A Prospective Cohort Study Describing The Neonatal Outcomes Of Patients With Different Categories Of Intrapartal Traces Among Pregnant Women Delivered In A Tertiary Hospital*

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ABSTRACT

Background: Continuous electronic fetal monitoring has been under close scrutiny due to lack of consistent interpretation of fetal heart rate tracings, even by perinatologists. In 2008, NICHD revised their definitions, interpretation and research guidelines. ACOG incorporated these guidelines into a 2009 practice bulletin on EFM definitions and the three-tiered fetal heart rate interpretation. After a year of adapting the new classification, the Department of Obstetrics and Gynecology of tertiary hospitals has yet to evaluate locally its use in fetal surveillance during labor and subsequently its value in decision-making. To date, no local study has been published regarding the neonatal outcome of those women whose intrapratal tracings were categorized under the three-tier system.

Objectives: This study aimed to describe the neonatal outcomes of patients with Category I, II, and III traces among pregnant patients admitted in a tertiary hospital. This included APGAR score and disposition of the neonate as primary outcomes.

Methods: This was a prospective cohort study. It was conducted in a tertiary hospital from December 2012 to July 2013. The population consisted of women admitted in the labor room for delivery and underwent intrapartal monitoring and eventually delivered. Inclusions were term or preterm pregnancy ≥ 34 weeks, singleton pregnancy with no known congenital or lethal fetal anomalies. Exclusions were women with clinically evident chorioamnionitis on admission, multifetal gestations, preterm pregnancy (less than 34 weeks), post-term pregnancy, women who were mentally incapacitated to give consent, and those for outright cesarean section indications. There was no specified number of subjects but all laboring patients who underwent trial of labor in were included. Data was analyzed using descriptive analysis and z-test for proportion. And these data were held confidential. Reading and interpretation of the traces was made by perinatologist fellow on duty. Neonatal outcomes, on the one hand, including the APGAR score were analyzed by pediatrician on duty.

Results: There were a total of 163 subjects included in the study, with age range of 19-33 years old. Subjects were G1P0 to G9P6, with a mean prenatal check-up of 5 times. Among the 163 subjects, 134 had a Category I trace and 17 had Category II traces all throughout their laboring period, and the remainder had combination of category I and II traces. There was no Category III trace observed. For Category I trace, 97.8% of babies had a one minute APGAR score of 7-9, 1.5% had a one minute APGAR score of 4-6, and 0.7% had a one minute APGAR score of 1-3. The five-minute APGAR score with Category I trace were as follows: 99.3% had APGAR score of 7-9, 0.7% had APGAR score of 4-6, but there was none with a five-minute APGAR score of 1-3. Majority (63.4%) of the babies in Category I were direct room-in, 14.9 % were high-risk direct room-in, 10.4% babies were admitted in Neonatal Intensive Care Unit 2 (NICU2) and 11.2% in NICU3. Three (2.2%) of the babies in NICU3 were intubated. For the Category II trace, 100% of babies had one and five minute APGAR score of 7-9. Thirteen (54.2%) of the babies were direct-room in. 37.5% of the babies were admitted in NICU2. One baby (4.2%) was admitted in NICU3 but not intubated. The resuscitative measures done were as follows: tactile stimulation, thermoregulation, suctioning, inhalation, and intubation. Among these measures, suctioning (with a p-value of .02) showed a significant difference between Category I and Category II traces. Category II traces were associated more with abdominal delivery. Spinal anesthesia which was usually used in abdominal deliveries is also significantly different from the two traces, with a p-value of 0.02. Category I traces had a significantly higher morbidity and mortality compared to Category II traces.

Conclusion: There was no significant difference between the one-minute and five-minute APGAR score and disposition of babies be¬tween Category I and Category II traces. Abdominal delivery, spinal anesthesia and suctioning were higher in Category II trace than in Category I trace.

Keywords: Intrapartal monitoring; Category I trace; Category II trace; Category III trace

INTRODUCTION

Continuous electronic monitoring has been under close scrutiny due to the lack of consistent interpretation of fetal heart rate tracings, even by perinatologists.

The National Institute of Child Health and Human Development (NICHD) in 1997 developed guidelines to "… allow identification of fetal asphyxia so that timely intervention can avoid brain damage or death." NICHD added "a major impediment is lack of agreement in definitions and nomenclature of FHR patterns."

