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An analytical study on motor nerve conduction velocity of ulnar & common peroneal nerve in athletes of anaerobic sports

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Abstract
The aim of the present study was to investigate motor nerve conduction velocity (MNCV) of ulnar & common peroneal (CPN) nerves of bilateral side (i.e. dominant & non-dominant) of athletes who are engaged in an anaerobic type sport activities (sprinters & weight lifters). A total of 50 male sprinters & weight lifters with an average age, height and weight of 21.70±1.76 years, 170.38±3.31 cm and 72.06±6.04 Kg respectively, volunteered to participate in this study. Each subject's MNCV was measured with the help of computerized equipment called "NEUROPERFECT" (Medicaid Systems, India) and the data was analysed using Mean ± SD, t-test and Pearson correlation. Results show that MNCV of ulnar nerve of right and left side was significantly different ($p<.05$). MNCV of common peroneal nerve of bilateral side also significantly different ($p<.05$). For both ulnar and common peroneal nerves, results showed that the right ulnar nerve had significantly faster MNCV than the right CPN nerve ($p<.05$). According to the results, faster MNCV in right ulnar nerve (i.e. dominant) and left CPN as compared to left ulnar nerve and right CPN in sprinters and weight lifters may be from their long term training adaptations and further it may be relate to their upper & lower extremity movement requirement of changing their movement direction quickly and skill fully.

Keywords: Motor nerve conduction velocity, sprinters, weight lifters

Introduction

Anaerobic training is sometimes called "high-intensity training," and it is intense, requiring you to push yourself to the limit of your ability. Anaerobic exercise gets your heart rate and your breathing rate up-so carrying on a conversation while you're exercising anaerobically is out of the question. Unlike aerobic exercise, it can't be sustained for long periods of time without adequate rest. Sprinting and weightlifting are two examples of anaerobic exercise.

When you exercise intensely, your body burns a lot of calories in a short time, and it continues to burn calories at a higher rate for up to two hours after you're done, as your body recuperates. This is commonly called "after burn" or "oxygen debt" and can add to exercise's usefulness in weight management. The higher the intensity of exercise engaged in, the more energy that will be expended in the recovery phase.

Anaerobic exercise is a type of exercise that breaks down glucose in the body without using oxygen; anaerobic means "without oxygen". In practical terms, this means that anaerobic exercise is more intense, but shorter in duration than aerobic exercise.

The biochemistry of anaerobic exercise involves a process called glycolysis, in which glucose is converted to adenosine triphosphate (ATP), which is the primary source of energy for cellular reactions.

This type of exercise leads to a build-up of lactic acid.

Anaerobic exercise may be used to help build endurance, muscle strength, and power.

Metabolism

Anaerobic metabolism is a natural part of metabolic energy expenditure. Fast twitch muscles (as compared to slow twitch muscles) operate using anaerobic metabolic systems, such that any use of fast twitch muscle fibres leads to an increased anaerobic energy expenditure. Intense exercise lasting upwards of four minutes (e.g. a mile race) may still have considerable anaerobic energy expenditure. An example is High-intensity interval training, an exercise strategy that is performed under anaerobic conditions at intensities that reach an excess of 90% of the maximum heart rate. Anaerobic energy expenditure is difficult to accurately quantify. Some methods estimate the anaerobic component of an exercise by

Determining the maximum accumulated oxygen deficit or measuring the lactic acid formation in muscle mass.

In contrast, aerobic exercise includes lower intensity activities performed for longer periods of time. Activities such as walking, jogging, rowing, and cycling require oxygen to generate the energy needed for prolonged exercise (i.e., aerobic energy expenditure). For sports that require repeated short bursts of exercise, the aerobic system acts to replenish and store energy during recovery periods to fuel the next energy burst. Therefore, training strategies for many sports demand that both aerobic and anaerobic systems be developed. The benefits of adding anaerobic exercise include improving cardiovascular endurance as well as build and maintaining muscle strength and losing weight.

As muscles contract, Calcium ions are released from the sarcoplasmic reticulum by release channels. These channels close and calcium pumps open to relax muscles. After extended exercise, the release channels can begin to leak and cause muscle fatigue.

The anaerobic energy systems are:

- The galactic anaerobic system, which consists of high energy phosphates, adenosine triphosphate, and creatine phosphate; and
- The lactic anaerobic system, which features anaerobic glycolysis.

