Short report

The conduction velocity of slower and the fastest fibres in infancy and childhood

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SUMMARY Motor nerve conduction velocity of the ulnar nerve was measured in 54 infants of various ages. Conduction velocity of slower fibres was measured using Hopf's technique, and maximal conduction velocity was measured with the usual method. Both maximal conduction velocity and conduction velocity of slower fibres increased with maturation. The former was about 65 m/s at the age of about 3–5 years, but thereafter it decreased slightly to about 60 m/s. Conduction velocity of slower fibres increased gradually until about 3 or 4 years of age, and then ranged about 40–50 m/s. The difference between the two velocities increased until 7 or 9 months of age; during the next 8 years, it tended to decrease to about 8–16 m/s. The increasing difference in size between the largest and the smallest myelinated fibres with maturation correlated with the developmental increase of the difference between maximal conduction velocity and conduction velocity of slower fibres. The anatomical evidence of the slight decrease of the axon diameter of the large fibres at the age of 7–14 years may correspond to the slight reduction of maximal conduction velocity after about 5 years of age.

Measurement of the conduction velocity of slower fibres (CVSF) using the method of antidromic block has been described by Hopf.¹ Although the normal values and clinical significance of CVSF have been reported in adults,^{2–6} there are no data concerning infants and children. The purpose of this study is to investigate the evolutionary changes of CVSF and some features of the motor nerve conduction velocity with maturation.

Materials and methods

Fifty-four infants below 13 years of age, including premature babies, were the subjects of this study. They manifested no signs of peripheral nerve impairment clinically or electromyographically. CVSF was measured using

Hopf's technique in the ulnar nerve, and at the same time, maximal conduction velocity (MCV) was measured with the usual method. The details of Hopf's technique was described elsewhere.^{1–6} A DISA type 14 A 11 electromyograph was used in combination with Nihon-koden electric stimulator model SEN 1101. The left ulnar nerve was stimulated first at the wrist and second at the elbow with supramaximal rectangular stimuli of 0.2 ms duration by superficial electrode. The evoked response was derived from the left abductor digiti minimi by superficial electrode. The duration between the paired stimuli was gradually prolonged by 0.2 ms at a time until the response evoked by the second stimulus showed no further increase.

Each evoked response was recorded using a Polaroid camera with 2 or 3 overlapping pictures. Just when the second response showed the maximal amplitude, the duration of the paired stimuli was measured. CVSF was calculated by the following formula.

$$\text{CVSF (m/s)} = \frac{\text{distance between the 2 stimuli (mm)}}{\text{duration between the 2 stimuli (ms) - refractory period (1 ms)}}$$

During the recording, the room or incubator temperature was adjusted, and skin temperature was maintained at more than 34.0°C.

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Results

Figure 1A shows values of MCV and CVSF at various ages. With increasing age, both MCV and CVSF increased. MCV was about 65 m/s at the age of about 3–5 years. After this period it tended to decrease to about 60 m/s. CVSF increased gradually until about 3 or 4 years of age, and thereafter it was

Fig (A) MCV and CVSF at various ages. Ordinate, conduction velocity (m/s). Abscissa, age. Weeks represent gestational age. (B) Difference between MCV and CVSF at various ages. Ordinate, Difference between MCV and CVSF (m/s). Abscissa, age. Weeks represent gestational age.

about 40–50 m/s. The difference between MCV and CVSF (fig 1B) increased until 7 or 9 months of age. Between about 1 and 8 years it tended to decrease to about 8–16 m/s.

Discussion

Conduction velocity is known to be related to fibre diameter and the degree of myelination.⁷ The increase of MCV and CVSF was the consequence of the maturation of the peripheral nervous system (that is increased fibre size and myelin thickness). The difference between MCV and CVSF increased for the first 7 or 9 months after birth, reflecting the maturational changes of the distribution of the fastest and the slowest fibres in the ulnar nerve. Carpenter *et al*⁸ showed developmental changes of the distribution according to the size of the myelinated fibre in the chick sciatic nerve trunk. The difference between the size of the largest and the smallest myelinated fibres increased gradually with maturation, thus correlating with the developmental increase of the difference between MCV and CVSF. Schröder *et al*⁹ have reported the developmental changes of the sural nerve. Although it is not certain whether the ulnar nerve shows similar development, the difference in the size of the large and small fibres was more prominent in older infants than newborn baby. The difference between MCV and CVSF tended to diminish from about 1 to 8 years, and MCV also revealed the same tendency at about 3–5 years. Schröder *et al*⁹ observed a slight decrease in the axon diameter of the large fibres between the ages of 7–14 years. They considered it might correspond to the slight reduction of MCV by Gamstrop beyond the age of 3–8 years in the ulnar nerve. Our findings were identical.

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