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Basketball Anterior and Posterior Portal Veins Doppler Imaging of Sports Medicine Technique Exploration

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Abstract

INTRODUCTION: Basketball, as a high-intensity sport, has attracted much attention for its effects on the cardiovascular system of athletes. The anterior and posterior portal veins are some of the vital blood vessels in the human circulatory system, and their blood flow is closely related to the athletes' physical status. Doppler ultrasound technology is widely used in sports medicine and provides a powerful tool for an in-depth understanding of the effects of basketball on portal vein blood flow. This study aimed to explore the potential of sports medicine technology in assessing cardiovascular adaptations in athletes through portal Doppler imaging before and after basketball exercise.
OBJECTIVES: The primary objective of this study was to analyze the effects of basketball exercise on portal vein blood flow in athletes before and after basketball exercise through the use of Doppler ultrasound technology. Specifically, this study aimed to explore the dynamics of pre- and post-exercise Doppler imaging of the posterior and posterior veins in order to assess the cardiovascular adaptations of athletes during exercise more comprehensively and objectively.
METHODS: A group of healthy professional basketball players were selected as the study subjects, and Doppler ultrasound instruments were utilized to obtain portal Doppler images before, during, and after exercise. The functional status of the vasculature was assessed by analyzing parameters such as portal blood flow velocity and resistance index. At the same time, the physiological parameters of the athletes, such as heart rate and blood pressure, were combined to gain a comprehensive understanding of the effects of basketball on portal blood flow.
RESULTS: The results of the study showed that the anterior and posterior portal blood flow velocities of the athletes changed significantly during basketball exercise. Before the exercise, the blood flow velocity was relatively low, while it rapidly increased and reached the peak state during the exercise. After exercise, blood flow velocity gradually dropped back to the baseline level. In addition, the change in resistance index also indicated that portal blood vessels experienced a particular stress and adaptation process during exercise.
CONCLUSION: This study revealed the effects of exercise on the cardiovascular system of athletes by analyzing the Doppler images of the portal vein before and after basketball exercise. Basketball exercise leads to significant changes in portal hemodynamics, which provides a new perspective for sports medicine. These findings are of guiding significance for the development of training programs for athletes and the prevention of exercise-related cardiovascular problems and provide a valuable reference for further research in the field of sports medicine.

Keywords: basketball, portal vein, Doppler imaging, sports medicine

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1. Introduction

The rapid development of sports medicine has not only made remarkable contributions to academic research but has also contributed positively to the promotion of national health and the improvement of the practical application of sports medicine(Zhang, 2021). In the broad field of sports medicine research, significant progress has been made in studies on endocrine regulation of exercise and other aspects (Carter, 2022). These studies have not only provided insight into the links between exercise and different physiological systems but also provided solid support for the prevention and treatment of exercise-related diseases (Lona et al., 2021). However, despite the outstanding achievements in many areas of sports medicine, more research needs to be done on the renal-biliary and portal venous systems. In many branches of medicine, although the kidney, bile, portal vein and other tissues and organs have received extensive attention, most research is still focused on the fields of anatomy, physiology, pathology and clinical medicine(Khatra et al., 2021). The dynamic changes of the kidneys during exercise are still relatively understudied in the fields of clinical medicine and sports medicine. In fact, the changes in the kidneys, gallbladder, and portal veins during exercise should be one of the essential topics in sports medicine research (Jin et al., 2021). Therefore, in view of the above background and reasons, it is imperative to find scientific, safe and practical research methods to comprehensively and deeply understand the effects of exercise on the renal, gallbladder and portal vein systems (Pourahmadi et al., 2021). This will help to fill the knowledge gaps in related fields, provide more comprehensive and in-depth knowledge for the field of sports medicine, and promote the research and application of sports medicine (Liu et al., 2022). Overall, the development of sports medicine provides an opportunity to deepen the understanding of the relationships between body systems.

Many scholars have demonstrated that strenuous exercise or acute depletion can cause the formation of excess free radicals in vivo, which leads to significant oxidative damage in the kidney (Heyward et al., 2021). Ultrastructural observations of mouse kidneys after exercise failure showed a significant decrease in renal glycogen, enlargement of the smooth endoplasmic reticulum, and rupture of some renal cells after seven consecutive exercise failures (Broeker et al., 2021). In the study of mice subjected to exhaustive basketball exercise after 6 weeks of endurance training, the mitochondria of the control group were structurally intact. In contrast, the mitochondria of the training group were morphologically altered, with lysis and rupture of cell membranes and cristae and even disintegration and vacuolization of the entire mitochondria (Deckey et al., 2022). Meanwhile, electron microscopic observation of the renal cytoplasm in the exhaustive basketball group revealed that a large number of lipid droplets were incorporated into vesicles, accompanied by localized cytoplasmic lysis and a slight dilation of the rough endoplasmic reticulum (Tang et al., 2021). These studies not only revealed the potential mechanism of the effect of exercise on the kidneys but also provided a solid scientific basis for further understanding of the physiological changes induced by exercise.

