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Analysis of the application of creatine kinase (CK) in exercise training monitoring

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Abstract
The fundamental purpose of sports training is to improve athletes' competitive ability and to achieve excellent athletic performance in the competition. The quality of athletic performance mainly depends on the scientific degree of sports training. In this paper, the application of creatine kinase in exercise training monitoring is preliminarily explored and analyzed by means of literature review. The results showed that creatine kinase can promote the recovery of exercise-induced fatigue, delay muscle soreness and other myopathy, maintain individual exercise ability and monitor athletes' reasonable nutrition.

Keywords: Creatine kinase exercise training monitoring

1. Introduction
The fundamental purpose of sports training is to improve athletes' competitive ability and to achieve excellent athletic performance in the competition. The quality of athletic performance mainly depends on the scientific degree of sports training [1]. The so-called "scientific sports training" refers to the dynamic process of using scientific theories, methods and advanced technologies to organize the implementation and effectively control the whole process of sports training, so as to realize the ideal goal.

Creatine Kinase (CPK) is called Creatine Phospho Kinase (CK). Creatine kinase is closely related to mammalian energy metabolism, widely distributed in human skeletal muscle, cardiac muscle, brain and smooth muscle, with the highest content in skeletal muscle. Its biological role is to catalyze the reversible transformation of high-energy phosphate bonds between adenosine triphosphate (ATP) and phosphocreatine. It is a catalytic enzyme for energy supplementation and ATP recovery reaction during intense movement in a short time. It is closely related to energy balance and transfer during and after movement. Creatine kinase is involved in glycolysis control, mitochondrial respiration and muscle contraction energy supply, and is one of the key enzymes of ATP – CP energy supply system metabolism. Under normal circumstances, the contents of CK in muscle cells and blood are greatly different (about 5 times 105:1). This is because muscle cells have complete structure and normal function. CK in muscle cells rarely passes through the cell membrane and human serum CK remains in the normal range [2].

When the athlete is quiet, CK activity is at the normal range level or the high limit of normal level. When the athlete is quiet, CK concentration increases, which is a manifestation of cell function decline. Due to the movement to change the physical and chemical factors such as the organization cell damage, decreased body temperature, pH, ion concentration change and intracellular ATP levels drop, causes ageing of the cell membrane permeability increased and enzyme, increase enzyme to escape from the cells, as a result, both anaerobic and aerobic exercise can cause after exercise or the next morning the activity of CK up. The increase of CK concentration in serum is related to the duration, intensity and training level of exercise [3]. The activity change of serum CK can be used as an important sensitive index to evaluate the muscle endurance stimulation, skeletal muscle microdamage and adaptation and recovery. As a microscopic reference index, it is more scientific than blood lactic acid index. Coaches and researchers can use the changes of serum CK before and after training to assess the training load of the athletes' active muscles, and timely understand the fitness level of the athletes' muscle to the training load and the athletes' functional state, so as to prevent excessive fatigue.

2. Methods

2.1. Literature Review Method: In recent years, the application of creatine kinase in sports training monitoring is reviewed.On this basis, a summary and analysis is made to provide theoretical reference for the research content

3. Results and discussion

3.1. The monitoring effect of CK on exercise fatigue and recovery

The CK test research is a powerful tool for coaches and team doctors. Compared with ordinary people, athletes tend to have higher CK quietness, which may be related to their participation in daily training and greater muscle mass. However, post-training serum CK activity depends on the level of training: although athletes are at greater risk of muscle damage, their serum CK activity peaks are lower than the average [4]. At the same time, significant increase of CK was found in those who participated in less training. Reporting by Gui zi heng, *et al*. [5] CK recovering slower contestants, special qualities and techniques are difficult to consolidate and improve. The excellent young players may have strong endurance and recovery ability to the high training load under the condition of high CK. However, if the high CK appears for too long, that is, the athlete body bears the high load for too long, and with the decline of the body ability, it is more prone to local damage. And the athletes who can't bear the heavy load during training and the increase range of CK is low can hardly improve the special performance. Ulrich Hartmann *et al*. [6] found that athletes with chronically low serum CK (female, 100IU/L, male, 200IU/L) showed mainly low variability, while athletes with long-term high serum CK(female, 200IU/L, male, 400IU/L) showed relatively high variability, suggesting that the monitoring of serum CK level plays an important role in the development of athletes' individual training plans. The "training value" of CK mainly reflects the stress level of the body to the exercise load, and the "recovery value" can better reflect the body's adaptation to the training load and the recovery status after training [7-9].