High energy phosphates are stored in limited quantities within muscle cells. Anaerobic glycolysis exclusively uses glucose (and glycogen) as a fuel in the absence of oxygen, or more specifically, when ATP is needed at rates that exceed those provided by aerobic metabolism. The consequence of such rapid glucose breakdown is the formation of lactic acid (or more appropriately, its conjugate base lactate at biological pH levels). Physical activities that last up to about thirty seconds rely primarily on the former ATP-CP phosphagen system. Beyond this time, both aerobic and anaerobic glycolysis-based metabolic systems are utilized.

The by-product of anaerobic glycolysis- lactate- has traditionally been thought to be detrimental to muscle function. However, this appears likely only when lactate levels are very high. Elevated lactate levels are only one of many changes that occur within and around muscle cells during intense exercise that can lead to fatigue. Fatigue, which is muscle failure, is a complex subject that depends on more than just changes to lactate concentration. Energy availability, oxygen delivery, perception to pain, and other psychological factors all contribute to muscular fatigue. Elevated muscle and blood lactate concentrations are a natural consequence of any physical exertion. The effectiveness of anaerobic activity can be improved through training.

Anaerobic exercise also increases an individual's basal metabolic rate (BMR).

Examples

Anaerobic exercises are high-intensity workouts completed over shorter durations, while aerobic exercises include variable-intensity workouts completed over longer durations. Some examples of anaerobic exercises include sprints, high-intensity interval training (HIIT), and strength training.

How do Aerobic and Anaerobic Training Impact Sports Performance?

Both resistance training (anaerobic) and endurance training (aerobic) are excellent ways to improve fitness and burn calories. However, exercise that is primarily aerobic (i.e. that uses oxygen to make energy) generally results in greater amounts of calories being burned during a given amount of time, as compared to highly anaerobic exercise. For example, a person who runs for 1 hour, at a pace of 8 minutes per mile, will expend about 800 calories. The same person who does a vigorous resistance-based work-out will expend about 400 calories in the same amount of time. While the oxygen debt after resistance training is somewhat higher than after endurance training, the total caloric expenditure will still be less. The best choice when designing exercise programs for weight loss is to include both highly anaerobic, resistance-type training for maintenance of muscle, and aerobic exercise for its ability to burn calories and to improve overall cardiovascular fitness.

The specific amount and types of training will depend upon your specific sport and are best tailored by an experienced trainer, with physician guidance if health issues or sports injuries are a factor in achieving or returning to peak performance.

Reaction, coordination, speed and power ability are fundamental for sport. All of the above abilities in sports are linked to motor nerve conduction velocity (MNCV). MNCV is a measure of speed of pulse (nerve impulse) can be transmitted along a moto neuron. A fast MNCV is also an indicator of a short refractory period. In other words, the decreased refractory period may allow for greater impulse frequency, thereby increasing muscle activation levels (Moyano & Molica, 1980). It is known that exercise can cause structural changes in skeletal muscles as well as an increase in excitability of motor units (Hoppeler 1988) [2]. But the effects of the type and intensity of exercise on these changes have not been studied in detail. Some studies suggest strength and power athletes have faster MNCV than endurance athletes (Kamen *et al*., 1984) [4].

However, it has also been reported that no differences were evident between power and endurance groups (Sleivert *et al*., 1995) [7]. Other researchers have shown that trained individuals have faster MNCV than untrained ones (Hoyle & Holt, 1983) [3]. In theory, changes in MNCV may be an indicator of nerve system adaptation due to long-term physical exercise training. Previous studies had investigated the clinical type of individuals. But, it is more meaningful and interesting to test the athlete especially in which the predominant energy system is an anaerobic type like sprinters & weight lifters and that need to control their lower extremities accurately and speedy that is requiring more neural adaptation for motor nerve conduction velocity after specific physical exercise training. Therefore, the purpose of this study was to investigate motor nerve conduction velocity in upper and lower extremities (radial & sural nerve of bilateral side) of athletes who are engaged in an anaerobic type sport activities and to realize whether their neural specification would change from long term training.

Methodology

Subjects: Total 50 Sprinters & Weightlifters in the age range of 18-25 years were voluntarily participated as subjects in the present study on the basis of their predominant energy system i.e. anaerobic. The dominant hand of all the subjects was right hand. The data was collected in Exercise Neurophysiology Laboratory, wherein the room temperatures were kept 25.9±00.2 ºC during the MNCV testing. The right and left arm and leg was testing for ulnar and common peroneal nerve (CPN) respectively. Motor Nerve Conduction Velocity (MNCV) was assessed with the help of computerized equipment called "Neuro perfect" (Medicaid Systems, India) by using the traditional double stimulation technique (Smorto & Basmajian, 1979) [8]. Square pulses of 0.1 Ms duration and of sufficient intensity to evoke a supramaximal compound muscle action potential were applied at each stimulus point with surface stimulating electrodes. The subject lay on a wooden table with the straight arm and leg as radial and sural nerve was tested.