During high-intensity training, renal chemistry may occur in the short term due to redistribution of blood. As the intensity of the exercise decreases, the blood is reintroduced back into the bloodstream and forms a transfusion, which can cause potential kidney damage (Rivera Nez et al., 2022). Through investigations in ischemic animals, the researchers found that ischemic reinjection injury can cause renal cell death in mice. This phenomenon is usually apparent in the early stages after multiple injections. In addition, the effects of decreased haemoglobin levels in rats induced by prolonged weight plate exercise and dietary supplements were revealed through studies of rats subjected to weight plate exercise and dietary supplements (Rodney J., 2022). Renal mass structures were not evident in rat kidney tissues, with nephrocyte structures blurred and most of the nephrocytes showing turbid tumours or hydropic degeneration. However, no abnormal changes in renal morphology were observed in the exercise group and mice subjected to weight loss, suggesting that the dietary supplements used may have the potential to prevent renal injury due to exercise (Xu et al., 2021). After basketball training, brown apoptotic cells were significantly increased in rat kidney cells. Tumour cells reached the highest level in the 6-day basketball group, whereas they decreased in the 12-day basketball group and increased again in the 18-day basketball group. Exposure and bubble formation on the cell surface can be seen as tiny objects surrounded by fission membranes (i.e. apoptotic membranes). Phagocytes are active and can bind to these tiny objects (Hausken-Sutter et al., 2021). In the 12-day basketball training group, there was extensive organ rupture and swelling, near depletion of glycogen, many porous areas in the cells, damage to some cell membranes, saturation of the contents, and rupture of the rough internal network.

2. Background of the study

The intensity and duration of exercise affect the kidneys in different ways. Appropriate exercise helps to improve renal resistance to exercise-related fatigue and provides a theoretical basis for the moderate accumulation of exercise load. The results of the study showed that after 70 minutes of basketball exercise, malondialdehyde concentration in the renal tissues of mice was significantly lower than that before exercise. In contrast, peroxide dichotomous activity was significantly higher than that before exercise (Graynawiderska-Koacz et al., 2021). This suggests that short-term exercise activates peroxidase activity, improves the ability to scavenge free radicals from the heart, kidney and renal tissues, and reduces malondialdehyde concentrations. The study points out that exercise helps to increase the resistance of renal tissues to oxidative damage in mice (Modo et al., 2022). Notably, stressful exercise may adversely affect the structure and function of renal tissues. The results of the study showed that high-intensity exercise significantly increased serum lactate dehydrogenase, alanine, aspartate carboxylase, and serum glycine concentrations, suggesting that high-intensity exercise has a negative effect on renal cells.

Exercise-induced abdominal pain and constipation are phenomena of interest in the clinical practice of sports medicine. These phenotypes suggest that the kidneys undergo a number of changes during exercise; however, relevant research is currently limited and direct pathologic evidence is lacking (Mahtari et al., 2021). In the absence of objective scientific reports, data on renal dynamics, biliary tract and portal vein changes are also relatively limited (Lima, 2021). Currently, one of the most common theories regarding exercise-induced abdominal pain is the renal embolism theory, but this theory deserves to be revisited. During human exercise, input impulses to sensory nerves (e.g., muscles and joints) cause the cerebral cortex to accelerate, weakening the tone of the vaginal nerves and increasing the tone of the sympathetic nervous system. This further leads to an increase in adrenaline and epinephrine levels in the adrenal core, causing athletes to breathe faster and deeper and jump faster (Suvorova et al., 2023). However, due to the intense control of the sympathetic nervous system over the internal organs, there is an increase in internal vasoconstriction, which may even exacerbate visceral ischemia. Intense exercise leads to a decrease in visceral blood volume, and the contraction of the internal organs often triggers necrosis and secretion of the gastrointestinal mucosa.

In summary, the organs of the kidney and spleen, as internal organs of hematopoiesis, change rather than remain unchanged during exercise (Alexandra et al., 2021). Considering the complexity of the human body and the limitations of the experimental conditions, dynamic observation of the renal biliary system with imaging morphology was chosen to explore in detail the distribution of renal repair sites or their physiological and biochemical changes, with a view to providing a safe, non-invasive, and reliable indicator for the medical monitoring of sports injuries and diseases.

3. Research methodology

3.1 Exercise effects on the kidney and Doppler imaging mechanisms

Exercise affects the kidneys and causes changes in their function. High-intensity training may cause kidney damage, and the kidney pain that occurs is a significant manifestation of this. The initial effects on kidney function are mainly seen in renal glycogen levels. Findings show that this leads to a blurring of renal cell structure, with most renal cells being cloudy, swollen, or having some degree of degeneration. The development of an energy-fatigue exercise glycolysis model showed significant swelling of renal cells, narrowing of the renal lumen, swelling of mitochondria, and coarse expansion of the internal network. Studies on exercise-induced mice showed that fatigue led to an increase in the wet endoplasmic reticulum (ER) of renal cells after exercise. After seven fatigue-induced exercise sessions, some renal cells underwent tearing, and the ratio of renal cells to endoplasmic reticulum deteriorated. This unique fatigue exercise caused significant damage to the ultrastructure of renal cells and led to significant changes in some organs. Thus, the main effect of a single exercise on the microstructure of renal cells manifests itself as individual fatigue. In contrast, the destructive effect on the superstructure of renal cells manifests itself mainly as individual fatigue. Flow chart of plain Doppler imaging is as shown in Figure 1.

