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Correlation between the Neonatal Behavioral Assessment Scale and Auditory Brainstem Response in Full-Term Neonates.

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Auditory brainstem response (ABR) and Brazelton's neonatal behavioral assessment scale (NBAS) were used to study 25 healthy full-term newborn infants. Significant correlations were found between ABR component latencies and the following NBAS scales: irritability, cuddliness, consolability with intervention and self-quieting activity. We concluded that neonates with early brain maturation showed high irritability, high resistance to the examiners' arms when held, low self-quieting activity while in a fussing state and ready response to consolation by intervention.

Key words: Neonatal Behavioral Assessment Scale; auditory brainstem response (ABR); neonate

Child development is based on the degree of brain maturation; however, it is not influenced solely by biological maturation of the brain. Environment and psychological maturation are also important determining factors in the course of child development. The neonatal period is the most fruitful one to study the correlation between brain maturation and child development, because the influences of environment immediately after birth are minimal. Whether or not the fetus in the womb is affected by its surroundings is still under investigation. Two years ago we studied the correlation between fetal activity and the Neonatal Behavioral Assessment Scale, and our results suggested the existence of mother-fetus interaction. (Ishikawa & Minamide, 1984).

In this subsequent study, we considered birth as a starting point of child development and examined the relation between brain maturation and neonatal behavior. Auditory brainstem response (ABR) is a sensitive index of brainstem maturation and function. Progressive decrements in peak latencies (peaks I-VI) occur with the increase of gestational age. (Roberts, Davis, Phon, Reichert, Sturtevant, Marshall, 1982).

Therefore we adopted ABR testing as an index of brain maturation in this study. We also employed the NBAS method, which is considered to be useful for measuring the

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social capabilities of newborn infants. (Brazelton, 1973).

Materials and Methods

Twenty-five full-term newborn infants, who were born at the Hokkaido University Hospital Obstetrical Clinic, were investigated (Table 1). The number of risk babies was 10, 2 cases of neonatal asphyxia and 8 cases of fetal distress. Fifteen cases were normally delivered. No neurological abnormalities were detected during the neonatal period.

TABLE 1
Clinical summary and ABR components

Case	Sex	Gestational Age(wks)	Birth Weight(gr)	Complication	Latencies(msec)			I-V Interval (msec)
					Wave I	Wave III	Wave V	
1	F	40	2920		1.98	5.22	6.97	4.99
2	M	41	3220		2.22	6.06	7.33	5.11
3	M	40	2380*		2.02	4.79	6.69	4.67
4	M	40	3000	Fetal Distress	2.29	4.98	7.19	4.90
5	M	38	3060		2.78	5.88	7.95	5.17
6	M	41	3930	Asphyxia	1.95	5.05	7.56	5.61
7	F	39	3430		2.05	4.83	7.17	5.12
8	M	38	3030		2.13	4.98	7.11	4.98
9	M	39	3060	Fetal Distress	2.49	5.38	7.74	5.25
10	F	40	2760		2.31	4.80	6.97	4.66
11	M	40	3420		2.77	5.79	7.69	4.92
12	F	40	3400				6.94	
13	F	41	3190	Fetal Distress	2.18	5.33	7.34	5.16
14	F	40	3860	Asphyxia	2.30	5.19	6.78	4.48
15	M	38	3460		2.07	5.64	7.30	5.23
16	M	40	3000	Fetal Distress		5.75		
17	M	39	3220		2.75	5.58	7.61	4.86
18	M	38	3240	Fetal Distress	2.49	6.32	7.97	5.48
19	M	39	3480	Fetal Distress	2.59	5.50	7.33	4.74
20	M	39	3310		2.98	6.16	7.66	4.68
21	F	40	3150		2.53	6.16	7.23	4.70
22	M	41	2600*	Fetal Distress	2.03	5.60	7.71	5.68
23	F	40	3360	Fetal Distress	2.09	5.10	7.23	5.14
24	F	39	2920		2.48	5.23	7.11	4.63
25	F	40	2820		2.01	4.89	7.01	5.00

*SFD(small for date)

ABR testing was performed between 0 and 5 days of age; the average age was 2 days. All babies were tested in open cribs and slept naturally throughout the recording procedure. The test consisted of presenting 2000 clicks (0.1 msec) at a rate of 10 per second at the 100 dB level in the right ear and repeated 2-5 times. The following parameters of the response were measured and analyzed: the latency of waves I, III, V and the time interval between waves I and V (i. e. central conduction time).

Neonatal behavior using the Neonatal Behavioral Assessment Scale (NBAS) was

recorded between the third and fifth day of neonatal life. The reliability of the 2 testers (Ishikawa and Ishikawa) was 0.88.

