SHORT COMMUNICATION

THE INFLUENCE OF MUSCLE USE ON CONDUCTION VELOCITY OF MOTOR NERVE FIBRES

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Summary: The conduction velocity of the motor nerve fibres of the peroneal and posterior tibial nerves was estimated in 38 rickshaw pullers and 25 human volunteers serving as controls. The mean values for motor conduction velocity were greater in the case of rickshaw pullers as compared to control subjects. However, the difference was statistically significant ($P < 0.05$) for the peroneal nerve only. It is concluded that muscle hypertrophy produced by hyperactivity has an influence on nerves supplying the muscles.

Key words: nerve conduction velocity muscle hyperactivity

INTRODUCTION

Muscular inactivity leads to disuse atrophy and overactivity of muscle produces hypertrophy, leading to increase in the size of the muscle fibres, in the amount of sarcoplasm and in the number of myofibrils per fibre (1).

Muscular inactivity produced by tenectomy leads to decrease in number and diameter of nerve fibres in the nerve supplying the muscle (9). Studies on the effect of hypertrophy of muscle on nerves supplying them have shown conflicting results. Wedeles (11) and Edds (4) have demonstrated that overloading of a muscle by training, or by denervation of synergistic muscles, is associated with hypertrophy of nerve fibres. On the other hand Tomanek and Tipton (9) in a similar study did not find any change in nerve fibre diameter or in the number of nerve fibres.

The relationship between nerve fibre diameter and conduction velocity is well known. In view of the observations reported above, it is to be expected that hypertrophy of muscle produced in various ways, including increased activity, would result in a faster rate of conduction. Such an effect has been reported by Lastovka (5). This paper presents the findings of a comparison of nerve conduction velocity in the lower limbs of normal adults and of rickshaw pullers in whom the lower limbs are subjected to heavy exercise.

MATERIALS AND METHODS

The present investigation was done on 38 rickshaw pullers (RP) who had been practicing this calling for a period of two to five years. The subjects selected were all young males, well built and nourished. They varied in age from 16 to 25 years. 54% of the subjects were 20 years or less in age. 25 subjects (drawn from medical students and laboratory staff) served as controls. Measurements of motor conduction velocity (MCV) were done in the peroneal (lateral popliteal) and posterior tibial nerves using a MEDICOR electromyograph instrument with built in stimulator and camera. The compound muscle action potentials recorded on the oscilloscope were photographed and enlargements were made to facilitate accurate latency measurements.

The peroneal nerve (PN) was stimulated supramaximally in the popliteal fossa and at the ankle and the compound muscle action potential recorded from the extensor digitorum brevis. In the case of the posterior tibial nerve (PTN), the motor response was recorded from the abductor digiti-minimi. The nerve was stimulated in the middle of the popliteal fossa proximally and behind the medial malleolus at the ankle. Details of technique were as described by Cohen and Brumlik (2). Results are expressed as mean standard deviations. Comparisons of the two groups were made using unpaired 't' tests.

RESULTS

The findings of MCV are shown in Table I. In the case of both nerves it is seen that MCV is greater in the case of rickshaw pullers. However, the difference is statistically significant for PN but not for PTN.

TABLE I : Motor conduction velocity in peroneal nerve and posterior tibial nerve in meters per second.

	PN		*PTN*	
	Controls	*Rickshaw pullers*	*Controls*	*Rickshaw pullers*
No. of subjects studied	26	38	23	38
Mean	50.72	52.71	51.82	53.96
S.D.	3.92	3.21	3.74	6.40
S.E.	0.77	0.52	0.78	1.03
't' test	$P<0.05$		$P<0.2$	

DISCUSSION

The trophic influence of nerve on muscle is well known (7). The concept of a reverse effect i.e., of muscle on nerve is more recent. It has been demonstrated that disuse of a muscle reduces the number and diameter of fibres in the nerve supplying the muscle (9,10). Conversely increased muscle activity has the opposite effect. Lastovka (5) studied the effect of physical training on conduction velocity in motor fibres of the posterior tibial nerve in human volunteers and was able to demonstrate an increase. Evidence in the same direction is provided by the work of Lewis (6). The worker transplanted nerves supplying slow twitch muscle to innervate fast twitch muscle. This resulted in an increase in conduction velocity in these nerves. Singh and his co-workers have shown that muscle weight is greater in the dominant limb both in human subjects and in other species (3, and other references cited therein); and that nerve conduction velocity is greater in the dominant limb (8). The findings of the present study regarding the peroneal nerve lend further support to the view that increased muscle mass, as a result of activity, has an influence on nerve which manifests in the form of faster conduction velocity.

It is, however, necessary to examine, why a statistical significant increase in conduction velocity has not been observed in the posterior tibial nerve. Examination of Table I shows that in this nerve, the mean conduction velocity is greater in rickshaw pullers than in controls. The quantum of difference in similar to that in the PN. The variability in mean conduction velocity (as indicated by the standard deviation) is of the same magnitude for PN and PTN, in controls. However, it is much greater for PTN in rickshaw pullers. The variability can be explained by the obseved fact that the increased muscular development in rickshaw pullers is far from uniform, and is influenced by factors like body build, nutrition and quantum of exertion. But for this variability, it is highly likely, that the difference in conduction velocity would have been significant in the case of PTN also, and that failure to demonstrate statistical significance difference is due to small size of the sample. These conclusions are supported by the finding of Lastovka (5) on PTN cited above.

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