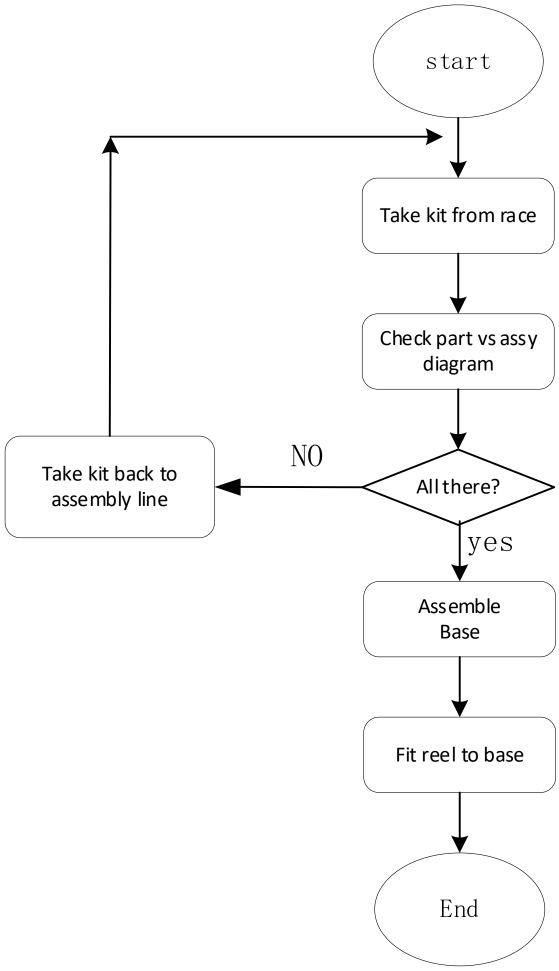

Figure 1 Flow chart of general Doppler imaging

Capillaries connect the two ends of the portal vein. This anatomical feature not only causes bleeding in the kidneys but can also cause renal arrest, spleen and hematoma, increased pressure over the portal, and pain or swelling in the kidneys and spleen. Another cause of kidney and spleen pain at the beginning of exercise is an irregular breathing rhythm. During high-intensity exercise, breathing becomes uneven and irregular, making it rapid and fast, leading to fatigue and even twitching of the respiratory muscles, which itself may cause pain. In addition, fatigue and twitching of the respiratory muscles may weaken the effect of massage on the kidneys, whilst shortness of breath, chest compression, and difficulty in returning to the inferior vena cava may also lead to blockage, swelling or tension in the kidneys and spleen, which can cause pain.

Before and after training, it is necessary to examine the morphology of the gallbladder, pancreas, spleen and kidneys with the help of medical imaging techniques. This is due to the critical role of morphological information in this process. The analysis of the human body before and after exercise still requires a combination of different perspectives, methods and disciplines. The introduction of three-dimensional ultrasound and contrast ultrasound imaging has not only met the need for ultrasound analysis and diagnosis but has also had a profound impact on the field of sports medicine. The use of ultrasound in sports medicine has a long history. Athletes are increasingly considering the value and role of ultrasound in the diagnosis of musculoskeletal disorders, especially in a number of injuries, such as rotator cuff injury syndromes, ankle injuries, soft tissue inflammation, joint fluids, muscle injuries, hematomas, etc., with an accuracy comparable to that of MRI and X-rays. Ultrasound technology makes it possible to dynamically observe the onset and progression of trauma, thus aiding in treatment and healing. In addition to monitoring physiological and biochemical indicators and treating athletic injuries, training is also conducted in the fields of exercise science and sports medicine. The study of visual changes in the organs and systems of the human body after exercise is an inevitable consequence of the development of human and sports medicine. As the largest organ in the human body, the kidney plays a vital role in metabolism, bile secretion, detoxification, coagulation, immunity, thermogenesis, and regulation of water and electrolytes.

$$p(A|B)=\frac{P(A_i)P(B|A_i)}{\sum_{j=1}^{n}P(A_j)P(B|A_j)}, i=1,2....n \quad (1)$$

In Equation (1), *P(A|B)* is the process of finding conditional probability in Bayes' equation. The specific rules are as follows:

$$P(A|B)=\frac{P(A,B)}{P(B)}=\frac{P(B|A)P(A)}{P(B)} \quad (2)$$

The Bayesian equation can be correlated and simplified as shown in Equation (2), where *P(A, B)* is the probability of occurrence of either A or B.

$$P(A_i|E)=\frac{P(E|A_i)P(A_i)}{P(E)}=\frac{P(E|A_i)P(A_i)}{\sum_i P(E|A_i)P(A_i)} \quad (3)$$

In Equation (3), E is the conditioning variable, and *P(A|E)* is the probability P of A under the conditioning variable.

$$h_1=p(c_1), h_2=p(C_2), h_1+h_2=1 \quad (4)$$

In Equation (4), C_1 and C_2 are the variables of functions 1 and 2, respectively.

$$R(a_i|x)=\sum_{j=1}^{N}\lambda_{ij}p(c_j|x) \quad (5)$$

In Equation (5), the *R(a|x)* function is the risk function and is the expected implied risk.

One of the common symptoms during exercise is abdominal pain. Abdominal pain can be caused by a variety of factors, including stomach disorders such as nephritis and gallbladder inflammation, coronary artery disease, and factors related to physical activity. The target heart rate is a specific heart rate that must be achieved during exercise. This indicator plays a vital role in assessing aerobic exercise.

