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Original Research Article

Correlation of intra partum electronic fetal monitoring with neonatal outcome

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ABSTRACT

Background: The importance of fetal monitoring during labour has been realized since long. The stress of uterine contractions may affect the fetus adversely especially if the fetus is already compromised, when the placental reserves are suboptimal, or when cord undergoes compression as in those associated with diminished liquor amnii or iatrogenic uterine hyperstimulation due to injudicious use of oxytocin. Even a fetus which is apparently normal in the antenatal period may develop distress during labour. Hence fetal monitoring during antepartum and intrapartum periods is of vital importance for timely detection of fetal distress so that appropriate management may be offered.
Methods: This study was a prospective observational study included 100 patients of more than 34 weeks period of gestation were divided into two groups. Patients in labour were analyzed on an Electronic Monitor. Delivery conducted was either by vaginal route, instrumental or by caesarean section depending upon the fetal heart rate tracings and their interpretations as per the case. At the time of delivery umbilical cord blood was taken for the pH analysis. All new born babies were seen by the paediatrician immediately after the delivery and 1 and 5 minute APGAR score assessed for the delivered baby. The various EFM Patterns obtained were compared with the neonatal status at birth using the parameters already mentioned. The false positives and false negatives if any were tabulated. Data so obtained was analyzed statistically thereafter. Statistical Package for Social Sciences (SPSS) Version 13.0 was used for the purpose of analysis.
Results: Results revealed that among the 50 subjects of the case group, 7 subjects showed the absence of the beat to beat variability, 12 subjects showed early deceleration, 32 subjects showed late deceleration, and 6 subjects showed the presence of variable deceleration. No significant association of beat to beat variability, early and variable deceleration could be established with meconium staining/NICU admissions/low APGAR. A significant positive association between persistent late deceleration with MSL, APGAR <7 at 1 min, and Instrumental/LSCS delivery was seen. A significant positive association between any CTG abnormality and APGAR at 1 min, type of delivery, and meconium staining was seen.
Conclusions: EFM should be used judiciously. Cardiotocography machines are certainly required in the labour room. Equally important is the proper interpretation of the CTG tracings so that unjustified caesarean sections can be minimized, at the same time picking up cases of fetal distress in time which is likely to improve fetal outcome.

Keywords: Cardiotocography, Deceleration, Delivery, Electronic fetal monitoring

INTRODUCTION

The ability to diagnose fetal life through auscultation of the fetal heart by applying the ear to the pregnant woman's abdomen was discovered in Europe during the early 19th century. Advances in the techniques of auscultation were limited until the arrival of audio-visual technologies in the early 20th century. These promised the possibility of a continuous form of monitoring.

Early electrocardiographic techniques were limited by their inability to sufficiently eliminate maternal complexes. In 1968, the first commercially available EFM applied Doppler's principle of a distinct change in frequency when a waveform is reflected from a moving surface. The monitoring of fetal scalp blood acid-base was developed in Germany in the 1960's and was introduced clinically as an adjunct to continuous electronic fetal heart rate monitoring to increase its specificity. The obstetric use of continuous electronic fetal heart rate monitoring increased rapidly. Medical and socio-economic advances transformed maternal birth outcomes in the 19th and 20th centuries. While the original aim of the intrapartum EFM was to prevent harm, it was introduced on to the labour wards in the 1950s with the emphasis on improving fetal birth outcomes by detecting fetal hypoxia, before it led to death or disability. Like intermittent auscultation in the 19th century, continuous EFM was introduced clinically before its effectiveness had been fully evaluated scientifically.

The FHR is under constant variation from the baseline. This variability reflects a healthy nervous system, chemoreceptors, baroreceptors and cardiac responsiveness. Prematurity decreases variability; therefore, there is little rate fluctuation before 28 weeks. Variability should be normal after 32 weeks. Fetal hypoxia, congenital heart anomalies and fetal tachycardia also cause decreased variability Clinically, loss of beat-to-beat variability is more significant than loss of long-term variability and may be ominous. Decreased or absent variability should generally be confirmed by fetal scalp electrode monitoring when possible[1].Uncomplicated loss of variability usually signifies no risk or a minimally increased risk of acidosis or low APGAR scores. Decreased FHR variability in combination with late or variable deceleration patterns indicates an increased risk of fetal pre-acidosis (pH 7.20 to 7.25) or acidosis (pH less than 7.20) and signifies that the infant will be depressed at birth. The combination of late or severe variable decelerations with loss of variability is particularly ominous. The occurrence of a late or worsening variable deceleration pattern in the presence of normal variability generally means that the fetal stress is either of a mild degree or of recent origin; however, this pattern is considered nonreassuring.[1]

