ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 14, Issue, 04, pp.21315-21320, April, 2022

DOI: https://doi.org/10.24941/ijcr.43414.04.2022

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

CORRELATION OF ELECTRONIC-FETAL MONITORING WITH NEONATAL OUTCOME IN A TERTIARY CARE HOSPITAL

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ARTICLE INFO

Article History:

Received 19th January, 2022
Received in revised form
20th February, 2022
Accepted 09th March, 2022
Published online 30th April, 2022

Key words:

Electronic Fetal Monitoring,
Beat to Beat variability,
Cardiotocography.

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ABSTRACT

Background: Fetal monitoring during labour has been known as the most important tool in clinical practice. The stress of uterine contractions may affect the fetus adversely especially if the fetus is already compromised. 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. . EFM is defined as use of electronic monitoring of the fetal heart to ensure well being of the fetus during labour **Methods:** This study is a prospective observational study of 100 patients presenting to antenatal OPD and to Labour room at >34 weeks period of gestation and was performed over a period of two years . Delivery conducted was either by vaginal route, instrumental or by caesarean section depending upon the foetal 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 paeditrician 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 Pediatricians advice were admitted in NICU. 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, 03 subjects showed the absence of the beat to beat variability, 24 subjects showed early deceleration, 07 subjects showed late deceleration, and 20 subjects showed the presence of variable deceleration. There is a significant association between absent beat to beat variability and mode of delivery and low Ph. In parturients showing early deceleration the incidence of low pH was significantly higher whereas there is no association with remaining parameters. Variable and late deceleration showed a significant association with all the parameters. **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.

Citation: Dr. Gaurav Mukhija, Paediatrician, Dr. Yashika Bhatia and Dr. Sunil Chawla. 2022. "Correlation of Electronic-fetal monitoring with neonatal outcome in a tertiary care hospital", *International Journal of Current Research*, 14, (04), 21315-21320.

INTRODUCTION

Fetal monitoring during labour has been known as the most important tool in clinical practice. Unlike ante-natal period, where DFMC (Daily fetal movement count), NST (Non stress test) or BPP (Biophysical Profile) may be used as markers of fetal well being, natal period still relies on intermittent auscultation or continuous EFM (Electronic Fetal Monitoring). These modalities in intra-partum rely on fetal heart monitoring either on auscultation of fetal heart sounds using a stethoscope or use of Doppler.

This further benefitted in judicious use of oxytocin in clinical practice where indicated, to minimise the stress induced by uterine contractions which may adversely affect the fetus especially if already compromised. EFM is defined as use of electronic monitoring of the fetal heart to ensure well being of the fetus during labour. The concept of EFM during labour was pioneered by Edward Hon in late 1950s when it was used intermittently while the continuous electronic fetal monitoring came in vogue in late 1960s. With the concept coming into practice, it established as an inevitable tool in reducing

Perinatal morbidity and mortality by ensuring optimum fetal outcomes. In the following years, the intrapartum use of EFM increased rapidly and fetal monitor was overwhelmingly accepted, but physicians have not fully grasped the knowledge to interpret the monitor's data. The clinician responds in various ways when the meaning of information supplied by the fetal monitor is unclear. One of the more common responses is to take advantage of the increased safety of cesarean sections, thereby cutting ones way through dilemma. Moreover, the expectation was that EFM would reduce hypoxia – induced intrapartum Perinatal mortality. This has not occurred and the role of EFM in labour has been questioned. The present study is therefore taken which aims to correlate the EFM to neonatal outcome.[1,2,3]

MATERIALS AND METHODS

This study is 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 Jan 2019 to Dec 2020. Our study was carried out at Command Hospital Udhampur. Study included 100 patients of more than 34 weeks period of gestation and were admitted in the hospital for any high risk factor or for the delivery.In our study 100 Patients in labour were analyzed on an Electronic Monitor. The conclusions were drawn correlating their Electronic fetal monitoring results and the neonatal outcome achieved. The inclusion criteria :100 Patients in antenatal period or labour with or without risk factors. These will include the patients with normal tracings and the Patients with tracings suggestive of foetal compromise ie. Nonreassuring/ Ominous patterns.

The exclusion criteria:

- Twin Pregnancy
- Congenital Malformation detected on USG
- Period of gestation < 34 weeks.

The EFM was carried out using a cardiotocography (CTG) machine where one probe is meant to pick up continuous tracing of FHR and the other one is for monitoring the uterine contractions. During normal labour at least three contractions greater than 25 mm of Hg occur every ten minutes.