3.2 Experimental Methods and Procedures

Not all patients had kidney disease, alcohol-related kidney disease, or fatty kidney disease. Alcohol was not allowed two days before the test, and participants were allowed to eat hungry. Color Doppler measured the size and width of the kidneys, gallbladder, and portal vein in 10 athletes of the same size before training. Moderate exercise using a treadmill was performed for 5, 10, 15, and 20 minutes prior to immediate examination of the kidney, gallbladder, and portal vein tests.

Before starting the study, participants must undergo a starvation test. The goal was to better monitor the shape and size of the gallbladder without affecting the results of the kidney and portal vein intestinal gas analysis. While performing the experiments for this study, the subjects first performed a 5-minute walk to ensure that their heart rate was maintained within the target range of 140-160 beats per minute. Immediately after that, they received a scan of the image data and waited during the subsequent rest period until the heart rate was fully restored to a calm level. Participants who had returned their heart rates to silent levels then returned to the treadmill at an average heart rate of 140-160 beats per minute. After an additional 10 minutes of walking, an instant image scan and rest were again performed to ensure that the heart rate was able to return to silent levels. At this point, the heart rate had fully returned to silent levels, allowing the participant to get back on the treadmill again at an average heart rate of 140-160 beats per minute. After 15 minutes of walking, the image data was again scanned and rested to ensure that the heart rate had returned to quiet levels. Those individuals whose heart rates had calmed returned to the treadmill again and walked for 20 minutes at an average heart rate of 140-160 beats per minute. Immediate image scans were then performed at five-minute intervals, and the recorded image data was re-measured to ensure that the heart rate remained within the target range. This process was designed to provide a comprehensive picture of the subject's heart rate variability and recovery on the treadmill and to provide detailed data to support the study in order to improve the understanding of cardiovascular health. In order to obtain accurate data for each analysis, three critical pieces of data are needed to obtain the following statistics. Move the object to the left posterior position. Posterior left position: encourages freezing the image to measure different metrics before and after exercise and smooths the edges of the image data. Basketball Doppler image flow, as shown in Figure 2.

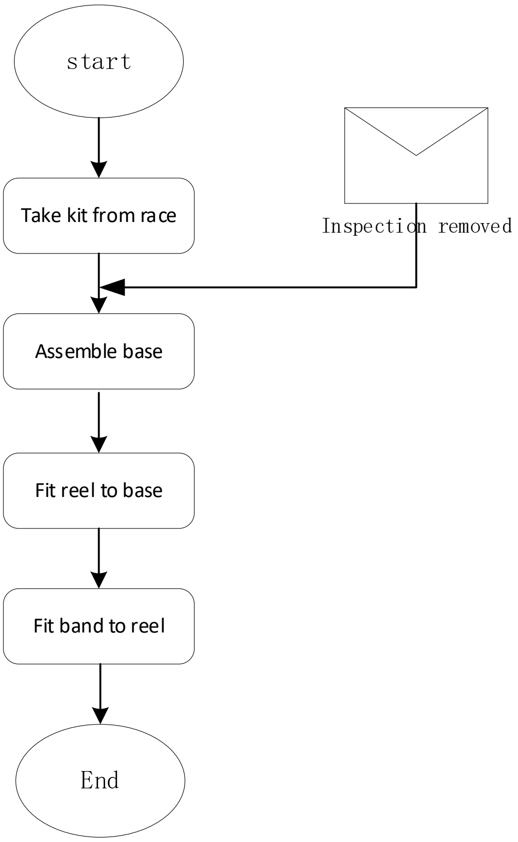

Figure 2 Basketball Doppler imaging flow

The length of the kidney is measured at a distance from the centre of the right clavicle to the base of the kidney. Longer real-time images help to measure the kidney accurately, especially when the kidney becomes larger. However, it is difficult to measure the kidney accurately due to the limited real-time viewing area of the sector scan. However, it wasn't easy to measure length and diameter from the vertical profile. Experimental data showed that the length of the kidneys was significantly reduced after exercise. During the initial 5-10 minutes of exercise, the kidneys were significantly contracted. The maximum value of kidney length measured during exercise was 1 cm lower than the maximum value before exercise, resulting in a significant decrease in kidney volume. This decrease in renal volume may reflect the distribution of blood from the kidneys to the whole body after exercise. Due to the exercise involving the right upper abdomen, a painful sensation may be induced, usually during the first 5-10 minutes of exercise. After exercise, skeletal muscles and skin are involved in the movement, resulting in an even distribution of blood throughout the body, with some blood returning to visceral reserves. If swelling of the kidneys occurs with the removal of the renal shell, it may cause tugging pain.

4. Results and discussion

4.1 Discussion of sports medicine in young basketball players

In the global basketball playing field, the competition on the web is gradually increasing, and athletes are witnessing a higher level of development. Every country is vying for height and strength advantages, making the physicality of the athlete a key factor. They usually possess high body weight, physiological muscle thickness and great muscular strength.