Results

1) *Auditory brainstem response*

The mean latency of waves I, III, V and the mean time interval between waves I and V of each case are presented in Table 1. There were no significant differences between risk babies (10 cases) and normally delivered babies (15 cases). The peak latencies of the 2 cases of SFD were not always long as compared with those of the AFD babies.

2) *Correlation between ABR components and NBAS scores*

Significant correlations were found between scale 19 (irritability) scores and the latency of wave III, between scale 14 (cuddliness) scores and the I-V interpeak latency, between scale 16 (consolability) scores and the latency of waves III and V, and between scale 25 (self-quieting activity) scores and the latency of wave III (Table 2).

TABLE 2
Correlations between NBAS scores and ABR components

	Latencies							
	Wave I		Wave III		Wave V		I-V interval	
	<i>n</i>	<i>r</i>	<i>n</i>	<i>r</i>	<i>n</i>	<i>r</i>	<i>n</i>	<i>r</i>
1 Response Decrement to Light	20	0.21	20	0.32	21	0.02	20	-0.11
2 Response Decrement to Rattle	17	0.14	17	0.02	18	0.21	17	0.05
3 Response Decrement to Bell	18	-0.36	18	-0.02	19	-0.23	18	0.15
4 Response Decrement to Pinprick	17	0.27	17	0.21	18	0.13	17	-0.13
5 Orientation-Inanimate Visual	19	0.03	20	0.07	20	-0.24	19	-0.28
6 Orientation-Inanimate Auditory	16	0.30	17	0.23	17	0.29	16	-0.26
7 Orientation-Animate Visual	17	0.34	18	0.20	17	0.14	17	-0.15
8 Orientation-Animate Auditory	17	0.25	18	0.01	17	0.09	17	-0.24
9 Orientation-Animate Visual and Auditory	15	0.33	16	0.11	15	0.14	15	-0.16
13 Pull-to-sit	19	0.05	20	0.07	19	0.09	19	0.06
15 Defensive Movement	19	0.01	20	0.39*	19	0.08	19	0.08
18 Rapidity of Buildup	20	0.07	21	0.11	20	-0.09	20	-0.17
19 Irritability	15	-0.43	16	-0.57**	15	-0.42	15	-0.07
14 Cuddliness	22	-0.11	23	-0.06	23	0.38	22	0.52**
16 Consolability with Intervention	19	-0.43*	20	-0.49**	20	-0.55*	19	-0.25
25 Self Quieting Activity	22	0.10	23	0.45**	23	0.00	22	-0.06
26 Hand-mouth Facility	14	-0.40	15	-0.10	15	-0.12	14	0.08

* $p < .1$ ** $p < .05$

It was clear that the neonates with short peak latencies of ABR showed high irritability, more resistance to the examiners' arms when held and low self-quieting activity while in a fussing state; however, the babies were consoled easily by intervention.

Discussion

The Neonatal Behavioral Assessment Scale (NBAS) is a psychological scale for the newborn human infant. It allows for an assessment of the infant's capabilities along dimensions that are considered relevant to his or her developing social relationships. An infant's state of consciousness is perhaps the single most important element examined in this method. The baby's reactions to all stimulation are dependent upon his or her ongoing state of consciousness and any interpretation of them must be made with this in mind. In addition, the infant's use of a behavioral state to maintain control of his or her reactions to environmental and internal stimuli is an important mechanism and reflects the potential for organization. This state sets a dynamic pattern which reflects the full behavioral repertoire of the infant. Specifically, the NBAS tracks the pattern of state change over the course of the examination, its lability and its direction in response to external and internal stimuli. Thus, the variability of state becomes a dimension of assessment that indicates the initial abilities of the infant for self-organization. (Brazelton, 1973).

Based on our results, we concluded that newborn infants with early brain maturation cried easily when presented with adverse stimuli, showed low self-quieting activity in a fussing state, and were more reactive to being amused by the examiner. It thus seems that the earlier the brain matures in the neonate, the more desirous he is of forming human relations. Neonates with early brain maturation elicit abundant maternal behavior from the mother and participate significantly in mother-infant interactions.

In this study, four NBAS scales (19, 14, 16, 25) significantly correlated with ABR components, and all came within the category of range and regulation of state. In scales 19, 14 and 16, we observed responses to multiple stimuli such as vision, audition, touch, and sense of equilibrium. On the contrary, there were no correlations between ABR and scales 1-8, 13 and 15, which were tested by presenting stimuli through a single sensory pathway. It was very interesting that complexity and variety of stimuli had an influence on the presence of correlation. This difference may be due to the immature ability of neonates to process information from stimuli presented through a single sensory pathway.

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