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Original Research Article

Abnormal cardiotocographic findings and perinatal outcome: a prospective study

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ABSTRACT

Background: CTG as an intrapartum fetal surveillance can be judged appropriately taking the abnormal features of CTG individually into account for decision making of early delivery to reduce the fetal and neonatal morbidity. Objectives of this study were to identify the fetuses at risk of developing hypoxia as evidenced by abnormal FHR pattern seen by CTG and to correlate the abnormal features with perinatal outcome and find out the most specific feature among all abnormal features of CTG in detecting the adverse perinatal outcome.

Methods: This was an observational study where total of 249 uncomplicated pregnant patients in active labor were selected randomly and CTG were done for them. Progress of labor was recorded in partogram. Only pathological CTGs were considered for early decision of delivery by LSCS. After delivery Apgar score 1 min, 5 min, baby weight, colour of liquor, NICU admission and no of days of admission in NICU were recorded.

Results: For liquor colour, variability and absence of acceleration were good screening heart rate features and baseline was considered the most specific feature. For all babies with poor Apgar score at 1 min, abnormal baseline was the most specific feature. For NICU admission, the abnormal baseline the most specific feature. Acceleration was found to be the most sensitive heart rate feature among all other heart rate features. Liquor colour had better sensitivity for detecting poor Apgar score at 1min and 5 min. There was increase rate of cesarean section and operative vaginal delivery.

Conclusions: Abnormal intrapartum CTG features of an uncomplicated laboring mother >37 weeks can detect fetuses at distress with different specificities and sensitivities when considered individually and can reduce the perinatal morbidity.

Keywords: Abnormal heart rate features, Cardiotocography, Perinatal outcome

INTRODUCTION

Intrapartum “Non reassuring fetal status” (fetal distress) attributed to fetal hypoxia is an important cause of

adverse perinatal outcome in the form of still birth, neonatal death, cerebral palsy and seizures after birth. Uterine contraction in labour put stress on placental circulation resulting in hypotension in fetal circulation. In

addition, there is head compression which affects the vital centers in the fetal brain. The combination of hypoxemia and cerebral ischemia due to hypotension causes a marked reduction in cerebral dysfunction and brain damage. With prolonged and profound hypoxia, anaerobic metabolism within the fetus results in lactic acidemia which aggravates acidosis.¹ The goal of intrapartum fetal surveillance is the diagnosis of fetal exposure to hypoxia and detection of fetal behavioural abnormalities at a stage where they are reversible. The current modalities of intrapartum fetal monitoring includes, assessing the colour of liquor, quantity of amniotic fluid, intermittent fetal heart rate auscultation, intrapartum cardiotocography, fetal scalp blood sampling cord blood gas estimation, fetal pulse oximetry and ST analysis of fetal ECG.² Cardiotocography has been used as a basic noninvasive method of evaluating fetal condition during pregnancy and labour.³ A non-reassuring trace occurs in up to 50% of all recordings but only a small proportion of these fetuses are at risk of hypoxia.⁴ Clinical outcome of fetal distress can be assessed by Apgar score, umbilical artery PH, neonatal encephalopathy, perinatal death and cerebral palsy which have been used in isolation or in combination.

The present prospective observational study was performed to correlate perinatal outcome with abnormal fetal heart rate patterns (RCOG 2001) as evidenced by electronic fetal monitoring by cardiotocography during labour.

METHODS

This was an observational study conducted in department of obstetrics and gynecology, Vivekananda Institute of Medical Sciences, Ramakrishna Mission Seva Pratisthan, Kolkata. A total of 249 pregnant patients in labour were taken for this study and were selected randomly. All the women were at term and were in either spontaneous or induced labour. Women with preterm labour, multiple pregnancies or with any medical or surgical or obstetrical

complications were excluded from study. They were followed up both by clinically and intermittent electronic fetal rate monitoring (Doppler, cardiotocography) during labour. Progress of labour, fetal heart rate monitoring were recorded in partograph. Active management if necessary was offered to those laboring women.