A late deceleration is a symmetric fall in the fetal heart rate, beginning at, or after the peak of the uterine contraction and returning to baseline only after the contraction has ended. The descent and return are gradual and smooth. Regardless of the depth of the deceleration, all late decelerations are considered potentially ominous. A pattern of persistent late decelerations is non-reassuring, and further evaluation of the fetal pH is indicated. Persistent late decelerations associated with decreased beat-to-beat variability is an ominous pattern.

In a study by Cilibs et al. on a population of high-risk patients in labor who had continuous "direct" electronic monitoring. A variety of clinical aspects of mother and fetus were analyzed, considering some alterations observed in the FHR pattern. APGAR scores were lower among decelerations group, and there was a negative correlation between these two. Maternal pathology, other than PROM, was higher among decelerations group and these required enhancements more often. There was very high association with tachycardia, saltatory, and fixed baseline among the decelerations group, and these infants were very often distressed and born depressed. Within the group of decelerations, small fetuses had lower APGAR scores. There was a negative correlation between number of decelerations and APGAR score. The small fetuses had a high incidence of tachycardia and fixed baseline, saltatory being almost absent. Their neonatal outcome was poor.[2]

The FHR is an indirect indicator of fetal health during the intrapartum period. Various direct methods, such as fetal capillary scalp pH and continuous tissue pH quantifications and transcutaneous PO_2 determinations, are available to assess the fetal state during labour.

Kubli and colleagues studied the association of FHR patterns with fetal scalp pH. Scalp pH values above 7.25 are considered normal, values between 7.20 and 7.25 signify preacidosis, and those below 7.20 represent acidosis.[3] In patients with normal FHR patterns during 20 minutes preceding a blood sampling, the frequency of pH values above 7.25 was 94%. When heart rate accelerations were present, a sign of fetal well-being, all scalp pH values were above 7.25. Those fetuses with scalp pH values of less than 7.20 manifested mild variable decelerations, which may signify that these are not normal heart rate patterns.

Z Alfirevic et al did thirteen trials involving 37,000 women that compared CTG monitoring with auscultation and concluded that continuous CTG is associated with a reduction in neonatal seizures, but not significant in cerebral palsy, infant mortality or other standard measures of neonatal well-being.[4] However, continuous cardiotocography was associated with an increase in caesarean sections and instrumental vaginal births.

METHODS

This study was a prospective observational study of patients presenting to antenatal OPD and to Labour room at >34 weeks period of gestation and was performed over

a period of two years between Jul 2013 to Feb 2015. 100 patients in labour were analyzed on an Electronic Monitor. Out of the 100 patients – 50 patients were controls and 50 patients were tests. The findings of the two were compared and the conclusions were drawn about the Electronic fetal monitoring and the neonatal outcome.

100 patients in antenatal period or labour with or without risk factors. These will include 50 normal tracings and 50 patients with tracings suggestive of fetal compromise i.e. Nonreassuring/Ominous patterns. Twin Pregnancy, congenital Malformation detected on USG, period of gestation <34 weeks were excluded.

EFM was carried out using a cardiotocography (CTG) machine Delivery conducted was either by vaginal route, instrumental or by caesarean section depending upon the fetal heart rate tracings and their interpretations as per the case. At the time of delivery umbilical cord blood was taken for the pH analysis. All new born babies were seen by the paediatrician immediately after the delivery and 1 and 5 minute APGAR score assessed for the delivered baby. Babies having low APGAR score or any other complication as per Paediatrician's advise were admitted in NICU. Once the condition improved they were discharged from the NICU.

Statistical analysis

The various EFM Patterns obtained were compared with the neonatal status at birth using the parameters already mentioned. The false positives and false negatives if any were tabulated. Data so obtained was analyzed statistically. Statistical Package for Social Sciences (SPSS) Version 13.0 was used for the purpose of analysis.