In China, there is a consistent trend in the development of young male and female basketball players, in which increasing the number of athletes is crucial. Especially for those young basketball players, athletes often possess a high level of education but are also more prone to injury, especially in fast-paced and intensive playing environments. One study found that 35.93 per cent of athletes and 75 per cent of coaches attributed sports injuries to poor physical conditioning. Athletics is the cornerstone of all technical, tactical, and motor skills in basketball. Still, athletes are less physically fit than basketball teams, especially men's teams, when compared to Chinese athletes. The physical development of adolescents is uniquely characterized, with the fastest and most significant rate of physical development occurring at age 15 for males and 12 for females. The rate of improvement in physical condition varies with age and is often referred to as the sensitive stage. Young athletes are at a stage of physical development where muscle development is relatively slow, and strength and performance are relatively weak. The technical movements of basketball are primarily dependent on the upper body, waist and abdomen, and physical training of the upper body plays a crucial role in basketball. However, research data reveals a trend that makes it difficult to maintain the overall quality development of young athletes, and the core problem lies in the overemphasis on lower limb physical fitness training relative to upper limb training during training, which leads to severe damage to the athlete's upper body (including the shoulders, waist, back, and elbows). This imbalanced training pattern may expose athletes to a greater risk of injury during competition. There is an urgent need to address this issue by developing a scientific and reasonable training program based on the physiological development of youth and the specific needs of basketball, including balancing lower and upper limb physical fitness training in training to ensure that the overall fitness is comprehensively improved. In addition to this, it is also crucial to emphasize the importance of diet. Through a reasonable diet, young athletes can receive sufficient nutrition to ensure a balanced weight gain, promote physical development, and provide them with sufficient energy reserves to better cope with intense sports activities.

Meanwhile, moderately improving strength quality is a crucial step to improve the status quo. Through scientific and reasonable strength training, athletes can enhance muscle strength, improve body adaptability, and effectively reduce the incidence of sports injuries. In summary, solving the problem of unsustainable quality development of young athletes requires careful consideration of multiple aspects, such as training programs, dietary management and strength enhancement to ensure the healthy and sustainable development of athletes in their competitive careers.

With the development of modern basketball, the speed of basketball has become faster and faster, and the technical movements have become more and more complicated. Athletes are also required to be technically and tactically accurate at a reasonably high level. Minor oversights can lead to errors that are often associated with athletic injuries. In children's basketball, 62.5% of coaches attributed athletes' injuries to poor technical behaviour. These technical behaviours violate anatomical characteristics, organ function, and biomechanical movement rules.

Professional studies have shown that injuries to young athletes during their training and competition are primarily rooted in deficiencies in the planning of their training and relaxation activities. One of these deficiencies is the lack of knowledge these athletes have about training or pre-professional activities. Often, preparation for training is limited to simple jogging and occasional stretching, which clearly fails to achieve an adequate level of preparation. Even more concerning, some young athletes even participate in practices and competitions unprepared. Skeletal muscle plays a vital role in human movement. It is not a fully flexible part of the body but becomes part of the ligament cells during development. In addition, temperature has a significant effect on skeletal muscle. As temperature decreases, intermolecular friction in muscle plasma increases, leading to an increase in muscle viscosity along with a decrease in elasticity and flexibility.

In contrast, as temperature increases, muscle viscosity decreases and flexibility and elasticity increase. In order to circumvent sports injuries, professional athletes should always prepare for individual conditions and weather conditions before training. Particular attention needs to be paid to potential weak points in the sport to protect the body from potential injury better. It is essential to consider these factors holistically when thinking about the overall health and performance of the athlete. Basketball sports medicine growth rates (1), (2), and (3) are shown in Figures 3, 4, and 5.

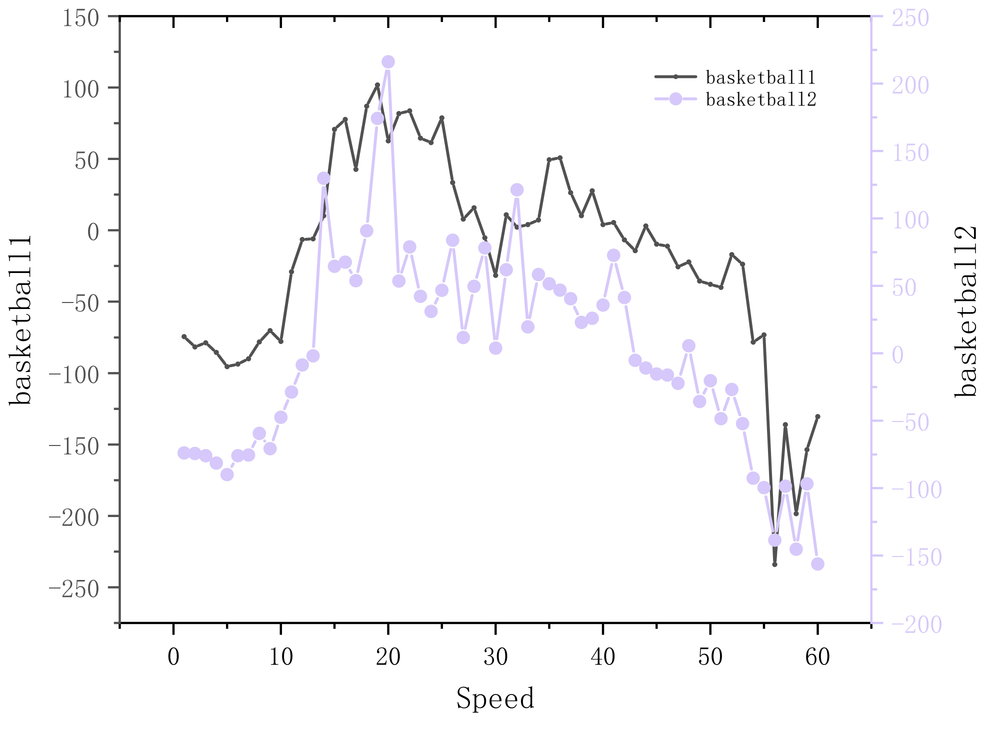

Figure 3 Basketball sports medicine growth rate (1)

