http://jmscr.igmpublication.org/home/
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v7i12.49

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Original Research Article

A Study on Electronic Fetal Heart Rate Monitoring in Fetal Distress and Neonatal Outcome

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Abstract
A prospective study was done in Kamla Nehru Hospital IGMC shimla on 100 women with one or more signs of fetal distress like decreased fetal movement perception by mother, meconium staining of amniotic fluid and fetal heart rate abnormality; out of which 32 patients were chosen randomly for electronic fetal heart rate monitoring. Fetal bradycardia, decreased beat to beat variability, late deceleration and sine wave pattern groups were resulted in more asphyxiated babies at 1 and 5 minutes Apgar score in comparison to variable deceleration group. Fetal tachycardia resulted in nonasphyxiated babies at 1 and 5 minutes Apgar score.

Introduction

Every fetus has a potential risk of intrapartum asphyxia or birth injury and an optimum outcome can be concluded only at the end of labour or occasionaly much later. The aim is to detect at the earliest any evidence of fetal jeopardy to take prompt measures before any adverse effects of anoxia occurs. Prior to introduction of electronic fetal heart rate monitors, intermittent auscultation was usual method of fetal monitoring in labour. It carries serious limitations viz. samples only 7% of heart rate if ausculatated at 15 minutes interval for 1 minute; counting is inaccurate during rapid and variable heart rate and during uterine contractions and cannot be monitored continuously. During the last few years relatively newer biochemical and electronic methods of fetal monitoring during labour have allowed a more accurate analysis and reevaluating old classical signs of fetal distress. However, these techniques are not frequently available in all hospitals. We look forward a day when every labour will be electronically monitored so that no neonate will be lost on account of fetal distress.

Apgar score is a quick method of assessing the newborn infant (Apgar V. 1953)[1]. Ease of scoring has lead to its use in studies of neonatal outcome. Total score: 10, No depression:7-10, Mild depression:4-6, Severe depression:0-3. The 1 minute Apgar score predicts the immediate neonatal outcome which determines the immediate need for resuscitation of the neonate. Apgar score at 5 minutes predicts the long term neurological outcome, which is a useful index of effective resuscitation effort.

A full description of a FHR(Fetal Heart Rate) tracing requires a qualitative and quantitative description (NICHD-1997)[2].

1. Base line heart rate: Base line FHR is the approximate mean rate rounded to increment of 5

bpm during a 10 minute tracing segment; with a miniumum interpretable base line duration of atleast 2minutes. (i) Normocardia: 110-160bpm. (ii) Tachycardia: [a] Mild tachycardia: 161-180 bpm. [b] Severe tachycardia: 181bpm or more. (iii) Bradycardia: FHR<110 bpm, [a] Mild bradycardia: 100-109bpm. [b] Moderate bradycardia: 80-100 bpm. [c] Severe bradycardia <80bpm.

2. Base line beat to beat variability (BBV): Defined as fluctuations of base line FHR of 2 cpm or greater. It is visually quantitated the amplitude of peak to trough in bpm. 6-25bpm considered as normal.

3. Accelerations: Defined as visually apparent abrupt increase (onset of acceleartion to peak in <30 seconds) in FHR above the base line. The acme is > or = 15bpm above the baseline and acceleartion lasts > or = 15 seconds and < 2minutes from the onset to return to baseline. Acceleration of > or = 10minutes is a baseline change.

4. Periodic or episodic decelerations: Periodic patterns are those associated with uterine contractions and episodic patterns are those not associated with uterine contractions. Decelerations are nowadays classified as early, variable, late and prolonged (NICHD)[2].

Early Deceleration: Is a visually apparent gradual decrease (defined as onset of deceleration to nadir > or = 30 seconds) and return to baseline FHR associated with a uterine contraction. Onset, nadir and recovery is co-incident with the uterine contractions.