In 2008 NICHD revised their definitions, interpretation and research guidelines. NICHD reviewed the fetal

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monitoring approach used in the United Kingdom and Sweden, as well as the work of Parer. ACOG incorporated these guidelines into a 2009 practice bulletin on electronic fetal monitoring definitions and the three-tiered fetal heart rate interpretation system (Practice Bulletin No 106). In 2010 ACOG released a second practice bulletin on management of intrapartum fetal heart tracings based on the three-tier category system and management of uterine tachysystole (Practice Bulletin No 116). ACOG describes FHR tracings as visual patterns that should be adaptable to computerized interpretation and that definitions should be applied to intrapartum tracings but also can be used for antepartum FHR tracings. The Philippine Obstetrical and Gynecological Society (Foundation), Inc. has already adopted this guidelines.[1]

The rationale for monitoring fetal heart rate (FHR) is that fetal heart rate patterns are indirect markers of the fetal cardiac and medullary responses to blood volume changes, acidemia, and hypoxemia, since the brain modulates heart rate. The primary goal of FHR monitoring is to identify hypoxemic and acidotic fetuses in whom timely intervention will prevent death. A secondary goal is to avoid fetal neurologic injury if possible. If the FHR and pattern are normal, it is usually certain that the fetus is not suffering hypoxia, acidemia or other causes of distress.[2] EFM is used to detect fetal heart rate patterns that reflect significant hypoxia and allow intervention before fetal injury.[3]

The use of intrapartum EFM is widespread, with 89% of singleton pregnancies monitored in 2004.[4] Initial studies demonstrated the significance of EFM in reducing intrapartum mortality and detecting fetal acidemia when compared with intermittent auscultation but also showed an increase in cesarean and operative vaginal deliveries.[5] Intrapartum fetal asphyxia is an important cause of stillbirth and neonatal death. Some neonates with intrauterine hypoxia require resuscitation and other aggressive medical interventions for such complications as acidosis and seizures. Asphyxia has also been implicated as a cause of cerebral palsy, although most cases of cerebral palsy occur in persons without evidence of birth asphyxia or other intrapartum events. Most fetuses tolerate intrauterine hypoxia during labor and are delivered without complications. The positive predictive value of a nonreassuring pattern to predict cerebral palsy in singleton newborns with birthweight of 2.5 kilograms or more is 0.04%. The false positive rate is greater than 99%.[6] EFM remains the gold standard method for fetal surveillance in labor and there is a common belief that a normal reactive, accelerative and not decelerative EFM pattern is suggestive of a reassuring fetal status. Similarly, the tracings characterized by absent variability with persistent late deceleration and/or prolonged decelerations represent an ominous sign, potentially associated with adverse perinatal outcome.[7] Continuous EFM has resulted in an increased use of cesarean delivery, however, the incidence of perinatal mortality and cerebral palsy has not fallen, and a decrease in neonatal seizures is the only demonstrable benefit.[14]

Within the 3-tier system, Category I is characterized by a normal baseline fetal heart rate, moderate variability, the presence or absence of accelerations, and absence of decelerations. This category excludes fetal acidemia. Category III tracings predict current or impending fetal asphyxia with absent fetal heart rate variability in the presence of recurrent late or variable decelerations, bradycardia, or a sinusoidal pattern. The remainder and majority of FHR tracings that do not fit into Category I or III are classified as Category II, an intermediate category for which the recommendations are less clear. It is estimated that 80% of FHR tracings will fall into this category.[8]

Categorization of FHR tracings are for intrapartum use only. Category I FHR tracings are strongly predictive of normal fetal acid-base status at the time of observation. Category I FHR tracings may be monitored in a routine manner and no specific action is required. Category II traces are not predictive of abnormal fetal acid-base status, but requires continued surveillance and reevaluation. Various causes of Category II fetal heart tracings have been implicated such as the use of certain medications and maternal hypotension.