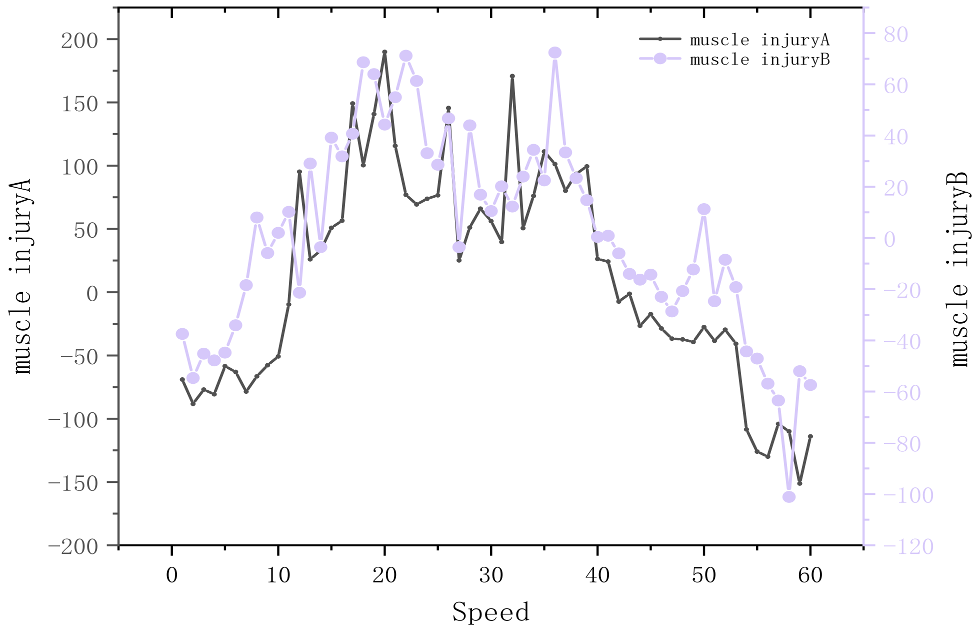

Figure 4 Basketball sports medicine growth rate (2)

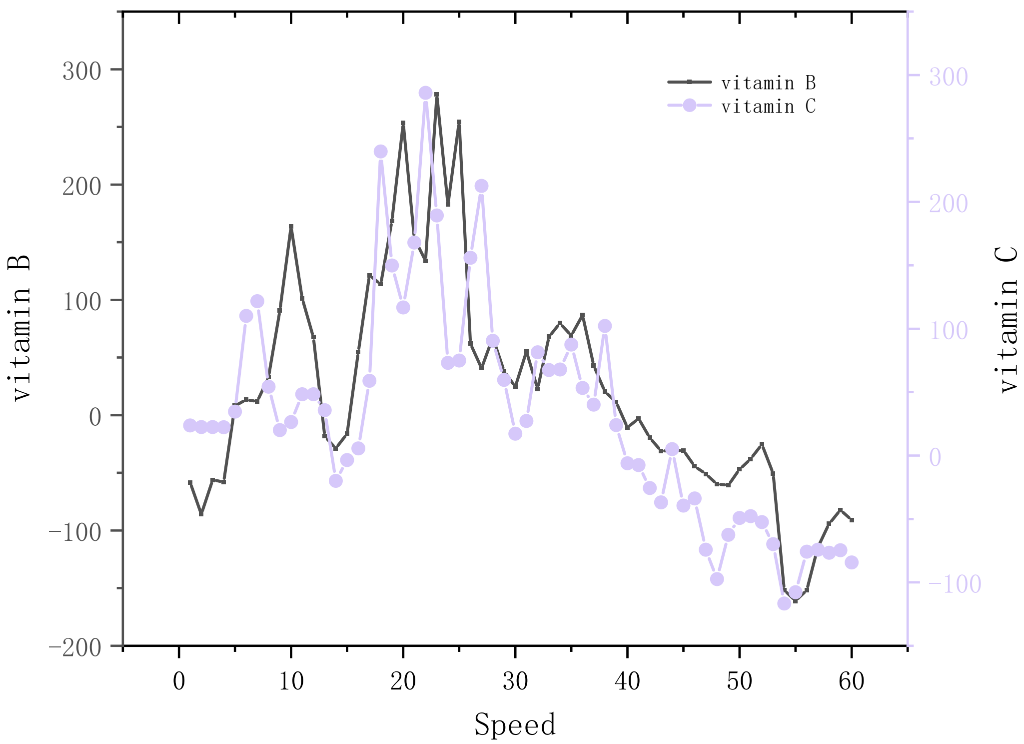

Figure 5 Basketball sports medicine growth rate (3)

This last session takes place after a relatively easy workout and is designed to promote rapid recovery of body functions. Research has shown that one of the most essential ways to achieve good training results and prevent sports injuries is to end training with proper activity. Organizational activities help relieve muscle stiffness, reduce fatigue, and improve physical function. Youth teams have a relatively small medical staff, and the athletes themselves manage most courts. Exercise makes athletes more tired and often more passive when organizing activities, problem-solving, and even walking.

