Clinical Application of Neonatal Instantaneous Heart Rate Monitoring (Part Two: Asphyxia and Variability of Instantaneous Heart Rate)

H. Nishida, K. Oguchi, R. Haku, T. Mihara, S. Hiraishi, K. Yashiro

Introduction: We have been evaluating neonatal instantaneous heart rate whether the accumulated knowledge of fetal monitoring is also applicable for neonatal monitoring. This study was focused on the relation between variability of neonatal IHR and clinical outcomes of severely asphyxiated neonates.

Method: Subjects for the study were 15 severely asphyxiated neonates who were admitted to Kitasato University Hospital during 1977-8. Eleven of them were expired mainly due to anoxic brain damage and CNS bleeding which were confirmed by autopsy and/or CT scan. One of them was asphyxiated postnatally due to diaphragmatic hernia. Four neonates survived but two of them had neurological sequele. Their clinical informations are summarized on table 1.

Table 1. Severely Asphyxiated Neonates

B.W. (g)	G.A. (w)	Perinatal Complication	Apgar Score	Neonatal Complication
630	24	cloudy amniotic fluid	1/1	RDS, died at 1 day old
746	26	abraptio placenta, C-S	2/1	RDS, pneumothorax, CNS bleeding, died at 5 days old
1005	27	PROM (5 days), cloudy amniotic fluid	6/1	apnea, CNS bleeding, PRA & CHF, died at 3 days old
890	30	toxemia, fetal distress percipitated delivery	1/1	subaponeurotic bleeding shock, died at 5 days old
1320	31	PROM, fetal distress, C-S	4/1	renal failure, died at 7 days old apnea, CNS bleeding
2312	37	none	7/1	diaphragmatic hernia, pulmonary hypoplasia, died at 1 day old
2628	38	twin, interlocking PROM, toxemia	1/1	intraabdominal bleeding shock, died at 1 day old
3740	39	rupture of uterus fetal distress	2/1	shock, renal failure, anoxic encephalopathy, died at 2 days old
2862	39	abraptio placenta fetal distress	1/1	anoxic encephalopathy died at 2 days old
3020	40	PROM, cloudy amniotic fluid, maternal fever	?	MAS, brain edema died at 3 days old
3300	41	malpresentation, fetal distress, C-S	6/1	MAS, PFC, died at 1 day old
3400	42	cloudy amniotic fluid	8/1	MAS, pneumothorax survived without sequele
2540	39	toxemia, cloudy amniotic fluid, C-S	3/1	MAS, PFC, survived with neurological abnormality
1710	33	PROM for 10 days	1/1	apnea, seizure, survived with neurological abnormality
2950	39	PROM for ?	?	MAS, PFC survived without sequele

0300-5577/81/0091-0050 $ 2.00

Instantaneous heart rate and respiration were recorded on strip chart from the time of admission till expiration or till definite improvement of clinical status. Instantaneous heart rate was automatically calculated from R-R interval and plotted continuously. Respiratory movement were recorded by impedance method.

Result: Eleven fatal cases had marked loss of variability from the time of birth till death except one extremely premature baby who became apnic on the 4th day of life due to CNS bleeding. His variability was lost since then. Four survived cases had loss of variability initially but reappeared concomitant with clinical improvement.

Discussion: Though system controling heart rate is complex, it is well appreciated that existence of good variability of heart rate represents well-being of the fetus and the neonate. Loss or decreased variability of heart rate is seen on the fetus and the neonate under serious condition such as profound acidosis, hypoxia, congestive heart failure, hypovolemic shock, etc. There are several methods to quantify variability to express them in subjective numerical values. But in this study, we have evaluated variability of heart rate by eye ball analysis following Dr. Hon's original classification. Loss of variability represents grave outcome of the neonate and 13 neonates with loss of variability for longer than 24 hours expired or survived with neurological sequele. As autopsy findings of 11 fetal cases showed marked brain damage mainly due to CNS bleeding, we speculate that CNS damage and loss of variability have close correlation. Also as 4 survived cases had reappearance of variability concomitant with clinical improvement, variability of heart rate could be used as prognostic indicator. Loss of variability could be seen on relatively normal neonates such as preterm infants, sleeping babies, and infants under influence of sedatives or narcotics. Currently we are evaluating neonatal heart rate response to painful stimulation (pinch-test) to evaluate their condition. Normally the neonate response to pinch-test by definite accerelation pattern. This pinch-test is especially useful to distinguish whether loss of variability is due to severely compromised condition or is just due to temporary phenomenon of relatively normal neonates.

Conclusion: Variability of neonatal heart rate has clinical values similar to fetal heart rate. Though loss of variability could be seen on various conditions, it is strongly related with brain damage. Combined analysis of variability and response to painful stimulation (pinch-test) of heart rate give us more information to assess neonatal well or ill condition.

H.Nishida, M.D.
Dept.Pediatrics
Kitasato University
School of Medicine
1 Asamizodai
Sagamiharashi, Kanagawaken
Japan