BILATERAL ASYMMETRY IN CONDUCTION VELOCITY IN THE EFFERENT FIBRES OF THE MEDIAN NERVE AND ITS RELATIONSHIP TO HANDEDNESS

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Summary: The conduction velocity in the efferent fibres of the median nerve has been compared in the right and left forelimbs of 38 human subjects. Six independent estimates were made for each limb. Estimates on the right and left limb of a subject were made at the same sitting. Conduction velocity was faster on the right side in the majority of right handed subjects; and on the left side in the majority of left handed subjects. The mean conduction velocity was greater on the right side in right handed subjects ($P<0.02$).

Key words: nerve conduction median nerve asymmetry

INTRODUCTION

Studies on the anatomical implications of one-sided limb dominance have been in progress in this institution for several years. It has been observed that the muscles and bones of the dominant upper limb are heavier than those of the opposite limb, and that the differences are statistically significant for some muscles or bones but not in others (2,7). Using these findings as a guide, several other aspects of one sided limb dominance have been investigated. It has been shown that in the majority of human adults most of the muscles and bones of the left lower limb are heavier than those of the right (1, 8, 12) presumably because the left limb is used preferentially in the transmission of body weight. It was also been demonstrated that asymmetry in muscle and bone weight is present in human fetuses (2, 11) and in several species of animals (5,6,13). In the present investigation, we have compared the conduction velocity in efferent fibres of the right and left median nerves of human subjects.

MATERIAL AND METHODS

This report is based on observations in 38 healthy human volunteers drawn from medical students, faculty and their children. The subjects varied in age from 12 to 52 years. Twenty-four of the subjects were right handed and all of them were males. Fourteen subjects were left handed; of these 11 were males and 3 were females. Handedness was determined by the criteria described by Cromwell and Rife (4). Persons who wrote, ate, lifted and played with the right hand were classified as right handed; a person using the left hand for any of these acts, was classified as left handed.

Six independent estimates of conduction velocity were made on either limb of each subject. The estimates on the right and left limb were made at the same sitting. Conduction velocity in the median nerve was measured using a Medicor electromyograph instrument having dual oscilloscopes for observtion and photography, with built in stimulator and camera. The sweep speed of the instrument was kept at 5 milliseconds per centimeter. The nerve was stimulated at the elbow and at the wrist using surface electrodes, by stimuli ranging from 15 to 20 volts and having a duration of 0.05 milliseconds. The action potential generated in the thenar muscles

was picked up by disc shaped surface electrodes. The photographic record showing the point of stimulation and the response was enlarged so that a distance of four millimeters corresponded to an interval of one millisecond. The time lag between stimulation and response was measured from these enlargements. The length of the nerve between the two points of stimulation was measured. Care was taken that both limbs were kept in exactly the same position during these measurements and also during the experiment. Conduction velocity in the nerve was calculated from these data, and was expressed in meters per second.

In a separate series of 20 individuals, skin temperatures were measured in the right and left forearms using a H & B temperature measuring instrument.

RESULTS

The findings in right handed and left handed subjects are shown in Tables I and II respectively.

TABLE I: Conduction velocity (metres per second) in the right and left median nerves in right handed subjects.

Subject	*Conduction velocity (mean of six measurements)*		
	Right	*Left*	*Difference in favour of right*
1	60.7	58.6	+2.1
2	53.6	53.8	−0.2
3	59.8	59.7	+0.1
4	53.1	52.2	+0.9
5	61.7	59.7	+2.0
6	59.5	54.1	+5.4
7	57.4	52.7	+4.7
8	61.2	59.8	+1.4
9	63.3	59.0	+4.3
10	64.6	65.2	−0.6
11	63.7	62.8	+0.9
12	59.9	58.7	+1.2
13	68.0	61.0	+7.0
14	63.4	66.9	−3.5
15	58.7	53.3	+5.4
16	68.0	71.2	−3.2
17	59.5	62.2	−2.7
18	64.5	63.0	+1.5
19	57.5	58.6	−1.1
20	60.3	60.0	+0.3
21	61.5	59.3	+2.2
22	57.5	54.4	+3.1
23	63.7	61.3	+2.4
24	62.5	56.9	+5.6
Mean	60.98	59.35	+1.63