A category II tracing requires initial evaluation and treatment may include the following: discontinuation of any labor stimulating agent, cervical examination to determine umbilical cord prolapsed; rapid cervical dilatation, or descent of the fetal head; changing maternal position to left or right lateral recumbent position, reducing compression of the vena cava and improving uteroplacental blood flow; monitoring maternal blood pressure level for evidence of hypotension, especially in those with regional anesthesia and treatment with volume expansion or with ephedrine or both; and assessment of patient for uterine tachysystole by evaluating uterine contraction, frequency and duration. In some circumstances, either ancillary tests to ensure fetal well being or intrauterine resuscitative measures. Amnioinfusion is considered when FHR tracing include recurrent variable decelerations; this intervention is intended to relieve umbilical cord compression.[1] Such intrauterine resuscitative measure have been advocated to improve fetal oxygenation and improving uteroplacental blood flow.[9]

Category III tracings are associated with abnormal fetal acid-base status at the time of observation. Initial evaluation and treatment of Category III traces is similar to Category II traces.[9] Detection of abnormal fetal heart rate pattern warrants immediate intervention, usually through immediate cesarean section. If an emergency cesarean section is warranted, it should be started as quickly as possible,

ideally within 30 minutes. Only in a few instances would delivery have to be achieved much faster than 30 minutes to avoid disability or death because in most cases, delivery after 30 minutes is not associated with adverse fetal outcome.[10]

After a year of adapting the new classification, the Department of Obstetrics and Gynecology of the tertiary hospitals in the Philippines have yet to evaluate the use of the new classification system in fetal surveillance during labor and subsequently its value in decision-making. At present, the management guideline remains imprecise and vague, leaving the management of indeterminate tracings up to the clinician's judgment.[11]

OBJECTIVES

The general objective of this study was to describe the neonatal outcomes of patients with Category I, Category II, and Category III traces among patients admitted in a tertiary hospital. The specific objectives were as follows:

1. To describe the following primary outcomes:
   a. APGAR score
   b. Disposition – NICU admission or direct room in
2. To compare the following secondary outcomes:
   a. Resuscitative measures done for those neonates with poor outcomes
   b. Interval of delivery from the time the last trace was called
   c. Route of delivery of those with poor neonatal outcomes
   d. Type of anesthesia used for those with poor neonatal outcomes
   e. Neonatal weight
   f. Other neonatal outcomes:
      - death or serious outcome for the infant
      - seizures at <24 hours age or requiring two or more drugs to control

METHODS

STUDY DESIGN

This is a prospective cohort study, which analyzed the neonatal outcomes and other factors associated with the said outcomes. This study underwent technical and ethical review and was subsequently approved.

A. Patient population:

The study was conducted in a tertiary hospital from December 2012 to June 2013. The population consisted of women who were admitted to the labor room for delivery, and who underwent electronic fetal monitoring, and who eventually delivered either by abdominal route or vaginal route at this same institution. These included the following: term or preterm pregnancy ≥ 34 weeks, singleton pregnancy, with no known lethal fetal anomalies or congenital malformations. The exclusion criteria were as follows: women with clinically evident chorioamnionitis on admission, multifetal gestations, preterm pregnancy < 34 weeks, postterm pregnancy, women who were mentally incapacitated to give consent, women with indications for outright cesarean section during admission- e.g. placenta previa, uterine rupture, diagnosed dystocia upon admission or point dystocia, women delivered abdominally for indications other than fetal distress or dystocia.

B. Methodology:

There was no need for sample size computation. The sample size was based on the number of patients who meet the criteria. This sampling technique is known as purposive sampling.

C. Description of the study procedure:

For all patient meeting the inclusion criteria, the principal investigator introduced and discussed the details, goals and expectations of the research. Once they accepted and agreed to be a part of the investigation, they were asked to sign an informed consent. For every patient recruited into the study, the lead investigator and research assistant/s completed an information data form and checklist documenting the following:

1. Demographics: Name, age, address and contact details, height, weight, body mass index (BMI); patient's occupation, patient's income, husband/partner's occupation
2. History: Past medical and surgical history;
3. Labor: monitor the progress of labor including patient's vital signs and temperature throughout the labor until delivery.

D. Description of outcome measurements:

1. The following primary outcomes were compared:
   i. APGAR score
   ii. Disposition – NICU admission or direct room in
2. The following secondary outcomes were also compared:
   i. Resuscitative measures done for those neonates with poor outcomes
   ii. Interval of delivery from the time the last trace was called
   iii. Route of delivery of those with poor neonatal outcomes

iv. Type of anesthesia used for those with poor neonatal outcomes
v. Neonatal weight
vi. Other neonatal outcomes:
    - death or serious outcome for the infant
    - seizures at <24 hours age or requiring two or more drugs to control

E. Data Analysis

Data was analyzed using descriptive analysis and z-test for proportion.