3.2. The monitoring effect of CK on delayed muscle soreness and other myopathy

A large number of studies have shown that muscle after a high intensity load (especially centrifugal exercise or work - based exercise) may lead to delayed muscle soreness in skeletal muscles, resulting in decreased athletic ability. Some scholars believe that the delayed increase of CK in serum may be the final stage of the sports injury process, and the muscle soreness is highly correlated with the serum CK level [10]. Rodenburg *et al*. found that after centrifugal exercise, changes in muscle soreness were significantly correlated with changes in serum CK activity. The increase of serum CK activity induced by motor skeletal muscle injury is characterized by delay. After the centripetal, equal-length exercise and endurance running, the peak value of CK appeared earlier, about 18-24h, while the peak value was usually reached on the fourth day after the centrifugal exercise and remained high.Increased activity of CK prior to muscle soreness is helpful for earlier diagnosis of muscle injury. The field study found that the increase of serum CK after exercise was synchronized with the changes of muscle soreness, and the activity of serum CK could be used as an objective index to evaluate the delayed muscle soreness after one-time exercise and continuous exercise. Elevated serum CK level in healthy people may be related to muscle injury caused by physical activity. The total activity of serum CK increased significantly 24 hours after one exercise, and gradually recovered to the basic level when the body rested. There are also occasional instances of increased serum CK levels in healthy individuals, which may indicate the presence of early myopathy. Skeletal muscle dysfunction is mainly manifested by pain, fatigue, weakness and increased serum CK. Different muscle diseases show different increase value of serum CK, as shown in the table below [11].

Table 1: CK values for certain myopathy

Muscle disease	Increased numerical criteria for CK
Duchene and Beck type muscular dystrophy	25-200 times
Acromiotrophic dystrophy	10-100 times
Acromiobrachial dystrophy	2-7 times
Peripheral myopathy	Three times
Endocrine myopathy	As many as ten times
Congenital myopathy	Slight increase
Metabolic myopathy	Slight increase
Mitochondrial myopathy	Slight increase
Drug-induced myopathy	Slight increase or no change

3.3 The monitoring effect of CK on individual motor ability

Xu wen Hao *et al*. [12] Believe that the activity of CK is not significantly changed in general intensity exercise even if it lasts for 140-160min, but the activity of CK is significantly increased in athletes after speed and speed endurance training. Du guo mu's study [13] found that athletes in training all the year round the run-up of restorative low intensity training did not affect its quiet in CK values, even lower than the student, after intensive strength training, different levels significantly increased CK activity in the body, he also found that the speed skating athletes after high intensity training, CK activity in a quiet state, man was 170%, and the woman was 190%. Du zhong Lin [14] analyzed the serum CK value of national rowing team athletes for the Olympic year (2000). The serum CK activity of the 7 female players after high-load strength training was 15.3 times of that before training on average. Muscle coordination and competition stress also had significant effects on the athletes' serum CK. Studies have shown that both high-intensity and low-intensity exercise training can increase the activity of CK in serum. Su quan sheng[15] let 10 professional students of football in the run, such as the stage to complete the incremental load movement until exhaustion, when quiet, immediately after exercise and recovery after 30 min of blood urea, serum muscle activated kinase indicators, such as found immediately after exhaustion exercise and exercise 30 min after serum CK increased significantly, the quiet state has a significant difference ($P < 0.01$), with no significant changes in blood urea, which accords with the majority of research results at home and abroad. The mechanism of increased serum CK activity is not clear. It is generally believed that the permeability of tissue membrane, especially the myomembrane, is temporarily changed or damaged due to various reasons, which leads to the release of cellular enzymes. Intense vibration during exercise, increased osmotic pressure caused by the accumulation of intracellular metabolites, and relatively insufficient internal energy supply caused by muscle glycogen depletion, leading to changes in cell membrane structure, all of which can lead to temporary changes in membrane permeability, leading to CK release in cell membrane. With the increase of intensity in the training, the serum CK value

also increases accordingly. The training state of athletes is also manifested as the process from unadaptation to adaptation, and their special sports ability decreases when they are not fit, and the special ability will be broken after adaptation.