The RCOG 2001 grading system of fetal heart rate patterns and categorization scheme was followed in this study. Decision of cesarean section or any obstetric intervention was taken when CTG was pathological or if on duty doctor feels it was mandatory despite normal or suspicious CTG in the presence of other abnormal clinical findings. Overall outcome was assessed in terms of mode of delivery, Apgar score of the neonate at 1 min and 5 min, colour of liquor, presence or absence of seizures, NICU admission, duration of hospital stays and other adverse perinatal factors during the hospital stay. These were correlated with the abnormal CTG findings. Medical records were checked for maternal demographic characteristics antenatal history and birth data. Variables reviewed were maternal age, parity. After delivery, Apgar score at 1 min and 5 min, baby's sex, baby weight, colour were recorded. Apgar score <7 at 1 min was considered low. If baby was shifted to NICU, duration of NICU stay was recorded.

RESULTS

In our study sample, out of 249 cases with pathological CTG, 1 had abnormal baseline, 3 had non reassuring baseline and 245 had reassuring baseline. So, 98.39% of pathological CTG had reassuring baselines. Similarly, 7 cases had abnormal variability, 41 had non reassuring variability and 201 cases had reassuring variability. So, 80.72% of the pathological CTG had reassuring variability. Among deceleration, 173 (69.48%) had atypical variable deceleration, 62 (24.90%) had single prolonged deceleration and 14 (5.62%) had late deceleration. Of 249 cases, 103 cases had acceleration and in 146 cases there were no acceleration (Table 1).

Table 1: Incidence of baseline, variability, acceleration and types of abnormal deceleration.

	Baseline	Variability	Acceleration	Deceleration	
Abnormal	1 (0.4%)	7 (2.81%)	146 (58.63%)	SPD	62 (24.90%)
Non-reassuring	3 (1.20%)	41 (16.47%)		AVD	173 (69.48%)
Reassuring	245 (98.29%)	201 (80.72%)	103 (41.37%)	LD	14 (5.62%)
Grand total	249	249	249		249

When we compared baseline heart rate with colour of liquor, only 1 case of abnormal baseline had blood stained liquor. Out of 3 cases with non-reassuring baseline 2 had thick meconium (66.67%) and 1 (33.33%) had clear liquor. Out of 245 cases of reassuring baseline heart rate, 133 (54.29%) cases had clear liquor. In spite of

the base line heart rate being reassuring, 68 (27.76%) cases had thin meconium and 44 (17.96%) cases had thick meconium (Table 2). So positive predictive value, negative predictive value, sensitivity and specificity were 75%, 59%, 99%, 2.6% respectively. It was assumed that baseline heart rate was not a good indicator of abnormal

liquor colour. Out of 249 cases, 121 babies had Apgar score at 1 min <7 which is 48.59% and 128 (51.41%) babies had normal Apgar score. All the abnormal baseline heart rates had babies with Apgar score at 1 min <7 and all the non-reassuring baseline had Apgar score <7. At the same time 117 babies with reassuring baseline had Apgar score at 1 min <7. So positive predictive value, negative predictive value, specificity and sensitivity of baseline heart rate for Apgar score at 1 min

were 100%, 59%, 100%, 3.3% respectively. Similarly, 66.67% of the non-reassuring baseline heart rate had Apgar score at 5 min <7 and 92.65% of reassuring baseline heart rates had normal Apgar score at 5 min. It also showed that out of 121 babies with abnormal Apgar score at 1 min reduce to only 20 at 5 min. Positive predictive value of baseline heart rate for Apgar score at 5 min was 50%, negative predictive value was 91.9%, specificity (99.1%) and sensitivity (10%) (Table 3).

Table 2: Relation between baseline heart rates and colour of liquor.

Liquor colour	Baseline		
	Abnormal	Non reassuring	Reassuring
Blood stained, n=1 (0.40%)	1 (100%)	0	0
Thick meconium, n=46(18.47%)	0	2 (66.67%)	44 (17.96%)
Thin meconium, n=68 (27.31%)	0	0	68 (27.76%)
Clear, n=134 (53.82%)	0	1 (33.33%)	133 (54.29%)
Total no. of cases	1	3	245

Table 3: Relation of baseline heart rate with Apgar score at 1 min and at 5 min.