RESULTS

There were a total of 163 subjects included in the study. Patients' age ranged from 19-33 years old, with mean age of 26 years old. Their body mass index range from 21-29 kg/m2 with average of 25 kg/m2. Pertinent to the past medical history, the top five medical complications are as follows: bronchial asthma, gestational diabetes mellitus, hypertension, pulmonary tuberculosis, and diffuse toxic goiter. Subjects were G1P0 to G9P6. They had prenatal check-up 2-8 times during the whole length of their pregnancy.

Among the 163 subjects, 124 had a Category I trace during their laboring period, 17 had Category II traces all throughout their laboring period, and the remainder had combination of category I and II traces. There was no Category III trace observed. Intrapartal monitoring were recorded every four hours and were submitted for interpretation. However, because immediate neonatal outcomes were the primary goal of this study, only the latest trace prior to delivery was used for analysis.

Analysis of the data was based on the most recent trace before the delivery of the baby. Table 1 showed the primary outcomes of the babies of those mothers with Category I trace. Among those patients with Category I trace, 0.6 % had a one minute APGAR score of 1-3, 1.2% had a one minute APGAR score of 4-6, and 80.4% had a one minute APGAR score of 7-9%. The five-minute APGAR score of subjects with Category I trace are as follows: none had a five-minute APGAR score of 1-3, 0.6% had APGAR score of 4-6, and 81.6% had APGAR score of 7-9.

The babies of those subjects with Category I trace had the following disposition: 85 (52.1%) of babies are direct room-in, 20 babies (12.3 %) are high-risk direct room-in, 14 babies were admitted at Neonatal Intensive Care Unit2 (NICU2) and 15 were admitted in NICU3. Among the babies admitted in NICU2, 9 (5.5%) were on oxygen inhalation, 5 (3.1%) were on room air. Eight (4.9%) of babies in NICU2 were placed on oxygen support and two (1.2%) were on room air. Three (1.8%) of the babies in NICU3 were intubated, eight (4.9%) were on oxygen support, and four (2.5%) were on room air.

For patients with immediate Category II trace before delivery, all (14.7%) had one and five minute APGAR score of 7-9. Thirteen (8%) of the babies were direct-room in

Table 1. Summary of Neonatal Primary Outcome by Category I and II Most Recent Trace (n = 163)

Primary Outcome			Category I		Category II	
			Count	Percent	Count	Percent
Apgar Score	1 minute	1-3	1	.6	-	-
		4-6	2	1.2	-	-
		7-9	131	80.4	24	14.7
	5 minute	1-3	-	-	-	-
		4-6	1	.6	-	-
		7-9	133	81.6	24	14.7
Disposition	DRI		85	52.1	13	8.0
	DRI-HR		20	12.3	1	.6
	NICU 2					
		Observation	-	-	1	.6
		Room air	9	5.5	4	2.5
	NICU3	Intubated	3	1.8	-	-
		02 Inhalation	17	10.4	4	2.5

Table 2. Summary of Neonatal Poor Outcome (NICU I to III) by Category I and II (n = 37)

Secondary Outcome		Category I (n = 28)		Category II (n = 9)		Z statistic (p-value)	Remarks
		Count	Percent	Count	Percent		
Resuscitative	Tactile stimulation	25	89.3	8	88.9	.97	NS
	Thermo-regulation	25	89.3	8	88.9	.97	NS
	Suction	16	57.1	1	11.1	.02	S
	Intubated	2	7.1	-	-	-	-
	O2 Inhalation	7	25.0	-	-	-	-
	5-30 min	1	3.6	-	-	-	-
Interval of delivery	31-60 min	4	14.3	2	22.2	.57	NS
	61-90 min	4	14.3	1	11.1	.81	NS
	>90 min	18	64.3	5	55.6	.64	NS
Route of delivery	Abdominal	1	3.6	4	44.4	.00	S
	Spontaneous Vaginal Delivery	16	57.1	4	44.4	.51	NS
	Outlet Forceps Extraction	7	25.0	1	11.1	.38	NS
	Vacuum Assisted Delivery	4	14.3	-	-	-	-
Type of anesthesia	Local	10	35.7	2	22.2	.45	NS
	Spinal	3	10.7	4	44.4	.02	S
	Epidural	6	21.4	2	22.2	.96	NS
	None	4	14.3	1	11.1	.81	NS
Neonatal Weight	1001-2000 g	11	39.3	5	55.6	.39	NS
	2001-3000 g	12	42.9	3	33.3	.61	NS
	>3000 g	4	14.3	1	11.1	.81	NS
Other outcomes	Death	1	3.6	-	-	-	-
	Pneumonia	4	14.3	-	-	-	-
	Sepsis	11	39.3	2	22.2	.35	NS
	Hyper-bilirubinemia	1	3.6	-	-	-	-