Late Deceleration: Is a visually apparent gradual (defined as onset of deceleartion to nadir > or = 30 seconds) decrease and return to baseline FHR associated with uterine contractions. Onset, nadir and recovery of deceleration occurs after the beginning, peak and end of contractions. Ciblis[3] (1971) concluded that patients with late deceleration were very often had depressed neonates. Generally; any process that causes maternal hypotension, excessive uterine activity or placental dysfunction can induce late decelerations.

Variable Decelerations: Is defined as a visually apparent abrupt decrease (defined as onset of deceleration to beginning of nadir <30 seconds) in FHR below the baseline. The decrease in FHR below the baseline is > or = 15bpm lasting > or = 15 seconds and < 2 minutes from onset to return to baseline.

Prolonged Deceleration: Is defined as isolated decelerations lasting 2 minutes or longer but <10 minutes from onset to return to baseline.

Sinusoidal Pattern: Called due to its "Sine wave" like shape. Kubli and associates[4] (1972) who identified a sinusoidal wave form with frequency of 2-5cpm, believe to be "typical sign of fetal compromise" (Mondanlou[5] 1982).

Materials and Methods

A prospective study was conducted in the department of obstetrics and gynaecology at Kamla Nehru Hospital of IGMC Shimla between July 2002 – June 2003 with 100 patients of full term pregnancy in labour showing one or more clinical signs of fetal distress; out of which 32 patients were randomly enrolled for continuous electronic FHR monitoring.

Selection of Cases: Patients with full term (37-42 weeks) normal pregnancy with cephalic presentation in labour who had shown some alterations in FHR or rhythm, decrease or loss of fetal movements and meconium staining of amniotic liquor on spontaneous or artificial rupture of membrane were selected for the study. Pregnancy with antenatal complications lie pregnancy induced hypertension, twin pregnancy, diabetes mellitus, severe anaemia, Rh-incompatibilty, antepartum haemorrhage and post maturity were excluded from the study. In all cases following observations were made and recorded in the case proforma:

In each case a detailed obstetric and menstrual history was taken. Patients were asked about duration of labour pain, history of any bleeding or leakage per vaginum and colour of liquor and any

decrease or cessation of fetal movements. A detailed general, physical, systemic and obstetrical examination was done and findings were noted. Labour was monitored partographically. Out of 100 patients; 32 patients selected randomly were continuosuly monitored by electronic fetal monitor (cardiotocograph) and interpretations were made for baseline heart rate, period of acceleration, period of deceleration (early, variable and late), osciallation along the baseline for BBV and ampitude of oscillation and sine wave pattern. Hb%, blood grouping and Rh typing and urine for albumin and sugar were done in each patient. Duration of first and second stage of labour recorded in cases of normal vaginal delivery (NVD), low forceps delivery and in ventouse application. If delivery was not eminent and cardiotocographic monitoring showed a nonreassuring FHR pattern with or without any clinical sign or symptoms of fetal distress; patients were taken up for emergency cesarean section. Placenta and umblical cord were examined for any abnormality. Neonates were examined for Apgar score at 1 and 5 minutes, birth weight, gestational age, any congenital malformation, meconium staining of cord, nails and cornea and any evidence of meconium aspiration syndrome. According to Apgar score at 1 and 5 minutes neonates were classified into 3 categories: **1.** Apgar score 7-10: healthy, no asphxia. **2.** Apgar score 4-6: mild asphyxia. **3.** Apgar score 0-3: severe asphyxia and still birth.

Asphyxiated babies were admitted to neonatal intensive care unit after primary resuscitative measures and followed up as long as the neonate was in hospital.