4.2 Analysis of muscle testing results of youth basketball players

In this study, about 32.81% of sports practitioners believed that sports injuries were mainly caused by excessive tension. Sustained improvement in performance is closely related to increased loading. However, there is a limit to the amount of load or tension that different sports disciplines can tolerate. The higher the load, the more beneficial it is, especially for young people whose bodies still need to be fully developed. From a physiological and anatomical point of view, young bones are flexible. Joints have a wide range of motion but are less rigid and prone to dislocation. Muscles are underdeveloped, with differences in shape, composition and function from adults. The heart and nervous system are not yet fully developed, and the heart rate is low. The goal of exercise is primarily to increase heart rate and improve cardiac function to meet the needs of the young. Respiratory muscles are weak and under-regulated. During exercise, lung ventilation is increased primarily by increasing respiratory density rather than depth. Given these physiological characteristics, young people must be subjected to appropriate levels of stress during adolescence, and special care must be taken to avoid excessive localized exercise. When the body is overloaded, it not only interferes with adaptive capacity but may also experience degenerative responses. Excessive localized stress may also interfere with the smooth flow of education, increase the risk of injury, and impair a young person's growth and development.

Assessing athlete fatigue, adjusting training programs, and managing it in a timely manner is critical for science-based training coaches. A survey of 16 young men's and women's volleyball coaches found that only five coaches determined their workload based on basketball characteristics and their characteristics. Lack of targeted athletic training is also a cause of athletic injuries. Basketball is a sport that combines anaerobic and aerobic energy systems, with a primary focus on anaerobic purposes. There are differences in the demands of athletic training due to the differences in responsibilities and training methods of different professional positions. There are significant differences in training between young and adult athletes, especially in terms of movement.

Injuries resulting from athletic training are one of the common causes of high-level sports. When the body suffers damage, a variety of physiological and psychological side effects usually result. From a psychological perspective, young athletes have a more flexible nervous system. Still, they are less able to self-regulate, which can lead to symptoms such as lower self-confidence and traumatic depression. Research has shown that young basketball players are more susceptible to injury, especially when some athletes continue to train due to unrecognized injuries, especially for minor, chronic injuries that are difficult to detect and to continue training. Due to intense competition within sports teams, some athletes may conceal their injuries and continue to participate in traumatic training. However, this behaviour not only negatively affects the effectiveness of training but also has an apparent adverse effect on the growth and development of young athletes. According to foreign studies, 42% of sports injuries originate from repeated injuries in the same area, further emphasizing training-sports injuries are a significant factor in sports injuries. In addition, it is necessary to develop appropriate post-traumatic care, rehabilitation plans and training programs to promote the overall recovery and development of athletes.

4.3 Basketball sports medicine protection technology

Medical monitoring is widely recognized as crucial in the field of competitive sports. The core responsibility of this system lies in the review of an athlete's physical and functional indicators over a specific period to ensure that optimal performance can be achieved during training and competition. Emphasizing the importance of medical monitoring allows for a comprehensive assessment of an athlete's functional status and level of education, thus providing a solid basis for the development of appropriate training and competition rules. Medical monitoring is multifaceted and is mainly carried out in concert by self-help services, trainers and group physicians. The tasks are wide-ranging and include overseeing regular medical check-ups, designing individualized sports training programs, conducting in-competition medical examinations, and preventing and treating injuries and illnesses that may occur during sports. Nutritional monitoring of sports participants and health monitoring of the sports environment and equipment are also integral parts of the program. Establishing a self-monitoring system helps athletes to be more proactive in attending to and managing the health status of their athletes. Although medical monitoring is widely implemented in most competitive sports, there are some concerns in youth basketball teams. Of concern is the fact that only a few teams are staffed with medical professionals, while others need more support in this area. There are severe deficiencies in the system of medical supervision of youth teams, with the responsibility for medical supervision resting primarily with assistant coaches. This situation results in youth teams failing to identify and treat sports injuries in a timely manner and neglecting key treatment steps, thereby compromising the effectiveness of treatment. Therefore, there is an urgent need to improve the medical monitoring system for youth basketball teams. This improvement includes an increase in the staffing of medical professionals and the establishment of a comprehensive medical monitoring system to ensure that greater attention is paid to health and safety in the training process of youth athletes. Through this series of improvements, the level of timely diagnosis and treatment of sports injuries can be increased, which will ultimately help to develop healthier and stronger youth sports talents.