and one (0.6%) was high-risk direct-room in. Eight of the babies were admitted in NICU2. Among these babies, 3 (1.8%) was on oxygen inhalation, 4 (2.5%) babies were on room air, and 1 (0.6%) was just under observation. One baby (0.6%) was admitted in NICU3 on oxygen support only. No babies were intubated.

Table 2 showed the secondary outcomes of the babies of patients with Category I and Category II traces. All babies with poor outcomes were admitted either in NICU2 or NICU3. NICU2 admissions included babies which were growers and those babies of diabetic mothers. The resuscitative measures done for babies are as follows: tactile stimulation, thermoregulation, suctioning, inhalation, and intubation. Among these measures, suctioning (with a p-value of .02) showed a significant difference between Category I and Category II traces. Babies born to mothers with immediate category II traces are suctioned more than those with Category I traces. In terms of route of delivery, it was noted that Category II traces were associated more with abdominal delivery than those with Category I traces. In connection with this, spinal anesthesia which was usually used in abdominal deliveries is also significantly different from the two traces, with a p-value of .02. The other secondary outcomes measured in this study were not significantly different between Category I and Category II traces. The following are the secondary outcomes analyzed: interval of delivery form the last trace, route of delivery, type of anesthesia, neonatal weight, and other outcomes such as death.

Two patients had initial category I traces but eventually turned into Category II traces prior to their deliveries. First baby was born to a 32 year old, G4P3 (3003), and delivered by vacuum assisted delivery under epidural anesthesia. The trace was Category II for variable decelerations. The baby was admitted in NICU3 with a consideration of neonatal sepsis. She was placed on oxygen support. Initially, she was resuscitated by tactile stimulation, thermoregulation, suctioning. The second baby was born

to a 22 year old, G3P1 (1011), with gestational diabetes mellitus. Two Category II traces were called for early decelerations with minimal variability. The baby was delivered vaginally under epidural anesthesia, with a birth weight of 2,300 grams.

One baby, weighing 3100 grams, was born by spontaneous vaginal delivery to a 33 year old, G6P5 (5005), who had a Category I trace. However, the baby had a one-minute APGAR score of 2 and a five-minute APGAR score of 8. He was admitted to the NICU3 and was intubated.

During the study period, there was one late neonatal death. This baby was admitted to NICU3. He was born to a 19 year old, G1P0 with a history of bronchial asthma and was delivered by outlet forceps extraction under epidural anesthesia. The consideration was transient tachypnea of the newborn versus neonatal pneumonia and sepsis.

The mean pediatric aging of the babies were 37 weeks and their mean birth weights were 2666 grams.

Using z-test for difference in proportions, it can be deduced that there was no significant difference of the poor outcomes of babies under Category I and Category II traces, as shown by the p-value of 0.9328 (>0.05).

DISCUSSION

The National Institute of Child Health and Human Development (NICHD) (1997) held a succession of workshops in 1995 and 1996 to develop standardized and unambiguous definitions of fetal heart rate tracings and published recommendations for interpreting FHR patterns.[13] In 2008, revision of the NICHD tracing definitions was made and a three-category system was adopted.[14] This three-tier system provide information on the current acid-base status of the fetus and cannot predict the development of cerebral palsy.[11] Category I trace is a normal trace, Category II is an indeterminate trace, and Category III trace is an abnormal trace. If the FHR tracing is normal, structured intermittent auscultation or continuous EFM techniques can be employed in a low-risk patient, although reconsideration may be necessary as labor progresses. If the FHR tracing is abnormal, interventions such as position changes, maternal oxygenation, and intravenous fluid administration may be used. When continuous EFM tracing is indeterminate, fetal scalp pH sampling or fetal stimulation may be used to asses for the possible presence of fetal academia.[14] In recent years, several specific issues relating to the interpretation and management of FHR patterns have received considerable attention in the medical literature. These include the lack of agreement in interpretation even among recognized experts, the role of FHR patterns as a primary driver of a rising cesarean rate and the explosion of litigation involving FHR patterns, despite the consistent absence of scientific evidence to support the contention that intervention based on any single FHR pattern or a combination of FHR patterns in fact prevents cerebral palsy or other types of neurologic impairments.[15]