APGAR score 1 min	Baseline		
	Abnormal	Non reassuring	Reassuring
<7, n=121 (48.59%)	1 (100%)	3 (100%)	117 (47.76%)
Normal, n=128 (51.41%)	0	0	128 (52%)
Total no. of cases	1	3	245
APGAR score 5 min			
Less than 7, n=20 (8%)	0	2 (66.67%)	18 (7.35%)
Normal, n=229 (91.96%)	1(100%)	1(33.33%)	227 (92.65%)

Table 4: Relationship with baseline heart rates with INCU admission and >10 days hospital stay.

Admission in INCU	Baseline		
	Abnormal	Non reassuring	Reassuring
No, n=132 (53.87%)	0	0	132 (53.88%)
Yes, n=117 (47.75%)	1(100%)	3 (100%)	113 (46.12%)
Total no. of cases	1	3	245
> 10 days stay			
No, n=211 (84.74%)	1 (100%)	0	210 (85.71%)
Yes, n=38 (15.26%)	0	3 (100%)	35 (14.29%)
Total no. of cases	1	3	245

A total of 117 babies were needed NICU admission and only 38 babies stayed for more than 10 days. All the babies with abnormal and non-reassuring baseline required NICU admission and more than 10 days stay. So, predictive value of abnormal and non-reassuring heart rates was 100%. 113 cases with reassuring baselines also needed INCU stay and 35 babies needed more than 10 days stay meaning there being other abnormality in the CTG and only reassuring baseline couldn't predict the fetal well-being. Positive predictive value, negative predictive value, specificity and sensitivity of baseline heart rate for NICU admission were 100%, 53.8% 100%

3.41% respectively. Positive predictive value for >10 days hospital stay was 75%, negative predictive value was 85.71% specificity was 99.52% and sensitivity was 7.8% (Table 4). Out of 7 cases with abnormal variability 1 had blood stained liquor, 3 cases had thick meconium and 3 cases had thin meconium meaning a very poorer correlation between the two. Out of 41 cases with non-reassuring variability, 22 (53.66%) cases had thick meconium showing a fairly good predictive value of abnormal liquor colour. Out of 201 cases with reassuring, 124 (61.69%) cases had clear liquor. So, positive predictive value of the variability for liquor colour was

79.2% and negative predictive value was 61.7%, specificity was 92.53% and sensitivity was 33% (Table 5).

Table 5: Relation of variability with liquor colour.

Liquor colour	Variability		
	Abnormal	Non reassuring	Reassuring
Blood stained, n=1(0.40%)	1 (14.29%)	0	0
Thick meconium, n=46(18.47%)	3 (42.86%)	22 (53.66%)	21 (10.45%)
Thin meconium, n=68 (27.31%)	0	12 (29.27%)	56 (27.86%)
Clear, n=134 (53.82%)	3 (42.86%)	7 (17.07%)	124 (61.69%)
Grand total	7	41	201

Table 6: Relation of variability with Apgar score at 1 min and 5 min.

APGAR score 1 min	Variability		
	Abnormal	Non reassuring	Reassuring
<7, n=121 (48.59%)	7 (100%)	38 (92.68%)	76 (37.81%)
Normal, n=128 (51.41%)	0	3 (7.31%)	125 (62.18%)
Total no. of cases	7	41	201
APGAR score 5 min			
	Abnormal	Non reassuring	Reassuring
Less than 7, n=20 (8%)	4 (57.14%)	11 (26.83%)	5 (2.49%)
Normal, n=229 (91.96%)	3 (42.86%)	30 (73.17%)	196 (97.51%)

Table 7: Relation of variability with INCU admission and >10 days INCU stay.

Admission in INCU	Variability		
	Abnormal	Non reassuring	Reassuring
No, n=132 (53.02%)	0	6 (14.63%)	126 (62.69%)
Yes, n=117 (46.98%)	7 (100%)	35 (85.37%)	75 (37.31%)
Total no. of cases	7	41	201
>10 days NICU stay			
	Abnormal	Non reassuring	Reassuring
No, n=211 (84.74%)	2 (28.5%)	25 (61%)	184 (91.5%)
Yes, n=38 (15.26%)	5 (71.5%)	16 (39%)	17 (8.5%)
Total no. of cases	7	41	201

Table 8: Relation of deceleration with liquor colour.