Statistical analysis

Data were statistically evaluated with the t test and Pearson correlation test using SPSS version 10.0 (SPSS Inc., Chicago, IL, USA). Significance was set at the $p< 0.05$ level.

Results

The mean age, body height and body weight of the subjects were 21.70±1.76 years, 170.38±3.31cm and 72.06±6.04 kg respectively (Table 1).

Table 1 Mean ± SD of Physical Characteristics of an Anaerobic Group of Players

Group	N	Age (yrs.)	Height (cm)	Weight (kg)
Anaerobic	50	21.70±1.76	170.38±3.31	72.06±6.04

The mean values of MNCV of right and left ulnar and common peroneal nerves were 45.0±6.8 m/s, 44.9±6.5 m/s, 44.9±6.2 m/s and 45.5±7.0 m/s respectively (Table 2). It was found that the difference in the mean values of MNCV of right and left ulnar nerve were statistical significant ($p<.05$) and further It was found that the MNCV of right ulnar nerve was higher than left. The difference in the mean values of MNCV of right and left common peroneal nerve were also statistical significant ($p<.05$) and further It was found that the MNCV of left common peroneal nerve was higher than right. Results also showed that the mean MNCV of left common peroneal nerve was significantly ($p<.05$) more than the mean MNCV of right ulnar nerve.

Table 2: Mean ± SD of motor nerve conduction velocity (MNCV) of ulnar & common peroneal nerve

	Ulnar Nerve (m/s)	Common peroneal nerve (M/s)
Right	45.0 ± 6.8*	44.9 ± 6.2*
Left	44.9± 6.5*	45.5± 7.0*

*$p< 0.05$

The results of correlation showed that body height was positively and significantly related with body weight (r = 0.378). The MNCV of right ulnar nerve was also found to be positively and significantly related with MNCV of left ulnar nerve (r =.672) and negatively related with MNCV of right common peroneal nerve (r = -.292). The MNCV of right common peroneal nerve was also found to be positively and significantly related with MNCV of left common peroneal nerve (r =.582).

Table 3: Correlation (Pearson) among physical characteristics & MNCV of ulnar & common peroneal nerve

	Height	Weight	MNCV of ulnar nerve (Right)	MNCV of ulnar nerve (Left)	MNCV of common peroneal nerve (Right)	MNCV of common peroneal nerve (Left)
Age	.111	-.046	.074	-.085	.082	-.064
Height		. 378**	.021	-.090	.147	.236
Weight			.140	.070	.111	.145
MNCV of ulnar nerve (Right)				. 672**	-. 292*	-.177
MNCV of ulnar nerve (Left)					-.034	.022
MNCV of common peroneal nerve (Right)						. 582**

**$p< 0.01$; *$p< 0.05$. MNCV: Motor nerve conduction velocity

Discussion

In the presented study, the results showed that right and left sural nerve of sprinters and weight lifters players had faster MNCV than right and left radial nerve. The result was reasonable, since the goals of these athletes' training are known as rapid and coordinate movement. Sale *et al*., (1982) [11] have shown that individuals who undergo limb immobilization for 5 weeks prior to 18 weeks of strength training demonstrate faster median nerve conduction velocity following training. As more agility and coordination training by legs was evidence in sprinter and weight lifters training, it may cause more physiological adaptation in nerve structure for these athletes. Gerchman *et al*., (1975) [1] indicated that ventral Moto neurons following long term exercise had histochemical changes. To characterize muscle fiber differences in trained and non-trained subjects, marked changes in motor unit morphology and functional aspects were reported (Tesch & Karlsson 1985) [9]. Aerobic exercise with long-lasting contractions and anaerobic exercise with brief but high intensity contractions causes biochemical changes in motor units (Hakkinen *et al*. 1985) [1]. The changes in MNCV may be indicative of adaptations in the nerve structure such as increased axon diameter and myelination (Ross *et al*. 2001) [10]. These changes may enhance the adaptation ability of athletes to excessive physical activity but the mechanism mediating these changes and the exact role of this modulation remains to be determined.

Conclusion

The faster MNCV in right ulnar and left common peroneal nerves as compared to left ulnar and right common peroneal nerve in sprinters and weight lifters may be from long term training adaptations and further it may be relate to their lower extremity movement requirement of changing their movement direction quickly and skill fully. The results of the present study also indicate that long term training is important for increasing MNCV. But the types of training may have different levels of adaptation.

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