UNSTRESSED ANTEPARTUM CARDIOTOCOGRAPHY IN THE MANAGEMENT OF PREGNANCIES COMPLICATED BY INTRAUTERINE GROWTH RETARDATION

by

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Introduction

The role of fetal heart rate (FHR) monitoring in the detection of fetal hypoxia is well established, and there is increasing understanding of FHR patterns associated with the fetus in jeopardy. Investigation has been extended to the antenatal period of "high-risk" pregnancies. Using a "non-stress" CTG test and a "ten-point" scoring system in a group of 1100 patient, we found a close correlation between heart rate and fetal activity patterns and the outcome of the fetus during labour and at delivery (Varma). The technique was therefore applied to patients showing poor intrauterine fetal growth.

Patients and Methods

From 1977 to 1980, 250 patients with intrauterine fetal growth retardation (IUGR) diagnosed on the basis of serial fetal cephalometry, serial fetal abdominometry and serial head to abdomen area ratio, were monitored daily using non-stress cardiotocograph (NST) until the decision was made to deliver the infant. This group of 250 patients delivered an infant whose birth weight was below the tenth centile standardised for maternal parity, duration of gestation, and the sex of infant (Thompson *et al*, 1968). The clinical features are listed in Tagle I.

TABLE I
Main Clinical Complications

Complications	No. of Patients
Intrauterine growth retardation without any other complications	80
Pre-eclampsia	60
Hypertension	36
Poor weight gain	24
Antepartum haemorrhage	12
Previous infertility	6
Previous stillbirth	6
Previous neonatal death	6
Bad obstetric history	8
Previous growth-retarded infant	6
Premature rupture of membrane	5
Diabetes	1
TOTAL	250

All the patients with a clinical diagnosis of intrauterine growth retardation (IUGR) were monitored using ultrasonic examination, and only those who had an ultrasonic diagnosis of IUGR were included in this study. All the patients were admitted to hospital and a cardiotocographic (CTG) recording was made daily until delivery or fetal death. CTG tracings were recorded using either a Hewlett-Packard 8020A or 8021B or Sonicaid FM 111 00438 monitor.

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Patients were placed in a semi-recumbent position with a lateral tilt of 15° or more to minimise aorto-caval compression during recording. A CTG recording was made for at least 20 minutes in each patient with the proviso that a minimum of two Braxton-Hicks contractions were recorded. Fetal movements were detected from a transient rise on the uterine contraction channel or by observing or palpating the maternal abdominal wall by the attendant and/or by the mother.

CTG tracing was continued for a further period of 20 minutes if there were no fetal movements or Braxton-Hicks contractions during the first 20 minutes of recording. Gentle palpation of maternal abdominal wall often provoked fetal movements and uterine activity and the second 20 minutes were used to assess the response of provoked fetal movement and uterine activity on the fetal heart.

A "ten-point scoring" system was based upon four FHR variables and fetal movement:

Base Line FHR (FHR [B])

Grading: The FHR (B) was graded along traditional lines. The normal range of 120 to 160 beats per minute was awarded a score of 2. Tachycardia to 180 or bradycardia to 100 were scored as 1. FHR (B) above 180 or bradycardia below 100 scored O.

Fetal Movements

Grading: More than 2 fetal movements during a period of 20 minutes' tracing score 2; 2 or less scored 1; and no fetal movement scored 0. Vigorous fetal activity in pregnancy has been related to good fetal outcome but rapidly diminishing fetal movements to the point of cessation may portend fetal death.

FHR Response to Fetal Movements (FHR [M])

Grading: Infants whose FHR showed an acceleration pattern of 15 beats or more/minute from the FHR (B) in association with movements scored 2. Infants whose FHR showed an acceleration pattern of the less than 15 beats/minute scored 1. Infants whose FHR remained unaltered with movements scored 0.

The quiescent but healthy fetus responds to a variety of stimuli by an increase in activity and with FHR changes. Acceleration patterns of the FHR in response to fetal movements have been associated with a good fetal prognosis, the overall outcome being poorer in those infants not showing this response (Flynn and Kelly 1977; Lee *et al* 1976; Trierwailer 1977).

Base Line Variability

Grading: Infants whose FHR showed a base line variability of more than 5 beats/minute scored 2; less than 5 beats/minutes scored 1; and no variability scored 0.

FHR Response to Braxton-Hicks Contractions (FHR [C])

Grading: Infants in whom FHR showed acceleration patterns in association with Braxton-Hicks contractions scored 2; those with no change from FHR (B) during a contraction scored 1; and those in whom deceleration patterns occurred scored 0. A deceleration pattern was defined as an FHR dip of at least 60 seconds duration with a minimum deceleration amplitude of 20 beats/minute.

Late deceleration patterns in association with Braxton-Hicks contractions have been correlated with intrauterine fetal hypoxia. (Emmen *et al* 1975; Visser and Huisjes 1977).