Liquor colour	Abnormal deceleration		
	AVD	LD	SPD
Blood stained, n=1 (0.4%)	0	0	1 (1.61%)
Thick meconium, n=46 (18.47%)	18 (10.40%)	4 (28.57%)	24 (38.71%)
Thin meconium, n=68 (27.31%)	51 (29.48%)	4 (28.57%)	13 (20.97%)
Clear, n=134 (53.82%)	104 (60.12%)	6 (42.86%)	24 (38.71%)
Total no. of cases	173	14	62

When compared with Apgar score, positive predictive value, negative predictive value, specificity and sensitivity of variability for Apgar score at 1 min was 93.8%, 62.2%, 97.7% and 37.2% respectively whereas for Apgar score at 5 min were 39.47%, 97.5%, 85.65 and 50% respectively (Table 6). It was observed that out of 117 INCU admissions 75 babies had reassuring variability. Out of 38 babies needing >10 days stay, 17

(8.5%) babies had reassuring variability, 16 (39%) had non reassuring variability and 5 (71.5%) had abnormal variability. So positive predictive value of variability for INCU admission was 89.4%, negative predictive value was 62.7%, specificity was 96.2% sensitivity was 35.9%. Positive predictive value for >10 days stay was 43.8%, negative predictive value was 91.54%, specificity was 87.2% and sensitivity was 55.26% (Table 7). Out of 173

cases with atypical variable deceleration, 104 (60.12%) cases had clear liquor, 69 cases had meconium stained liquor, so positive predictive value being 39.9%, negative predictive value 39.5%, specificity was 22.4% and sensitivity was 59.48%. Positive predictive value, negative predictive value, specificity and sensitivity of

late deceleration were 57.1%, 54.5%, 95.5% and 6.95% respectively. Positive predictive value of single prolonged deceleration for abnormal liquor was 61.3%, negative predictive value was 58.8%, specificity was 82.1% (Table 8).

Table 9: Relation of deceleration with Apgar score at 1 min and 5 min.

APGAR score 1 min	Deceleration		
	AVD	LD	SPD
<7, n=121 (48.59%)	55 (31.79%)	10 (71.43%)	56 (90.32%)
Normal, n=128 (51.41%)	118 (68.21%)	4 (28.57%)	6 (9.68%)
Total no. of cases	173	14	62
APGAR score 5 min	Deceleration		
	AVD	LD	SPD
Less than 7, n=20 (8%)	4 (2.31%)	2 (14.29%)	14 (22.58%)
Normal, n=229 (91.96%)	169 (97.69%)	12 (85.71%)	48 (77.42%)
Grand total	173	14	62

Table 10: Relation of deceleration with INCU admission and >10 days INCU stay.

Admission in INCU	Deceleration		
	AVD	LD	SPD
No, n=132 (53.02%)	121 (69.94%)	4 (28.57%)	7 (11.29%)
Yes, n=117 (46.98%)	52 (30.06%)	10 (71.43%)	55 (88.71%)
Total no. of cases	173	14	62
>10 days INCU stay	Deceleration		
	AVD	LD	SPD
No, n=211(84.74%)	162 (93.64%)	12 (85.71%)	37 (59.68%)
Yes, n=38 (15.26%)	11 (6.36%)	2 (14.29%)	25 (40.32%)

Table 11: Relation of acceleration with liquor colour.

Liquor colour	Acceleration	
	Abnormal	Reassuring
Blood stained, n=1 (0.40%)	1 (068%)	0
Thick meconium, n=46 (18.47%)	37 (25.34%)	9 (8.74%)
Thin meconium, n=68 (27.31%)	40 (27.40%)	28 (27.18%)
Clear, n=134 (53.82%)	68 (46.58%)	66 (64.08%)
Total no. of cases	146	103

Table 12: Relation of acceleration with Apgar score at 1 min and 5 min.