Four components of the tracing were identified:

- Baseline heart rate
- Beat to Beat variability
- Periods of speeding up or accelerations, generally a sign of fetal health
- Periods of slowing down or decelerations

FHR decelerations were termed as early, late or variable depending on their relation to the uterine contractions. Early deceleration began with the onset of uterine contraction recovering to the baseline by the end of the contraction. They were due to head compression and never associated with fetal hypoxia or acidemia. Late decelerations began at or after the peak of contraction and returned to normal only after the contraction had passed off. They may be associated with uteroplacental insufficiency. The onset of variable decelerations varies with successive contractions and are often associated with cord compression.

Delivery conducted was either by vaginal route, instrumental or by caesarean section depending upon the foetal 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 paeditrician 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 Pediatricians advice were admitted in NICU. Once the condition improved they were discharged from the NICU. The various EFM Patterns obtained were compared with the neonatal status at birth using the parameters already mentioned. The false positives & false negatives if any were tabulated. Data so obtained was analyzed statistically thereafter.

For the present analysis, the outcome variables have been taken as:

- Mode of delivery (Vaginal vs Vacuum, Instrument or LSCS)
- MSL (Nil, Thin or Thick)
- Apgar Score at 1 min (>7 or<7)
- Apgar Score at 5 min (>7 or<7)
- *NICU Admission*

For the purpose of univariate analysis chi-square test for proportions had been performed. Fisher exact test had been employed wherever the expected value of a cell was less than 5. Statistical Package for Social Sciences (SPSS) Version 13.0 was used for the purpose of analysis. If some significant association between outcome and test variables was found then we also did multivariate regression analysis.

OBSERVATION AND RESULT

The results were tabulated under following heading:

- Beat to beat variability
- Early deceleration
- Severe variable deceleration
- Persistent late deceleration.

Beat to Beat Variability: All the three cases with beat to beat variability absent were abnormal deliveries and had pH below 7.25, showing a statistically significant association of absent beat to beat variability with mode of delivery (p=0.008) and low Ph (p=0.004; Fisher Exact=0.018). There is no significant association of beat to beat variability with Apgar score at 1 minute, Apgar score at 5 minutes, requirement of NICU admission and meconium stained liquor (Table 1 to 6).

Table 1: b to b var * Mode of delivery

		Mode of delivery		Total
		Normal	Instrument/LSCS/Vacuum	
b to b var	Present	79	18	97
	Absent	0	3	3
Total		79	21	100

$\chi 2=11.635$ (df=1); p=0.001 (Fisher exact test, p=0.008)

Table 2: b to b var * APGAR at 1 min

		APGAR at 1 min		Total
		>=7	<7	
b to b var	present	77	20	97
	Absent	1	2	3
Total		78	22	100

$\chi 2=3.596$ (df=1); p=0.058 (Fisher exact test, p=0.121)

Table 3. b to b var * APGAR at 5 min

		APGAR at 5 min		Total
		>=9	<9	
b to b var	Present	90	7	97
	Absent	3	0	3
Total		93	7	100

$\chi2$=0.233 (df= 1); p=0.629 (Fisher exact test, p=0.803)

Table 4: b to b var * NICU

		NICU		Total
		Not required	NICU Required	
b to b var	Present	88	9	97
	Absent	3	0	3
Total		91	9	100

$\chi2$=0.580 (df= 1); p=0.580 (Fisher exact test, p=0.751)

Table 5: b to b var * MSL

		MSL			Total
		nil	thick	Thin	
b to b var	Present	80	1	16	97
	Absent	1	0	2	3
Total		81	1	18	100

$\chi2$=4.968 (df= 2); p=0.083

Table 6: b to b var * low pH

		pH		Total
		>7.25	<7.25	
b to b var	Present	73	24	97
	absent	0	3	3
Total		73	27	100

$\chi2$=8.362 (df= 1); p=0.004 (Fisher Exact = 0.018)

Early Deceleration: In parturients showing early deceleration the incidence of low pH was significantly higher as compared to remaining parturients (p=0.018) whereas there is no association with remaining parameters (mode of delivery, APGAR1, APGAR5 and MSL). No association of early deceleration with Meconium stained liquour could be seen (p=0.301). (Table 7 to 12)

Early Deceleration:

Table 7. early decel * Mode of delivery

		Mode of delivery		Total
		Normal	Instrument/LSCS/Vacuum	
early decel	Absent	56	20	76
	Present	23	1	24
Total		79	21	100

$\chi2$=5.394 (df= 1); p=0.020 (Fisher exact test, p=0.014)

Table 8. Early decel * APGAR at 1 min

		APGAR at 1 min		Total
		>=7	<7	
early decel	Absent	55	21	76
	Present	23	1	24
Total		78	22	100

$\chi2$=5.853 (df= 1); p=0.016 (Fisher exact test, p=0.011)