All the CTG tracings were scored using a "ten-point scoring" system. When a preliminary study was done of 5000 tracings from 300 in-patients taken during a period of two weeks prior to delivery, it was obvious that a score of 7 or more within 7 to 10 days prior to delivery was mainly associated with good fetal outcome as assessed on the basis of fetal distress in labour, Apgar score at birth, perinatal morbidity, and perinatal mortality; however, a score of 6 or less was associated with higher incidence of fetal distress in labour, poor Apgar score at birth (0-5), and higher perinatal morbidity and mortality. Hence, a score of 6 or less was taken as an abnormal score. If the score was 7 or more, the CTG tracing was repeated the following day. If the score was 6 or less, the CTG tracing was repeated two to four times daily depending on how low the score was. In some patients, the CTG tracings were recorded from 26 weeks onwards and the recordings were continued within 6 to 24 hours of delivery.

Results

The "ten-point score" was derived from 250 patients within 24 hours of delivery or fetal death. Table II shows the ten-point scoring system for antenatal cardiotocographs.

Of the 250 patients, 80 patients (32%) had a score of 6 or less, 170 (68%) had a score of 7 or more.

Table III related the mean duration of gestation at delivery and the mode of delivery in the two groups with a score of 7 or more and a score of 6 or less.

The mean duration of gestation was 37.4 weeks in the group with a score of 7 or more as compared with 33.5 weeks in the group with a score of 6 or less.

Of the patients with a score of 7 or more, 57.6 per cent achieved normal delivery, 20 per cent required forceps delivery, and 22.4 per cent needed Caesarean section. Of the patients with a score of 6 or less, 20 per cent had normal vaginal delivery, 22.5 per cent required forceps delivery, and

TABLE II

The 'ten-point' Scoring System for Antenatal Cardiotocography

	CTG SCORE		
	0	1	2
Base Line FHR (beats/minute) FHR (B)	Less than 100 or more than 180	100-120 or 160-180	120-160
Fetal Movements	None	2 or less/ 20-40 mins.	More than 2/ 20-40 mins
FHR response to Fetal Movements (FHR(M)	None	Acceleration less than 15 beats/min.	Acceleration 15 beats/min. or more
Base Line Variability	None	Less than 5 beats/min.	More than 5 beats/min.
FHR response to Braxton-Hicks Contractions (FHR(C)	Deceleraton	No change	Acceleration

TABLE III

Mode of Delivery in the Two Groups With a Score of 7 or More and a Score of 6 or Less, and the Mean Duration of Gestation

	CTG 'TEN-POINT' SCORE			
	7-10		0-6	
	No.	(%)	No.	(%)
Spontaneous Vaginal Delivery	98	(57.6)	16	(20)
Forceps Delivery	34	(20)	18	(22.5)
Caesarean Section	38	(22.4)	46	(57.5)
TOTAL	170	(100)	80	(100)
Mean Duration of Gestation (Weeks) at Delivery	37.4		33.5	

(P <0.01)

57.5 per cent needed Caesarean section. The difference between the two groups was significant (P < 0.01).

Table IV shows the incidence of fetal distress in labour, the incidence of low Apgar score (0-5) at one and five minutes, the birth weight, the incidence of fetal abnormalities, and the PNMR per 1000 births.

Twenty-five (14.7%) of 170 patients with a score of 7-10 within 6 to 24 hours of delivery developed evidence of fetal distress in labour as assessed by recurrent

TABLE IV

Incidence of Fetal Distress, Apgar Score at 1 and 5 Minutes Birth Weight, Incidence of Fetal Anomalies, and PNMR per 1000 Births

	CTG 'TEN-POINT' SCORE			
	7-10		0-6	
	No.	(%)	No	(%)
Fetal Distress				
Pathological CTG tracing and/or low scalp pH (<7.25) in labour	26	(14.7)	46	(57.5)
Apgar Score				
(0-5) at 1 minute	16	(9.4)	38	(47.5)
at 5 minutes	13	(7.6)	31	(38.8)
Birth Weight				
Below the tenth centile	110	(64.7)	28	(35)
„ „ fifth centile	60	(35.3)	53	(65)
Fetal Anomalies	2	(1.18)	5	(6.25)
PNMR per 1000 births	3	17.6 1000	12	150 1000

(P <0.01)

late deceleration on CTG tracing which was confirmed by a fetal scalp sample (pH less than 7.25), whereas 57.5 per cent of patients with a score of 6 or less showed evidence of fetal distress in labour ($P < 0.01$).

The incidence of low Apgar score (0-5) was 47.5 per cent and 38.8 per cent at one and five minutes after delivery for the group with a score of 6 or less, as compared with 9.4 per cent and 7.6 per cent respectively for the group with a score of 7 or more ($P < 0.01$).