APGAR score 1 min	Deceleration	
	Abnormal	Reassuring
<7, n=121 (48.59%)	87 (59.59%)	34 (33.01%)
Normal, n=128 (51.41%)	59 (40.41%)	69 (66.99%)
Total no. of cases	146	103
APGAR score 5 min	Deceleration	
	Abnormal	Reassuring
Less than 7, n=20 (8%)	17 (11.64%)	3 (2.91%)
Normal, n=229 (91.96%)	129 (88.36%)	100 (97.09%)

When deceleration was compared with NICU stay, positive predictive value of atypical variable deceleration, late deceleration and single prolonged deceleration for

Apgar at 1 min were 31.79%, 71.43% and 90.32% respectively and for Apgar at 5min were 2.23%, 14.28% and 22.58% respectively. Negative predictive value of

atypical variable deceleration, late deceleration and single prolonged deceleration for Apgar at 1 min are 13.15%, 52.8% and 65.4% respectively and for Apgar at 5 min are 78.9%, 92.5% and 96.8% respectively. Specificity of AVD, LD and SPD were 7.8%, 96.9% and 95.4%

respectively and for 5 min Apgar are 26.2%, 94.8% and 79% respectively. Sensitivity of AVD, LD and SPD for 1 min Apgar are 45.5%, 8.3% and 46.3% respectively and that for Apgar at 5min were 20%, 10% and 70% respectively (Table 9).

Table 13: Relation of acceleration with INCU admission.

Admission in INCU	Acceleration	
	Abnormal	Reassuring
No, n=132 (53.02%)	61 (41.78%)	71 (68.93%)
Yes, n=117 (46.98%)	85 (58.22%)	32 (31.07%)
Total no. of cases	146	103
>10 days INCU stay		
No, n=211 (84.74%)	115 (78.77%)	96 (93.20%)
Yes, n=38 (15.26%)	31 (21.23%)	7 (6.80%)

Table 14: Relationship of mode of delivery with baseline, variability, deceleration and acceleration.

Mode of delivery	Baseline			Variability			Deceleration			Acceleration	
	A	NR	R	A	NR	R	AVD	LD	SPD	A	R
Em LSCS, n=181, (72.69%)	1	1	179	5	24	152	151	2	28	109	72
	100%		73.06%	71.43%	58.54%	75.62%	87.28%	14.29%	45.16%	74.66%	69.90%
Forceps delivery, n=24, (9.64%)	0	1	23	2	7	15	2	8	14	14	10
		33.33%	9.38%	28.57%	17.08%	7.46%	1.16%	57.14%	22.31%	9.59%	9.71%
Vaginal delivery n=44, (17.6%)	0	1	43	0	10	34	20	4	20	23	21
		33.33%	17.55%		24.39%	16.92%	11.56%	28.57%	32.26%	15.75%	20.39%
Total no. of cases	1	3	245	7	41	201	173	14	62	146	103

Table 15: Relation of liquor colour with Apgar score-1 min and 5 min.

APGAR score-1 min	Liquor color			
	Blood stained	Clear	Thick meconium	Thin meconium
<7, n=121 (48.59%)	1 (100%)	45 (33.6%)	41 (89.1%)	34 (50.0%)
Normal, n=128 (51.41%)	0	89 (66.4%)	5 (10.9%)	34 (50.0%)
Grand total	1	134	46	68
Apgar score at 5min				
<7, n=20 (8.03%)	0	6 (4.5%)	13 (28.3%)	1 (1.5%)
Normal, n=229 (91.96%)	1 (100%)	128 (95.5%)	33 (71.7%)	67 (98.5%)

Table 16: Relation of liquor colour with INCU admission and >10 days INCU stay.

Admission in INCU	Liquor color			
	Blood stained	Clear	Thick meconium	Thin meconium
No, n=132 (53.1%)	0	93 (69.4%)	6 (13.0%)	33 (48.5%)
Yes, n=117 (46.9%)	1 (100%)	41 (30.6%)	40 (87.0%)	35 (51.5%)
Grand total	1	134	46	68
>10 days INCU stay				
No, n=211 (84.74%)	1 (100%)	120 (89.6%)	26 (56.5%)	64 (94.1%)
Yes, n=38 (15.26%)	0	14 (10.4%)	20 (43.5%)	4 (5.9%)