RESULTS

Results of the study indicate that total 100 subjects were recruited in the study duration. Among the 100 subjects, 50 subjects were recruited in the control group and 50 subjects were recruited in the case group.

Table 1 shows the results of various parameters between the cases and controls during the study, the 07 patients showed the absence of beat to beat variability,12 patients showed early deceleration, 32 patients showed variable deceleration and 06 patients had variable deceleration in the case group.

According to Table 2 ,Out of 93 subjects (50 controls and 43 cases) who had beat to beat variability, 18 neonates had APGAR score <7 at 1 min, 20 had APGAR score <9 at 5 min, 11 neonates had NICU requirement, 46 had instrumental/LSCS delivery, 22 neonates had MSL Out of 7 subjects (all cases) who had no beat to beat variability, 2 neonates had APGAR score <7 at 1 min, none had APGAR score <9 at 5 min, no neonate had NICU requirement, 2 had instrumental /LSCS delivery, 2 neonates had MSL Two cases out of seven with absence of beat to beat variability had instrumental/ cesarean delivery. There was no association of absence of beat to beat variability with type of delivery (p=0.439). meconium staining/NICU admissions/low APGAR score (p>0.05).

Table 1: Comparison of parameters between cases and controls.

Parameters	Cases (n=50)	Controls (n=50	Total (n=100)
Absence of beat to beat variability	07	00	07
Early deceleration	12	00	12
Late deceleration	32	00	32
Variable deceleration	06	00	06
Meconium stained liquor	22	02	24
LSCS	26	11	37
Vacuum delivery	08	03	11
Vaginal delivery	16	36	52
APGAR score ≤7 at 1 minute	16	04	20
APGAR score ≤9 at 5 minute	07	13	20
NICU admission	07	04	11

Table 2: Association of beat to beat variability with other variables (n=100).

Variable	b to b variability		P*
	Absent (n=7) (Case-7)	Present (n=93) (Case-43, control-50)	
APGAR <7 at 1 min	2	18	0.625
APGAR <9 at 5 min	0	20	0.339
NICU requirement	0	11	1.000
Instrumental/LSCS	2	46	0.439
MSL	2	22	0.672

According to Table 3, Out of 12 subjects (all cases) who had early deceleration, 2 neonates had APGAR score <7 at 1 min, 2 had APGAR score <9 at 5 min, 2 neonates had NICU requirement, none had instrumental /LSCS delivery, 2 neonates had MSL. Out of 88 subjects (38 cases, 50 controls) who had early deceleration, 18 neonates had APGAR score <7 at 1 min, 18 had neonates had APGAR score <9 at 5 min, 9 neonates had NICU requirement, 48 had instrumental/ LSCS delivery, 2 neonates had MSL. Early deceleration was found to be present in 12 patients. However, it was seen associated

with only 2/12 (16.67%) cases of APGAR <7 at 1 min. All twelve cases delivered vaginally showing a Fisher extract of 0.000 which is statistically significant. For other variables, no statistically significant difference was seen.

Table 03: Association of early deceleration with other variables (n=100).

Variable	Early deceleration		P*
	Absent (n=88) (Cases-38, Control-50)	Present (n=12) (Cases-12)	
APGAR <7 at 1 min	18	2	1.000
APGAR <9 at 5 min	18	2	1.000
NICU requirement	9	2	0.618
Instrumental/ LSCS	48	0	0.000
MSL	22	2	0.725

Table 4: Association of severe variable deceleration with other variables (n=100).