It is seen that :

(i) Conduction velocity is not equal on the two sides;

(ii) in the majority of right handed persons (19 out of 24), conduction is faster on the right side; and in the majority of left handed persons (8 out of 14), it is faster on the left side;

(iii) the mean conduction velocity is more on the right side in right handed persons and on the left side in left handed persons. The difference is significant for the right handed group ($P < 0.02$) but not in the left handed.

TABLE II: Conduction velocity (metres per second) in right and left median nerves in left handed subjects.

Subject	*Conduction velocity (mean of six measurements)*		
	Right	*Left*	*Difference in favour of left*
1	67.5	64.2	—3.3
2	59.7	62.8	+3.1
3	65.0	62.8	—2.2
4	60.0	59.3	—0.7
5	66.6	68.0	+1.4
6	65.7	66.4	+0.7
7	62.9	63.6	+0.7
8	59.9	66.2	+6.3
9	62.2	63.3	+1.1
10	59.2	60.8	+1.6
11	63.9	61.9	—2.0
12	63.8	64.9	+1.1
13	66.2	64.2	—2.0
14	70.2	70.0	—0.2
Mean	63.77	64.17	+0.4

As mentioned under methods, six independent estimates of conduction velocity were made on each limb of each subject. When these observations on the two limbs of individuals are subjected to 't' tests, it is found that the differences in mean conduction velocity on the right and left sides are significant in a number of subjects. Amongst the right handed subjects, a significant difference in favour of the right side is seen in 11 subjects and in favour of the left side in 3 subjects, the differences not being significant in 10 subjects. Among the left handed significance in favour of the left side is seen in 3 subjects, and in favour of the right side in one subject. When these findings are subjected to a Chi-square test, the probability of thier having occurred by chance is seen to be less than 2 per cent.

DISCUSSION

Conduction velocity in peripheral nerves is known to be influenced by various factors including fibre diameter, presence or absence of myelin, and temperature (9). It is also influenced by age (10). Of these the only factor relevant to the present study is temperature. The possibility of this factor leading to error has been eliminated by studiying the rigt and left limbs under the same conditions and at the same sitting. Furthermore, measurements of skin temperatures in the right and left forearms of 20 individuals have shown that the differences in temperature are insignificant.

According to Tanner (14): "Handedness is probably in the main a hereditary character; that is to say heredity determines some neurological difference which predisposes the individual to use preferentially his left or right hand.....the nature of the neurological difference is not yet understood." In this context the observation that, in the majority of subjects nerve conduction tends to be faster on the dominant side is a finding of considerable interest. It is common knowledge that "faster reflexes" can be developed with training. Whether the fastern conduction in the dominant limb is a result of such training (implicit in handedness) or represents a fundamental inherited trait can, at present, be only a matter of conjecture.

The finding that differences in conduction velocity between the right and left limbs are less clear cut in the left handed than in the right handed is no doubt due to the manner in which left handedness is defined. According to Cormwell and Rife (4) a right handed person is one who uses the right hand preferentially in all acts calling for dexterity or strength. The preferential use of the left hand for any of these acts has been considered a sufficient criterion for labelling a person as left handed. Only a small fraction of left handed subjects (2 out of 14 in the present study) use the left hand for all acts calling for dexterity or strength. It is only this group that can be validly compared with the right handed. In the present study this group is too small to allow any conculsions to be arrived at. The remaining subjects are really ambidextrous with one limb or the other predominating. It is, therefore, not surprising that left handed subjects, as a whole, fail to show a significant correlation of limb dominance and nerve conduction velocity.

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