Relation of deceleration with INCU admission and >10 days INCU stay showed that positive predictive value of single prolonged deceleration was maximum both for INCU stay and >10 days stay i.e., 88.7% and 40.32%

respectively, followed by that of late deceleration 71.42% and 14.3% respectively and that of atypical variable deceleration 30% and 6.4% respectively. Negative predictive value of single prolonged deceleration was

maximum for INCU and >10 days stay was 66.84% and 93%, that of late deceleration was 54.5% and 84.7% and that of atypical variable deceleration was 14.5% and 64.5%. Specificity of single prolonged deceleration for INCU and >10 days stay was 94.7% and 94.31%, that of late deceleration was 96.9% and 94.3% and that of atypical variable deceleration was very low (8.3% and 23.2%). Sensitivity of SPD, AVD and LD were low for INCU admission i.e, 47%, 44.4% and 8.5% and that for >10 days stay were 65.8%, 29% and 5.3% (Table 10). Relation of acceleration with liquor colour showed that the positive predictive value of absence of acceleration for abnormal liquor colour was 53.4% negative predictive value was 64.1%, specificity was 49.3% and sensitivity

was 67.8% (Table 11). Similarly Absence of acceleration for Apgar of babies at 1 min had positive predictive value of 59.6%, negative predictive value of 67%, and specificity of 53.9% and sensitivity of 71.9%. Positive predictive value of absence of acceleration for Apgar score at 5 min was very low 11.6%, negative predictive value was 97.1%, specificity was 43.7% and sensitivity was 85% (Table 12). Positive predictive value of absence of acceleration for NICU admission was 58.2%, negative predictive value was 68.9%, specificity was 53.8% and sensitivity was 72.6%. The negative predictive value of acceleration for >10 days hospital stay was 93.2% and sensitivity was 81.6% but positive predictive value and specificity were very low (Table 13).

Table 17: Relation of mode of delivery with Apgar score-1min and 5 min.

APGAR score-1 min	Mode of delivery			
	Em. LSCS	Low forceps	Outlet forceps	Vaginal delivery
<7, n=121 (48.59%)	72 (39.78%)	5 (71.43%)	14 (82.35%)	30 (68.18%)
Normal, n=128 (51.41%)	109 (60.22%)	2 (28.57%)	3 (17.65%)	14 (31.82%)
Grand total	181	7	17	44
Apgar score at 5 min				
<7, n=20 (8.03%)	6 (3.31%)	3 (42.86%)	6 (35.29%)	5 (11.36%)
Normal, n=229 (91.96%)	175 (96.69%)	4 (57.14%)	11 (64.71%)	39 (88.64%)

Table 18: Relation of mode of delivery with INCU admission and >10 days INCU stay.

Admission in INCU	Mode of delivery			
	Em LSCS	Low forceps	Outlet forceps	Vaginal delivery
No, n=132 (53.1%)	116 (64.09%)	2 (28.57%)	3 (17.65%)	11 (25%)
Yes, n=117 (46.9%)	65 (35.91%)	5 (71.43%)	14 (82.35%)	33 (75%)
Grand total	181	7	17	44
>10 days INCU stay				
No, n=210 (8.3%)	164 (90.61%)	4 (57.14%)	8 (47.06%)	35 (79.55%)
Yes, n=35 (14.1%)	17 (9.39%)	3 (42.86%)	9 (52.94%)	9 (20.45%)

Out of 245 cases with reassuring baselines 179 (73.06%) cases had cesarean section, only 43 (17.55%) had normal vaginal delivery and 23 (9.38%) cases had operative vaginal delivery. Out of 3 cases with non-reassuring baselines, 1 had vaginal delivery, 1 had cesarean section and 1 had outlet forceps delivery. Out of 181 cases that had emergency cesarean section 152 (75.62%) cases had reassuring variability only 5 (71.43%) had abnormal variability and 24 (58.54%) had non reassuring. Total of 146 cases had absence of acceleration, of which 74.66% required emergency cesarean section, 14 (9.59%) had operative vaginal delivery and 15.75% had vaginal delivery. We also found out of 173 cases with atypical variable deceleration 151 (87.28%) cases had emergency cesarean section, out of 14 cases with late deceleration, 2 (14.29%) had emergency cesarean section, 8 (57.14%) cases had instrumental vaginal delivery. Out of 62 cases with single prolonged deceleration 28 (45.16%) cases had

