload with a large number of high-risk cases and limited resources to help in 'triaging' foetuses.

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