Table 9. Early decel * APGAR at 5 min

		APGAR at 5 min		Total
		>=9	<9	
early decel	Absent	69	7	76
	Present	24	0	24
Total		93	7	100

$\chi2$=2.377 (df= 1); p=0.123 (Fisher exact test, p=0.137)

Table 10. Early decel * NICU

		NICU		Total
		Not required	NICU Required	
Early decel	Absent	67	9	76
	Present	24	0	24
Total		91	9	100

$\chi2$=3.123 (df= 1); p=0.077 (Fisher exact test, p=0.075)

Table 11. Early decel * MSL

		MSL			Total
		nil	thick	Thin	
Early decel	Absent	59	1	16	76
	Present	22	0	2	24
Total		81	1	18	100

χ^2=2.399 (df=2); p=0.301

Table 12. Early decel * pH

		pH		Total
		>7.25	<7.25	
Early decel	Absent	51	25	76
	Present	22	2	24
Total		73	27	100

χ^2=5.583 (df=1); p=0.018 (Fisher Exact=0.013)

Severe Variable deceleration: Parturients showing severe v deceleration had a significantly higher incidence of instrument/LSCS/vacuum delivery as compared to others (p<0.001). The neonates had low Apgar score (<7) at 1 minute (p<0.001) and at 5 minute (p<0.001) (Fisher Exact=0.003). There is a significant association between severe v deceleration and NICU admission (<9) (p=0.005) (Fisher Exact=0.015), MSL (p<0.001) and low pH (p<0.001). (Table 13-18)

Severe Variable decelerations

Table 13. Severe v decel * Mode of delivery

		Mode of delivery		Total
		Normal	Instrument/LSCS/Vacuum	
Severe v decal	Absent	73	7	80
	Present	6	14	20
Total		79	21	100

χ^2=36.181 (df=1); p<0.001

Table 14. Severe v decel * APGAR at 1 min

		APGAR at 1 min		Total
		>=7	<7	
Serere v decel	Absent	74	6	80
	Present	4	16	20
Total		78	22	100

χ^2=49.01 (df=1); p<0.001

Table 15. Severe v decel * APGAR at 5 min

		APGAR at 5 min		Total
		>=9	<9	
Serere v decel	Absent	78	2	80
	Present	15	5	20
Total		93	7	100

χ^2=12.442 (df=1); p<0.001(Fisher Exact=0.003)

Table 16: severe v decel * NICU

		NICU		Total
		Not required	NICU Required	
Severe v decel	Absent	76	4	80
	Present	15	5	20
Total		91	9	100

$\chi2$=7.814 (df= 1); p=0.005 (Fisher Exact=0.015)

Table 17. Severe v dec * MSL

		MSL			
		nil	thick	Thin	Total
severe v dec	Absent	73	0	7	80
	Present	8	1	11	20
Total		81	1	18	100

$\chi 2=28.202$ (df=2); $p<0.001$

Table 18. Severe v decal * pH

		pH		Total
		>7.25	<7.25	
severe v dec	Absent	69	11	80
	Present	4	16	20
Total		73	27	100

$\chi 2=35.629$ (df=1); $p<0.001$

Persistant late decelerations: There is a significantly higher incidence (100%) of complicated delivery ($p<0.001$) and Apgar score <7 at 1 minute ($p=0.020$) (Fisher exact=0.040) in parturients showing pers late deceleration. They also have increased incidence of NICU admission, meconium stained liquour ($p<0.001$) and low pH ($p<0.001$). Parturients showing pers late deceleration had a significantly higher incidence of neonates with Apgar score <9 at 5 minute ($p=0.020$). However, subsequent Fisher Exact Test analysis revealed the difference to be non-significant ($p=0.075$) (Table 19-24)

Persistant late decelerations:

Table 19: pers late decel * Mode of delivery

		Mode of delivery		Total
		Normal	Instrument/LSCS/Vacuum	
Pers late decel	Absent	79	14	93
	Present	0	7	7
Total		79	21	100

$\chi 2=28.315$ (df=1); $p<0.001$

Table 20. Pers late decel * APGAR at 1 min

		APGAR at 1min		
		>=7	<7	Total
Pers late decel	Absent	75	18	93
	Present	3	4	7
Total		78	22	100

$\chi 2=5.417$ (df=1); $p=0.020$ (Fisher exact=0.040)

Table 21. Pers late decel * APGAR at 5 min

		APGAR at 5min		
		>=9	<9	Total
Pers late decel	Absent	88	5	93
	Present	5	2	7
Total		93	7	100

$\chi 2=5.380$ (df=1); $p=0.020$ (Fisher exact=0.075)

Table 22. Pers late decel * NICU

		NICU		
		Not required	NICU Required	Total
Pers late decel	Absent	88	5	93
	Present	3	4	7
Total		91	9	100