emergency cesarean section, 14 (9.59%) cases had instrumental vaginal delivery (Table 14). The positive predictive value of liquor colour for Apgar score at 1 min was 66.1%, negative predictive value was 66.4%, specificity was 69.5% and sensitivity was 62.8%. The positive predictive value of liquor for Apgar score at 5 min was very poor only 66.1%, negative predictive value was 66.4%, specificity was 69.5% and sensitivity was 62.8% (Table 15). Positive predictive value of liquor for admission in NICU was 66.1%, negative predictive value was 69.4%, specificity was 70.5% and sensitivity was 65%. The positive predictive value of liquor colour for hospital stay >10 days was 22.95%, negative predictive value was 89.65%, specificity was 59.7% and sensitivity was 63.2% (Table 16). Out of 181 cases that had cesarean section for some abnormal heart rate feature, 109 cases (60.2%) had babies with normal Apgar score 1 min and 175 cases (96.7%) had babies with normal Apgar score 5

min. Similarly, 2 (28.57%) cases of low forceps and 4 (57.14%) cases of outlet forceps had normal Apgar at 1 min and 5 min respectively. Among the vaginal delivery cases, 14 (31.82%) cases and 39 (88.64%) cases had normal Apgar at 1 min and 5 min respectively (Table 17). When compared relation of mode of delivery with NICU admission and >10 days NICU stay we found that out of 181 cases, which had cesarean section for some abnormal heart rate feature, 116 cases (64.1%) had babies who did not require any INCU admission and 164 cases (90.6%) had babies who did not require more than 10 days hospital stay (Table 18).

DISCUSSION

A total of 249 women were selected randomly out of which, 181 women had cesarean section for abnormal heart rate features qualifying the CTG as a pathological (RCOG 2001). Total 128 women (48.59%) had babies with Apgar score at 1 min <7, only 20 babies (8%) had Apgar score at 5 min <7. Total 117 babies (47.8%) required INCU admission and only 35 babies (14%) required more than 10 days hospital stay. Our studies showed increased risk of maternal morbidity due to emergency cesarean section. Only 35 babies with >10 days hospital stay were considered to have increased neonatal morbidity.

Other studies had also shown intrapartum fetal asphyxia as an important cause of still birth and neonatal death. Most fetuses tolerate intrauterine hypoxia during labour and were delivered without complications but assessment suggesting fetal distress were associated with an increased likelihood of cesarean section.⁵

Accuracy of the screening

In our study, accuracy of pathological CTG or the four abnormal heart rate features were assessed by the negative predictive values and specificity. The negative predictive values and specificities of all the heart rate features were >60% except for the atypical variable deceleration, in detecting all the parameters of adverse perinatal outcome in our study. As a screening test the sensitivity and positive predictive values should be more. The sensitivities of the baseline, variability, deceleration and acceleration in detecting adverse perinatal outcome were very low, when each abnormal heart rate pattern was taken individually. Thus, the sensitivity of pathological CTG was found to be poor. This may be due to two factors that may limit the accuracy and reliability i.e. the method used to measure fetal heart activity and the variability associated with CTG interpretations.

Other studies had shown that an abnormal CTG trace occurs in up to 50% of all recordings, but only a small proportion of these fetuses were at risk of hypoxia.⁶ Abnormal deceleration in FHR and decrease in variability during uterine contraction were considered to be suggestive of fetal distress but the patterns were not

diagnostic. In addition, normal or equivocal fetal heart rate patterns did not exclude the diagnosis of fetal distress. Precise information on the frequency of the false negative and false positive results was lacking due to absence of an acceptable definition of fetal distress.⁷

Effectiveness of early detection

Out of 249 cases with abnormal heart rate features either individually or in combination, we could detect 128 (48.6%) babies with poor Apgar score at 1 min of which 20 (8%) still had a poor Apgar score at 5 min. So, we were able to save these 128 babies from deteriorating further and landing up in cerebral palsy or intrapartum still birth or early neonatal death. But we did not follow up the babies or mothers. It was true that we could detect early but how effectively what was the long-term benefit could not be assessed in our study. In Greece, a trial carried out in predominantly low risk women found no difference in most neonatal outcome but reported a significant decrease in perinatal mortality.

The neonatal seizure prevented by CTG may not be those associated with long term impairment. At 4 year follow up after seizures in the Dublin trial, the total no and rate of cerebral palsy were identical in monitored and controlled groups.⁸ A follow up study of the growth and development at 9 months of age infants involved in the second Denver trial failed to show any long-term benefits of CTG.

