DIFFERENCES BETWEEN CONGENITALLY BLIND AND NORMALLY SIGHTED SUBJECTS IN THE P1 COMPONENT OF MIDDLE LATENCY AUDITORY EVOKED POTENTIALS1

R. Nagarathna, H. R. Nagendra, Shirley Telles and K. V. Naveen.
Vivekananda Kendra Yoga Research Foundation

R. Srinivas, K. S. Nirmala
Department of Neurology, Ramaiah Medical College, &Teaching Hospital

Summary: Auditory evoked potentials (0 to 100 msec. range) were recorded two times for 9 congenitally blind children (age= 14.1 yr. ± 1.4 yr.) and 9 age-matched children with normal vision. The groups peak latency and amplitude of the P1 wave were compared. The peak latency was significantly lower for the congenitally blind than for the normally sighted on a two-factor analysis of variance. Since the P1 wave is thought to correspond to either the ascending, reticular activating system or the primary auditory cortex, these results suggest that information processing at these neural levels may occur more efficiently in the blind.

Congenitally blind subjects were reported by Strelow and Brabyn (1982) to show sensitivity in auditory perception, enabling them to use echoes to perceive spatial positions of objects. This interesting result has a neurophysiological basis. The long latency event related potential waves (NI, P2, and P3) showed shorter latencies and larger amplitudes in early blind humans than those with normal vision (Niemeyer & Starlinger, 1981). The Na and Pa components of middle latency auditory evoked potentials were not significantly different in congenitally blind subjects and those with normal vision (Naveen, Srinivas, Nirmala, Nagendra, & Telles, 1997); however, the Nb component (average peak latency 44.3 msec.) had a significantly shorter latency in congenitally blind persons. This suggested that auditory information processing at the level of the posteromedial part of the primary auditory cortex, the known generator of the Nb wave (Liegeois-Chauvel, Musolino, Badier, Marquis, & Chauvel, 1994) was more efficient in the blind.

The present report presents the analysis of the P1 wave in the congenitally blind and subjects with normal vision described above (Naveen, et al. 1997).

METHOD

Subjects

Two groups of 9 subjects each, congenitally blind and with normal vision, were tested. The congenitally blind group (M age 14.1 yr., SD 1.4) had a diagnosed peripheral visual deficit from birth and no other abnormality. This was confirmed by an absence of visual evoked responses. The normal vision group (M age 14.0 yr., SD = 1.1) had normal visual evoked responses elicited by light flashes.

Design of Study, and Testing Procedure

Subjects were assessed in a single sitting with two consecutive assess ments or recordings (R1, R2).

Auditory middle latency evoked potentials were recorded in the 100 msec. poststimulus time period, from the vertex referenced to the right earlobe, with the ground electrode on the forehead. The preamplifier band width (Nihon Kohden, Neuropack 8, Japan) was set at 10 to 1500 Hz. Altogether 1500 responses were averaged for each assessment. Click stimuli of 40 msec., duration and alternating polarity were delivered through acoustically shielded earphones (Elga DR-531, Japan). The intensity was kept at 80 dB for all assessments. The threshold of bearing was noted. Visual evoked potentials were recorded in the 200-msec. time period, using parameters as described elsewhere (Naveen, et al, 1997).

Middle Latency Auditory Evoked Potentials, P1 Component

The peak latency and amplitude of the P1 component were measured from the baseline existing at the beginning of the sweep. The P1 wave is a positive component following the Nb wave (Cacace, Satya-Murti. & Wolpaw, 1990) and occurring between 30 and 100 msec. (Picton, Champagne, & Kellett, 1992). The components of the P1 wave for congenitally blind subjects and those with normal vision were compared using separate two factor analyses of variance, for the peak latency and the peak amplitude. For this, the first factor was the different groups, i.e., congenitally blind versus normal vision, and the second factor was repeated recordings (R1, R2).

RESULTS AND DISCUSSION

A significant difference in the peak latency of the P1 wave between the congenitally blind (59.85±8.7 msec.) and subjects with normal vision (66.48 + 6.7 msec.) was noted. These values are the average of 18 values per group, i.e., n=9, with two replications. For the two-factor analysis, for groups $F_{1.32} = 6.24$ ($F = 5.53$ at $P < .05$, two-tailed). The effect size for this ratio was .85. There was no significant difference between replications (ns) and the interaction was not significant (ns). The peak amplitude of the P1 wave was not statistically significantly different between groups congenitally blind (0.54± 0.4mV) and with normal vision (0.70±0.5 mV) or between replications.

The present results indicate that the P1 peak latency is significantly shorter for the congenitally blind compared to the subjects with normal vision. A shorter latency suggests enhanced efficiency of information processing in the underlying neural centers. The P1 wave is thought to correspond to either subcortical structures such as the brainstem ascending reticular activating system (Cacace, et al., 1990) or the dorso-posterolateral part of the Heschl's gyrus, i.e., the primary auditory area (Liegeois-Chauvel, et al., 1994). Hence the present results suggest that these neural centers along the auditory pathway may function more efficiently in the blind, in addition to those more distal reflected by NI, PI, P2 (Niemeyer & Starlinger, 1981) and those more proximal, i.e., Nb wave (Naveen, et al., 1997).

REFERENCES

1. CACACE, A. T., SATYA-MURTI, S., & WOLPAW, J. R. (1990): Human middle-latency auditory evoked potentials: vertex and temporal components. Electroencephalography and Clinical Neuro physiology, 77. 6- 1 8.

2. LIEGEOIS -CHAUVEL. C., MUSOLINO, A. BADIER J. M.. MARQUIS. P., & CHAUVEL P. (1994): Evoked Potentials recorded from the auditory cortex in man: evaluation and topography of the middle latency components. Electroencephalography and Clinical Neurophysiology, 92, 204-214.

3. NAVEEN K. V., SRINIVAS R., NIRMALA K. S., NAGENDRA H.R. & TELLES S. (1997): Middle latency auditory evoked potentials in congenitally blind and normal sighted subjects. International Journal of Neuroscience, 90. 105-111.

4. NIEMEYER W, & STARLINGER, I. (1981): i. Do the blind hear better? Investigations on auditory processing in congenital or early acquired blindness: ii. Central functions. Audiology, 20. 510-515.

5. PICTON, T. W., CHAMPAGNE, S. C., & KELLETT, A. J. C. (1992): Human auditory evoked potentials recorded using maximum length sequences. Electroencephalography and Clinical Neurophysiology, 84, 90-100.

6. STRELOW, E. R., & BRABYN. J. A. (1982): Locomotion of the blind controlled by natural sound cues. Perception, 11. 635-640.