Variable	Severe variable deceleration		P*
	Absent (n=94) (Case-44, Control-50)	Present (n=6) (Case-6)	
APGAR <7 at 1 min	18	2	0.597
APGAR <9 at 5 min	19	1	1.000
NICU requirement	10	1	0.513
Instrumental /LSCS	46	2	0.679
MSL	23	1	1.000

According to Table 4, Out of 6 subjects (all cases) who had severe variable deceleration, 2 neonates had APGAR score <7 at 1 min, 1 had APGAR score <9 at 5 min, 1 neonate had NICU requirement, 2 had instrumental /LSCS delivery, 1 neonate had MSL Out of 94 subjects (44 cases,50 controls) who had severe variable deceleration, 18 neonates had APGAR score <7 at 1 min, 19 had neonates had APGAR score <9 at 5 min, 10 neonates had NICU requirement, 46 had instrumental/ LSCS delivery, 23 neonates had MSL 4/6 cases (66.67%) with severe variable deceleration had a vaginal delivery. 1/6 cases (16.67%) had NICU admission and meconium staining. There was no stastically significant association between severe variable deceleration with APGAR score, NICU requirement, instrumental/LSCS delivery, MSL.

According to Table 5, out of 32 subjects (all cases) who had persistent late deceleration, 12 neonates had APGAR score <7 at 1 min, 4 had APGAR score <9 at 5 min, 4 neonates had NICU requirement, all 32 had instrumental/ LSCS delivery, 19 neonates had MSL.

Table 5: Association of persistent late deceleration with other variables (n=100).

Variable	Persistent late deceleration		P*
	Absent (n=68) (Case-18, Control-50)	Present (n=32) (Case-32)	
APGAR <7 at 1 min	8	12	0.006
APGAR <9 at 5 min	16	4	0.285
NICU requirement	7	4	0.741
Instrumental /LSCS	16	32	0.000
MSL	5	19	0.000

Out of 68 subjects (18 cases, 50 controls) who did not have late deceleration, 8 neonates had APGAR score <7 at 1 min, 16 neonates had APGAR score <9 at 5 min, 7 neonates had NICU requirement, 16 had instrumental/ LSCS delivery, 5 neonates had MSL. A significant positive association between persistent late deceleration with MSL, APGAR <7 at 1 min, and Instrumental/LSCS delivery was seen. As immediate instrumental/LSCS delivery was conducted in all of them, significant negative association between persistent late deceleration and, APGAR <9 at 5 min and NICU admission was seen.

Table 6: Association of any CTG abnormality with other variables (n=100).

Variable	CTG Abnormality		P*
	Absent (n=50) (Control)	Present (n=50) (Case-50)	
APGAR <7 at 1 min	4	16	0.005
APGAR <9 at 5 min	13	7	0.211
NICU requirement	4	7	0.525
Instrumental/LSCS	14	34	0.000
Thin MSL	2	22	0.000

According to Table 6, out of 50 cases with any of the CTG abnormality, 16 neonates had APGAR score <7 at 1 min, 7 had APGAR score <9 at 5 min, 7 neonates had NICU requirement, all 34 had instrumental/ LSCS delivery, 22 neonates had MSL. Out of 50 controls who did not have any CTG abnormality, 4 neonates had APGAR score <7 at 1 min, 13 neonates had APGAR score <9 at 5 min, 4 neonates had NICU requirement, 14 had instrumental/ LSCS delivery, 2 neonates had MSL. A significant positive association between any CTG abnormality and APGAR at 1 min, type of delivery, and

meconium staining was seen. It was seen that patients with abnormal CTG findings had significantly higher incidence of complications and instrumental delivery.

DISCUSSION

Electronic fetal Heart rate monitoring is commonly used to assess fetal well-being during labour. In the present study, we have correlated the electronic fetal monitoring (beat to beat variability, early decelerations, persistent variable deceleration, persistent late deceleration) with neonatal outcome under following heading: APGAR score, meconium staining, NICU admissions and mode of delivery.

In present study 7 patients had absent beat to beat variability out of which only two underwent instrumental/LSCS but 46 out of 93 patients with beat to beat variability underwent instrumental/LSCS deliveries, giving less significance to this parameter of electronic fetal monitoring. The results of our study were similar to Keith et al.[5] who concluded in their study that the most significant factor indicating the need for urgent operative delivery was fetal bradycardia and decreased variability for up to 1 hour before the bradycardia and urgent delivery should be considered in any clinical scenario in which the FHR shows evidence of a bradycardia with prior decreased variability.