CTG leads to an increase in obstetric interventions

Out of 249 cases, 181 (73%) had cesarean section. An increase in cesarean section rate and operative vaginal deliveries by more than 50% in comparison to the era when there was no CTG machine in our hospital. This finding was pertinent with Dundee study, cochrane review (2002), which also showed increased cesarean section rate (RR 1.41), operative vaginal delivery (RR 1.20).⁹ But the Dublin study showed no increase in operative deliveries by use of admission CTG.¹⁰ A randomized study in the seventies and eighties had demonstrated a higher incidence of artificial deliveries when CTG was compared with dedicated intermittent auscultation.¹¹ The addition of the cord blood sampling and fetal scalp blood pH to assess the fetal acid base status in a case of suspected or abnormal fetal heart rate patterns clearly reduces the number of obstetric intervention if compared with the application of CTG alone.¹²

There was also a correlation between liquor colour and adverse perinatal outcome. Meconium stained liquor had a sensitivity and specificity for Apgar score at 1 min of 69.5% and 62.8% respectively. Our study showed a positive correlation between meconium and heart rate patterns. This was also shown in various other studies. If the CTG was pathological, the presence of meconium was associated with significantly higher chance of a baby

being acidotic, born in poor condition and needing resuscitation.^{3,13} Meis et al, prospectively evaluated 2923 pregnancies and documented a statistically significant increase in fetal heart rate abnormalities, depressed Apgar scores, and even neonatal death in labours complicated by early heavy meconium. Fenton and Steer in their study concluded that variation in FHR without meconium and the passage of meconium without change in FHR were not true indicators of fetal distress. In our study single prolonged deceleration had maximum specificity, sensitivity, positive predictive value and negative predictive value for meconium staining liquor compared to atypical variable deceleration and late deceleration. But late deceleration exceptionally had a high specificity for meconium staining.

There was a correlation between fetal heart rate patterns and Apgar score. Baseline, variability and deceleration had a good specificity, avg >80% and acceleration had a good sensitivity for Apgar score at 1 min and 5 min. The predictive value of a normal FHR pattern in detecting a neonate with Apgar score >7 was 99%. The abnormal FHR pattern predicted a depressed neonate with 67% accuracy. The FHR was normal in 98% of neonates with Apgar score more than 7. A normal FHR pattern could also be seen in neonate with Apgar scores <7 but less frequent, representing a sensitivity of 77%.

High intra and inter observer variability

This factor was profound, because of changing registrars in different shifts of duty and their varied opinion regarding the CTG tracings. Reading, classification and interpretation should be the successive steps in the assessment of CTG tracings. Often a conclusion was reached in vague terms of suspicious, pathologic, ominous or terminal FHR pattern. The high inter or intra observer variability concerning the classification and interpretation of FHR pattern had been substantiated in a large no of publication.¹⁴

The low validity, high false positive rate

Our study showed that the sensitivity of the various abnormal heart rate features was very low, <20% for most of them, so false positive rates were high for abnormal heart rate features taken individually in a pathological CTG. It may be due to small sample size, and absence of confirmation of fetal distress by detection of acidosis by scalp blood PH or long term follow up.

There is no significant correlation of fetal heart rate patterns and perinatal outcome were found with maternal age, parity, fetal gender or baby weight which were in agreement with studies by Mahomed K et al.¹⁵

The main limitation of our study was that it was an observational study. Normal CTG has not been studied. There was interobserver variability markedly. The study was biased by patient relatives demand for early

intervention. Perinatal outcome was assessed by liquor colour, Apgar score, and INCU stay which were all subjective parameters and also suffered from interobserver variations. Follow up study for assessing long term effects of babies were not done.

CONCLUSION

We concluded that, the abnormal fetal heart rate features in a CTG, (RCOG 2001) were related to the adverse perinatal outcomes, meconium staining of liquor, Apgar score <7 at 1 min and 5 min after delivery, INCU admission and hospital stay >10 days. The specificities and sensitivities of each abnormal heart rate feature to detect adverse perinatal outcome differ when considered individually. Large study samples and addition of current modalities of intrapartum fetal monitoring can reduce the limitations of our study. So, abnormal fetal heart rate features in a intrapartum CTG of a labouring mother >37 weeks can detect fetuses in distress with different sensitivity and specificity when considered individually.

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