Statistics: Observations were recored and analysed using **Paired Student's t-test.**

Table I: EFM and its reation to clincal signs of fetal distress

Clinical Sign	Decereased BBV	Variable deceleration	Late deceleration	Normal heart rate	Total=32
a)FHRA=11					
Bradycardia	-	-	1	-	1
Irregular Heart Rate	-	10	-	-	10
b)MSAL=3					
Thick MSAL	2	-	1	3	3
c)MSAL+FHRA=18					
Thin MSAL + Tachycardia	-	-	-	-	1
Thin MSAL + ireregular heart rate	1	2	-	-	2
Thick MSAL + Tachycardia	-	-	-	-	2
Thick MSAL + irregular heart rate	3	7	4	-	13

In table I, out of 11 patients in Fetal Heart Rate Abnormality (FHRA) group, 1 patient had bradycardia with late deceleration and 10 patients had irregular heart rate with variable deceleration. Out of 3 thick MSL group; all had normal heart rate (110-160bpm). 2 patients with decreased BBV and 1 with late deceleration. 1 patient showed sinusoidal heart rate pattern. Out of 18 patients with meconium stained amniotic liquor (MSAL) + FHRA, 1 patient was with thin MSAL+ tachycardia and 2 patients had thin MSAL+ irregular heart rate in which 1 patient had variable deceleration and decreased BBV and 1 patient had only variable deceleration. 2 patients were of thick MSAL+ tachycardia. Out of 13 patients with irregular heart rate, 3 patients had decreased BBV, 7 patients with variable deceleration and 4 patients with late deceleration. 1 patient had history of decreased fetal movement which was associated with variable deceleration.

It was observed from the study that FHRA with or without MSAL appeared as the most common

clinical sign of fetal distress. Thick MSAL+ irregular heart rate were associated with increased incidence of decreased BBV, variable deceleration and late deceleration. Highest number of variable deceleration were associated with irregular heart rate pattern.

Table II: EFM distribution of signs of fetal distress and relation to neonatal outcome.

		At one minute			At five minute		
	Total=32	Group I	Group II	Group III	Group I	Group II	Group III
Normal heart rate	3(9.37%)	0	2(66.67%)	1(33.33%)	1(33.33%)	2(66.67%)	0
Irregular heart rate	25(78.12%)	10(40%)	13(52%)	2(8%)	22(88%)	3(12%)	0
Tachycardia	3(9.37%)	3(100%)	0	0	3(100%)	0	0
Bradycardia	1(3.12%)	0	1(100%)	0	0	1(100%)	0
Decreased BBV	6	0	3(50%)	3(50%)	2(33.33%)	4(66.67%)	0
Variable deceleration	20	9(45%)	9(45%)	2(10%)	18(90%)	2(10%)	0
Late deceleration	6	0	5(83.33%)	1(16.67%)	4(66.67%)	2(33.33%)	0

Paired student's t-test:

Normal Heart Rate, Irregular Heart Rate, tachycardia and bradycardia:

Group I : t= -1.23, p= 0.306
Group II: t= 1.13, p=0.340
Group III: t= -1.57, p=0.215

Decreased BBV, VD and LD:

Group I : t= - -2.40, p= 0.138
Group II: t= 1.30, p=0.324
Group III: t= 3.46, p=0.074

In table II: out of 32 patients in whom EFM was done, 3 showed normal FHR tracing, 25 had irregular heart rate tracing, 3 had tachycardia and 1 had bradycardia. In normal tracing group all were having thick MSAL. 2 had neonatal death out of which 1 was showing sine wave pattern. 25 patients had irregular heart rate. 60% (15 patients) at 1 minute and 12% (3 patients) at 5 minutes had asphyxiated babies. The patients having fetal tachycardia (2 patients) had healthy babies both at Apgar 1 and 5 minutes. 1 patient showed bradycardia had mildly asphyxiated baby at 1 and 5 minutes. 6 patients had decreased BBV. 100% (6 patients) at 1 minute and 66.67% (4 patients) had asphyxiated babies at 5 minutes. 20 patients had variable deceleration; 55% (11 patients) at 1 minute and only 10% (2 patients) at 5 minutes had asphyxiated babies. 6 patients had features of late deceleration, 100% (6 patients) at 1 minute and 33.33% (2 patients) at 5 minutes had babies with Apgar <7. Cardiotocographic monitoring had shown presence of decreased BBV, late deceleration, sinusoidal heart rate pattern and non-reactive admission test as a marker of very poor neonatal outcome. Variable deceleration pattern was also found to be associated with few asphyxiated babies.