In present study, not much significant was given to the presence of early decelerations in the CTG tracings. Early decelerations were not associated with instrument/LSCS/Vacuum delivery. There was no significant association with low APGAR or NICU admissions. The results of our study were comparable to Cibils et al.[6] where they studied in a population of high risk patients who had continuous direct monitoring during labor. The clinical characteristics, the fetal heart rate baseline alterations and neonatal outcome were compared between these two groups: there were no differences in any of the aspects evaluated, except that there was transient tachycardia more often among the early deceleration group.

In this study patient 66.67% cases showing severe variable decelerations in the CTG tracings had a vaginal delivery which is different from the study conducted by Ozden et al where they determined the clinical significance of the existence of poor prognostic features in fetal heart rate traces with variable decelerations.[7]

In present study patient showing persistent late decelerations in the CTG tracings had a significantly higher incidence of instrument/LSCS delivery, low APGAR score at 1 min, higher incidence of meconium stained liquor. Our study findings are similar to those of Low et al, whose group analysed the correlation between selected FHRs and showed that the FHR tracings had a narrow 1-hour window of opportunity in which minimal baseline variability and late or prolonged decelerations predict fetal asphyxia/acidosis.[8] They also had significant increase in reduced APGAR scores. Saldana LR et al in their study found that late decelerations showed a significant correlation with depressed infants and increased NICU admission rate but in our study, NICU admissions were less as we did immediate cesarean section / instrumental delivery in all cases.[9]

Present study was similar to the study conducted by Steer PJ who concluded that electronic fetal monitoring has significantly reduced the incidence of birth asphyxia but the rate of cesarean section has increased.[10] We concluded that continuous electronic fetal monitoring was beneficial in improving the fetal outcomes, but has led to an increase in cesarean / instrumental deliveries.

CONCLUSION

For the majority of the labouring women who display Non-reassuring patterns present study indicates that the EFM will lead a clinician only if he or she is familiar with its limitations and applies it appropriately viewing the patient in totality. Maintaining a relatively low threshold for caesarean section in cases showing non-reassuring patterns, who in addition also have severe preeclampsia, diabetes mellitus, IUGR, meconium stained liquor or previous history of unexplained intrapartum fetal demise, may help avoiding adverse fetal out come at the cost of increased rate of caesarean sections. On the other hand, it will mislead those clinicians who maintain the same readiness to section a mother in absence of other associated high risk factors mentioned earlier. Hence, the obstetrician's clinical discretion is of paramount importance to put EFM to effective use.

EFM should be used judiciously. Cardiotocography machines are certainly required in the labour room. Equally important is the proper interpretation of the CTG tracings so that unjustified caesarean sections can be minimized, at the same time picking up cases of fetal distress in time which is likely to improve fetal outcome.

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REFERENCES

1. Martin CB Jr. Physiology and clinical use of fetal heart rate variability. Clin Perinatol. 1982;9:339-52.
2. Cibils LA. Clinical significance of fetal heart rate patterns during labor. II. Late decelerations. Am J Obstet Gynecol. 1975;123:473-94.
3. Kubli FW, Hon EH, Khazin AF, Takemura H. Observations on heart rate and pH in the human fetus during labor. Am J Obstet Gynecol. 1969;104:1190-206.

4. Alfirevic Z. Thirteen trials to compare continuous CTG monitoring with intermittent auscultation, Cochrane review 2013.
5. Williams KP, Galerneau F. Fetal heart rate parameters predictive of neonatal outcome in the presence of a prolonged deceleration. Obstet Gynecol. 2002;100(5):951-4.
6. Cibils LA. Clinical significance of fetal heart rate patterns during labor. VI. Early decelerations. Am J Obstet Gynecol. 1980;136(3):392-8.
7. Ozden S, Demirci F. Significance for fetal outcome of poor prognostic features in fetal heart rate traces with variable decelerations. Arch Gynecol Obstet. 1999;262(3-4):141-9.
8. Low JA, Victory R, Derrick EJ. Predictive value of electronic fetal monitoring for intrapartum fetal asphyxia with metabolic acidosis. Obstet Gynecol. 1999;93:285-91.
9. Saldana LR, Schulman H, Yang WH. Electronic fetal monitoring during labor. Obstet Gynecol. 1976;47(6):706-10.
10. Steer PJ. Has electronic fetal heart rate monitoring made a difference. Semin Fetal Neonatal Med. 2008;13(1):2-7.

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