$\chi 2=21.301$ (df=1); $p<0.001$ (Fisher exact=0.001)

Table 23. Pers late decel * MSL

		MSL			
		nil	thick	Thin	Total
Pers late decel	Absent	78	1	14	93
	Present	3	0	4	7
Total		81	1	18	100

$\chi 2=7.834$ (df=1); $p=0.020$

Table 24. Pers late decel * ph

		ph		total
		>7.25	<7.25	
pers late decel	absent	73	20	93
	present	0	7	7
total		73	27	100

$\chi 2=20.350$ (df=1); $p<0.001$

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 foetal 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
- Mode of delivery
- Umbilical cord pH at birth

We will be discussing the results of our study with previous other studies on electronic fetal monitoring and neonatal outcome.

Beat to beat variability: In our study 3 patients had beat to beat variability and underwent instrumental/ LSCS but there were 18 false positives giving less significance to this parameter of electronic foetal monitoring. The results of our study were similar to Keith et al[4] who concluded in their study that the most significant factor indicating the need for urgent operative delivery with a fetal bradycardia is decreased variability for upto 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. Moreover there were 3 patients showing beat to beat variability less than 5 and had Ph below 7.25 showing a statistically significant association between the two. Gilstrapet al[5] identified a group of infants and assessed baseline variability for 10 minutes before delivery. He identified that the lack of FHR baseline variability before delivery was associated with a 1.5 to three fold increase in the incidence of acidosis in patients with a concomitant FHR bradycardia.Our study differs from theirs as we used continuous FHR monitoring before delivery to assess variability. Piquard et al[6] reviewed a multiple category classification of the second stage of labour and came to the conclusion supported by our study that decreased baseline beat to beat variability is significant component in any intrapartum FHR evaluation. Fleisher et al[7] demonstrated that the time taken for acidosis to develop in 50% of infants depending upon decreased baseline variability was 185 minutes.They used a Ph of 7.25 to define acidosis which was similar to our study.

In another study Spencer and Johnson[8] studied 301 consecutive FHR in beat to beat variability and outcomes in terms of Apgar scores at 1 and 5 minutes. No significant difference was noticed which was unlike our study.

Early Deceleration: In our study not much significant associations were seen 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 low Ph or NICU admissions. The results of our study were comparable to Cibil set al[9] where they studied in a population of high risk patients who had continuous direct monitoring during labor,598 had no decelerations during the first stage, while 247 had presented with early decelerations before the completion of dilatation. 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.

Severe Variable Deceleration: In our study patient showing severe variable decelerations in the CTG tracings had a significantly higher incidence instrument/LSCS/Vacuum delivery, low Apgar score at 1 and 5 minute, higher incidence of NICU admissions and meconium stained liquor. They also had a significantly higher incidence of low Ph. The results were similar to Ozdenet al[10] where they determined the clinical significance of the existence of poor prognostic features in fetal heart rate traces with variable decelerations. Fetal and neonatal outcomes were compared in the normal and variable deceleration group. There were statistically significant differences between the groups in 1 and 5 minute Apgar scores, fetal heart rate and umbilical artery blood ph. In another study Gazianoet al[11] found no differences in Apgar score distribution in the presence of uncomplicated variable deceleration pattern when compared to those tracings marked normal. However, the presence of variable decelerations in association with other heart rate patterns resulted in lower mean Apgar scores at 1 and 5 minutes, which were significantly different from those of the fetal heart rate normal group. Similar results were also seen in study conducted by Cibil set al[9].

Persistent Late Decelerations: In our study patient showing persistent late decelerations in the CTG tracings had a significantly higher incidence instrument/LSCS/Vacuum delivery, low Apgar score at 1 and 5 minute, higher incidence of NICU admissions and meconium stained liquor. They also had a significantly higher incidence of low Ph. Our study findings are similar to those of Low et al[12] , 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. Fleisher et al[7] demonstrated previously that the time taken for acidosis to develop in 50% of infants, depending on the different FHR pattern, was 115 minutes for late decelerations.

SUMMARY AND CONCLUSION

Electronic foetal monitoring is an essential clinical tool for the assessment of foetalwell being in Labour and should be used judiciously with a systematic approach in interpreting the patterns of foetal heart rate tracings. Although detection of foetal compromise is one benefit of foetal monitoring, the major risk associated with electronic foetal heart rate monitoring is a false positive test that may result in unnecessary surgical intervention. For the majority of the labouring women who display "Non Reassuring patterns" our 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 intrapartumfoetal demise, may help avoiding adverse fetal out come at the cost of only a marginally 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. Hence, cardiotocography machines are certainly required in the labourroom. 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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