Discussion

Several controlled studies concluded that EFM had shown clear cut benefit with respect to decrease in intrapartum still birth rate and neonatal death rate.

Correlation Of Sinusoidal Heart Rate Pattern And Neonatal Outcome: In the present study (Table I), with normal tracing group with MSAL, out of 3 patients 1 patient demonstrated sinusoidal heart rate pattern resulted in neonatal death which is consistent with the ominous features of sinusoidal heart rate pattern as expressed by Kubli et al[4] (1972) and Mondanlau et al[5](1983) resulting in a very high percentage of perinatal mortality.

Correlation of Irregular Heart Rate Pattern: When irregular heart rate pattern (Table II) had combination with MSAL, variable deceleration, late deceleration and decreased BBV, 60% (15 patients) at 1 minute and 12% (3 patients) at 5 minutes had asphyxiated babies out of which 3 neonatal deaths and 1 fresh still birth occurred. The result supports the observations made by Gaziano et al[6] (1979), Meis et al[7](1982), NICHD[2] (1997), Dellinger et al[8](2000) regarding the ominous prognosis of these signs.

Correlation with Fetal Tachycardia: In the present study (Table II); 3 patients with fetal

tachycardia had non-asphyxiated babies both at 1 and 5 minutes, which is consistent with Krebs et al[9](1979).

Correlation with Fetal Bradycardia: In the present study (Table II); 1 patient had bradycardia associated with late deceleration had 100% (1 patient) moderately asphyxiated baby at 1 minute and remained asphyxiated at 5 minutes, which is consistent with the views of Krebs et al[9](1979), Gaziano et al[6](1979), Meis et al[7](1982), NICHD[2] (1997) and Dellinger et al[8](2000) in which they concluded that progressive bradycardia with late deceleration was the most unfavourable combination.

Correlation with Late Deceleration: As depicted in Table I and II; 100% (6 patients) at 1 minute and 33.33% (2 patients) at 5 minutes had babies with Apgar <7; including 1 neonatal death. The findings were similar to the result of Cibilis[3] (1971), Krebs et al[9] (1979), Meis et al[7](1982) and Dellinger at al[8](2000); expressing poor neonatal outcome associated with late deceleration.

Correlation with BBV: As depicted in Table II; 100% (6 patients) at 1 minute and 66.67% (4 patients) at 5 minutes had asphyxiated babies; out of which 3 neonatal death occurred. It was associated with the worst neonatal outcome among FHR variables which is consistent with the findings of Meis et al[7](1982). It is generally believed that reduced baseline heart rate variabilty is the single most reliable sign of fetal compromise. Our study is also consistent with studies of Krebs et al[9](1979) and Dellinger et al[8] (2000).

Correlation with Variable Deceleration: As depicted in Table II; 55% (11 patients) at 1 minute and 10% (2 patients) at 5 minutes had babies with Apgar<7; out of which 2 neonatal death occurred. The findings are in accordance with the findings of Krebs et al[9](1979), Gaziano et al[6](1979), Meis et al[7](1982) and NICHD[2](1997). In the present study; we have done cesarean section liberally to reduce the neonatal morbidity and mortality which is consistent with the findings of et al[10] (1986) and Thacker et al[11] (1995) who also showed increase in cesarean section rate with EFM.

Conclusion

In the present study it was detected that patients with late deceleration decreased BBV, sinusoidal heart rate pattern and fetal bradycardia were associated with worst neonatal outcome in comparison to variable deceleration group. Fetal tachycardia resulted in non-asphyxiated baby both at 1 and 5 minutes like normocardia patients.

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