The incidence of low birth weight infants (below the fifth centile) was higher (65%) in the group with a score of 6 or less as compared with 35.3 per cent in the group with a score of 7 or more ($P < 0.01$).

The incidence of fetal anomalies was 6.25 per cent for the group with a score of 6 or less as compared with 1.18 per cent in the group with a score of 7 or more.

PNMR per 1000 births was 150 for the group with a score of 6 or less as compared with 17.6 for the group with a score of 7 or more ($P < 0.01$).

Of the group with a score of 7 or more, 2 babies had fetal anomalies incompatible with life (one was stillborn and the second died 24 hours after birth), and one died in utero from acute intrauterine asphyxia precipitated by abruptio placentae.

Of the group with a score of 6 or less, 5 babies had multiple anomalies incompatible with life and were not identifiable on ultrasonic examination. Two were stillborn and 3 died 12 to 36 hours after birth. Four died in utero within 12 hours after the last CTG tracing and the infants were grossly growth-retarded and were born between 27 and 30 weeks gestation. The remaining 3 died from prematurity and respiratory distress syndrome.

Discussion

In pregnancies associated with placental insufficiency and intrauterine growth-retardation, the proper timing of delivery is vital to a satisfactory fetal outcome. In addition to clinical assessment, most methods of evaluation of the fetal status are based on serial placental function tests. The reliability of these tests in high-risk pregnancies is questionable, and they do not always indicate the immediate state of the fetus or predict impending fetal death. CTGs have the advantage that the results are readily available and represent the immediate condition of the fetus. Visser and Huisjes (1977) included patients with IUGR in their study, though not specific for IUGR. It was Flynn *et al* (1979) who first reported the use of unstressed CTG in monitoring patients with IUGR. They studied a group of 57 patients with IUGR and stated that there was a good correlation between the non-reactive CTGs and the fetal outcome, operative delivery for fetal distress in labour, and perinatal mortality rate.

The appearance of deceleration pattern was considered as ominous and the 4 intrauterine deaths occurred within 12 to 24 hours of the appearance of repetitive late decelerations.

Our study of 250 patients with IUGR showed that the presence of CTG score of 6 or below was associated with increased incidence of fetal distress in labour, operative deliveries for fetal distress in labour, low Apgar score at birth, and a high PNMR and increased incidence of fetal anomalies. There were only 3 perinatal deaths (17.6/1000) in the group with a CTG score of 7 or more as compared with 12 perinatal deaths (150/1000) in the group with a CTG score of 6 or less. Our

PNMR in 1974 and 1975 prior to introduction of routine monitoring of patients at risk of fetal placental insufficiency, using antenatal CTG, was 25/1000. The PNMR in 1976 and 1977 was 19/1000, when the significance of the abnormal CTG tracings was not fully understood and the timing of the delivery was decided only using clinical and biochemical parameters. Retrospective analysis of the CTG tracings suggested that poor base line variability and/or decelerative patterns were associated with a higher perinatal morbidity and mortality.

Our policy is to monitor all patients 2 to 4 times daily if the CTG score is 6 or less. We regard the appearance of deceleration patterns and/or poor base-line variability as significant if the mother is not on drugs which will cross the feto-placental barrier and depress the fetal vital center. If the CTG score is consistently less than 6 and this includes a decelerative pattern for a period of 24 hours, we now advocate delivery of the infant, since the past experience has shown that there was a considerable risk of intrauterine death of the fetus when the CTG score was 4 or less with a decele rative pattern for a continuous period of 24 hours or more.

If the CTG scoring is 7 or more, we now allow the pregnancy to continue until the risk of immaturity is minimal in spite of the ultrasonic parameters and biochemical placental function tests suggert feto-placental insufficiency, provided there is no grave maternal illness which might warrant immediate delivery. Adopting this policy, our overall PNMR is 11 per 1000 total births in 1980 as compared with 25 per 1000 in 1974 when antenatal CTG was not used routinely to monitor all at-risk pregnancies.

We believe that antenatal CTG is useful in monitoring patients with IUGR. It helps to identify the correct timing of delivery of those fetuses who are at risk of dying in utero and it helps to choose the right mode of delivery. It also helps to continue those pregnancies which are at much less risk for a longer time to avoid premature intervention. Our results compare favourably with those of Visser and Huisjes (1977) and Flynn *et al* (1979).

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Summary

A study of antenatal cardiotocographs (CTG) in 250 patients with fetal growth retardation showed that non-reactive tracings were associated with a significant increase in operative deliveries for fetal distress in labour, a high perinatal mortality rate, and fetal anomalies, and a low Apgar score of the infant, both at one and five minutes after delivery. A 'ten-point' scoring system was used to evaluate the CTG tracing. A score of 6 or less was associated with a significantly higher perinatal morbidity and mortality rate compared with those who had a score of 7 or more ($p < 0.01$).

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