3.4 The monitoring effect of CK on athletes' reasonable nutrition

Reasonable nutrition is the basic guarantee of excellent achievements, athletes athletes for a long time the high strength of the great physiological load of exercise training to reinforce the body energy metabolism, metabolic product, reasonable nutrition can complement the athlete excessive consumption of thermal energy, increase energy material reserve, accelerate the elimination of metabolites, for athletes to give full play to the movement and physical recovery after exercise. Whether the supplement of athletes' nutrition is reasonable and effective needs to be evaluated by monitoring the physiological and biochemical indexes of athletes. Supplemental phospholipids play an important role in protecting cell membrane structural integrity and protecting internal organs from lipid peroxidation.

Weng xi *et al*. [16] found that the supplementation of phospholipids for 1 week can produce significant health care effect on the body: the activity of CK decreased significantly in the experimental group when it was quiet, while the control group kept the same level as before the experiment.Although CK activity was also significantly increased in the experimental group and the control group at the time of exhaustion exercise, the increased level was still significantly lower than that of the control group. CK is one of the key enzymes for metabolism of the body's atp-cp system, which is closely related to energy metabolism of the body.Under normal conditions, muscle cells have complete structure and normal function, CK rarely permeates the cell membrane, and the level of serum creatine kinase is very low.However, high-intensity training can lead to increased permeability of muscle cell membrane and even damage of muscle cells. The creatine kinase in muscle cells spills into serum, causing increased serum creatine kinase. Therefore, serum creatine kinase index is often used to reflect the adaptation and recovery of muscle cells to sports training.The increase of training amount and training intensity will lead to the increase of serum CK, but CK has relatively high sensitivity to load intensity, which is an important indicator of the athletes' functional state and body recovery after exercise.

According to the literature research of Xu haowen [17], the activity of CK can be increased to 100-200 U/L by the exercise of sub-extreme strength, and the activity of CK of extreme strength can be increased to 500-1000 U/L or so. The quiet reference value of general female athletes should not be higher than 200U/L.A significant increase in serum CK indicates that the athletes' muscles are in a state of sports injury, which will gradually lead to decreased athletic ability.In this period of training, the athletes can easily cause skeletal muscle damage.After high-intensity muscle contraction, muscle soreness was highly correlated with serum CK level.Increased activity of CK prior to muscle soreness is helpful for early diagnosis of muscle injury. Through literature at home and abroad, found a rise in serum CK activity of rowing athletes is more, in the process of the project are involved in a lot of muscle contraction, the muscle cells increase energy consumption, increase in the number of ATP hole to maintain normal cell function, muscle cell pH decline, lack of oxygen and ion concentration changes increase the micro damage of muscle cells, muscle cell membrane permeability increased red blood cell damage increase at the same time, increase cell escape CK, elevated serum CK.However, this situation does not mean that the degree of fatigue of athletes is extremely high.

4. Conclusions

In the process of sports training, due to the constant stimulation of the body by external loads, the degree and frequency of oxidative stress produced by the tissue is higher than that of ordinary people, resulting in the mass production of free radicals and the exhaustion of antioxidant enzymes, which exceeds the defense capability of the antioxidant system and reduces the overall antioxidant capacity. Exercise fatigue, apoptosis, senescence and many diseases are closely related to this mechanism. The results showed that creatine kinase can promote the recovery of exercise-induced fatigue, delay muscle soreness and other myopathy, maintain individual exercise ability and monitor athletes' reasonable nutrition.

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