In our study, most of those Category I traces were admitted in NICU3 as compared to those with Category II traces. As an indeterminate trace, physicians may lean toward the aggressive management of those with Category II traces. Abdominal deliveries (p-value of .00) and in turn, spinal anesthesia (p-value .02), were noted to be significantly different between the two traces. More patients with Category II traces underwent abdominal delivery than patients with Category I trace. It was also noted in the study that suctioning (p-value .02) as a resuscitative measure was significantly different between the Category I and Category II traces. This could also be attributed to the fact that physicians, pediatricians in this case, may also lean toward the aggressive management of such babies with Category II traces, taking into account that these traces were oftentimes labeled as non-reassuring traces. There were no significant difference between the Category I and Category II traces based on one- and five-minute APGAR scores and the disposition of the babies (direct-room in or admission in the neonatal intensive care unit). A study done by Wayock C et.al. published in 2009, showed that there was no statistically significant difference in umbilical cord pH, one-minute or five-minute APGAR scores between FHR categories I and II. Furthermore, there were no predictive difference between Category I and II of the NICHD Three-tier fetal heart rate interpretation system.[16] This study included singleton pregnancies >34 weeks gestation who had an umbilical artery cord pH performed during a four month period and with fetal heart rate pattern during the last 60 minutes prior to the delivery.

Other outcomes observed were not significantly different between the two traces and these included the following: resuscitative measures in the form of tactile stimulation and thermoregulation, vaginal route of delivery (spontaneous vaginal, outlet forceps, and vacuum assisted delivery), type of anesthesia (local or epidural), neonatal weight, and other outcomes noted (death, pneumonia, sepsis, and hyperbilirubinemia).

Another study done by Holmgren et.al in 2008 analyzing 1300 patients with category II traces showed that variable decelerations were the most common FHRT characteristic associated with Category II trace. In addition, recurrent decelerations and minimal variability were the characteristics most often associated with a pH <7.10.[17]

As mentioned, there was no standard consensus of the management of Category II traces. It could be resuscitation, amnioinfusion, or expedite delivery. More than 50% of fetal strips fall between Category I and Category II traces.[14] There is currently no standard national approach

to the management of category II fetal heart rate (FHR) patterns, yet such patterns occur in the majority of fetuses in labor.[15] Measurements of cord blood gases are generally recommended after any delivery for abnormal FHR tracing because evidence of metabolic acidosis (cord pH <7.0 or base deficit >12 mmol/L) is one of the four determining an acute intrapartum hypoxic event sufficient to cause cerebral palsy.

CONCLUSION AND RECOMMENDATIONS

This study analyzed the neonatal outcomes of the different Category tracings. No Cateory III trace was observed during the study period. The one- and five-minute APGAR scores and the disposition of the babies (direct room-in or NICU admission) were not significantly different between Category I and II traces. Since Category II traces remained a gray area or is an indeterminate trace, most physicians in the study institution, opted to expedite delivery after three consecutive Category II traces. Hence, abdominal delivery was significantly higher in Category II traces compared with Category I traces.

It is recommended that those babies with poor outcomes (admitted in NICU, poor APGAR scores, low birth weight) and those delivered after any abnormal trace should have measurements of cord blood gases. This is to detect the occurrence of metabolic acidosis; thus, correlating with the intrapratal monitoring or tracing of the babies. Metabolic acidosis, as mentioned, is sufficient to cause cerebral palsy.

Follow-up of these babies, with intrapartal abnormal trace, in their earlier years is suggested to detect cerebral palsy.

Another recommendation is to note specifically which among the variabilities in the Category II trace would suggest a poor neonatal APGAR score or poor neonatal outcome. The variabilities are: baseline fetal heart rate, variability, accelerations, decelerations, and uterine contractions.

It is further recommended that analysis of the time of the last trace and the time of delivery should be correlated with the neonatal outcomes.

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