The results of the study indicate a strong correlation between the leadership abilities of young basketball players and their sports injuries, and the discovery of this relationship has far-reaching implications for the understanding of sports training and management. Practical experience further highlights the complexity of sport improvement, which is not only governed by the development of athletes' skills but also involves the three critical factors of scientific competence selection, scientific education, and scientific management. Within this system, appropriate and adequate training management is recognized as a core element of training and competition success. Intensive training of approximately 5 hours per day has become an essential requirement for young basketball players to participate in training and competition, and the development of these training programs is an important decision made by the Board of Directors based on a thorough evaluation of the effectiveness of training and the physical condition of the athletes. The conditions for participation in training and competition include not only appropriate methods of medical rehabilitation but also an effective rest management system and work restrictions. Medical rehabilitation plays a crucial role in supplementing the way of work and recreation. As young athletes are more active, have relatively less control and are prone to display rebellious traits, the establishment of reliable work and rest schedules and team management systems is essential to ensure that athletes can recover well after intense exercise. However, sports injuries are a significant problem that plague athletes who stop or even postpone their games. Athletes' awareness of health information and protection can be increased by implementing a number of restrictions and communicating the learning process during the management process. For example, during training competitions, a good warm-up is achieved by effectively organizing pre-training preparatory actions and integrating self-defence awareness into daily core communication to minimize accidents during training and competition. To avoid stress trauma and chronic joint injuries, comprehensive protection should be provided through appropriate education, medical care and a sensible rest regime. This comprehensive management approach helps to ensure that athletes are able to sustain success and maintain good physical condition throughout their competitive careers. Doppler imaging techniques, Doppler contributions to sports medicine, and Doppler monitoring of athletic ability are shown in Figures 6, 7, and 8.

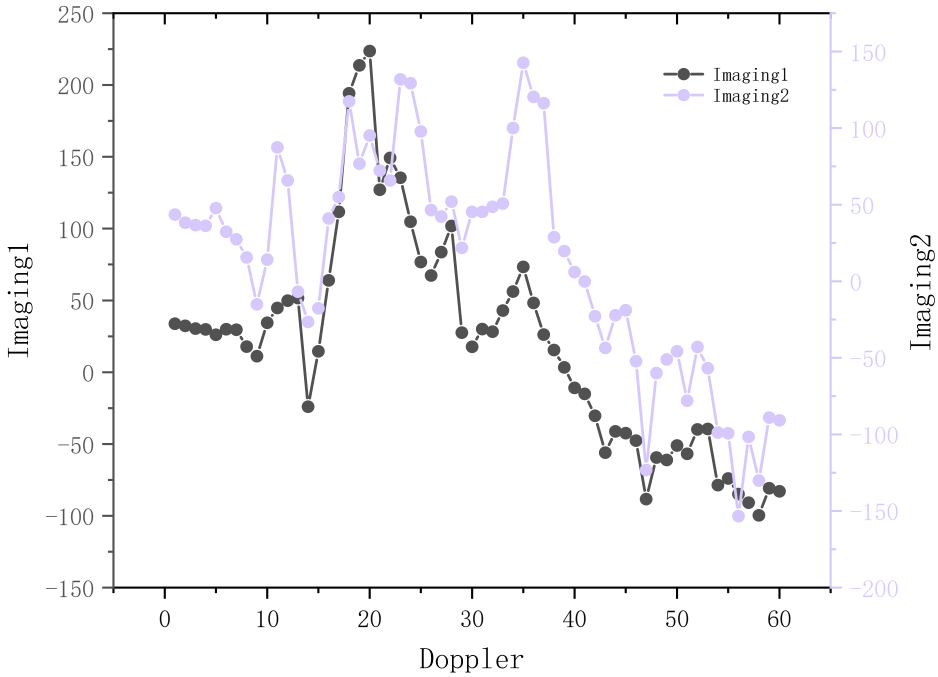

Figure 6 Doppler imaging technique

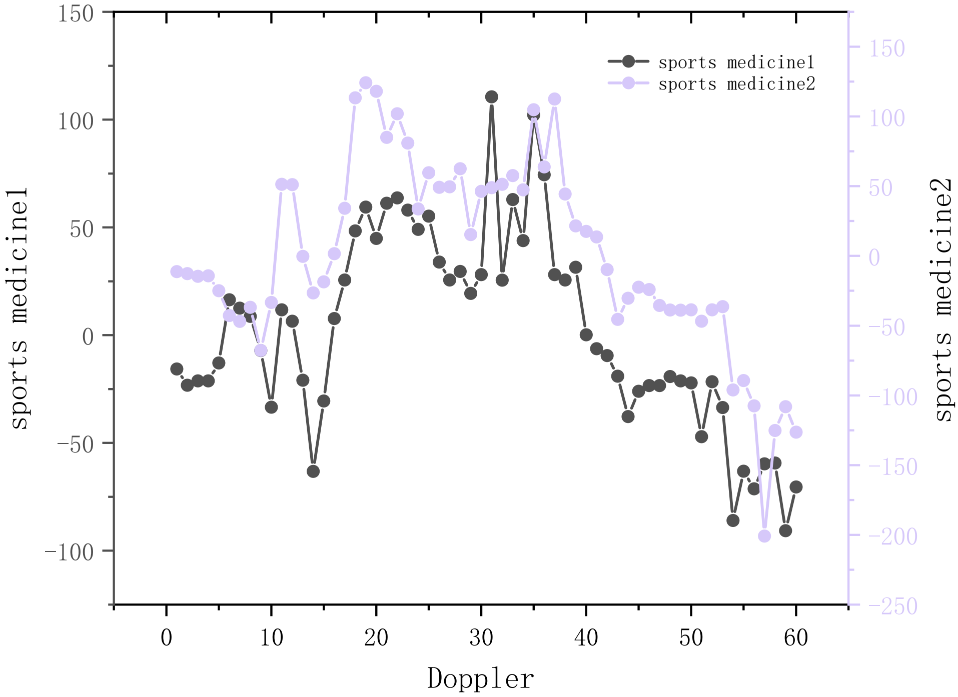

Figure 7 Doppler's contribution to sports medicine

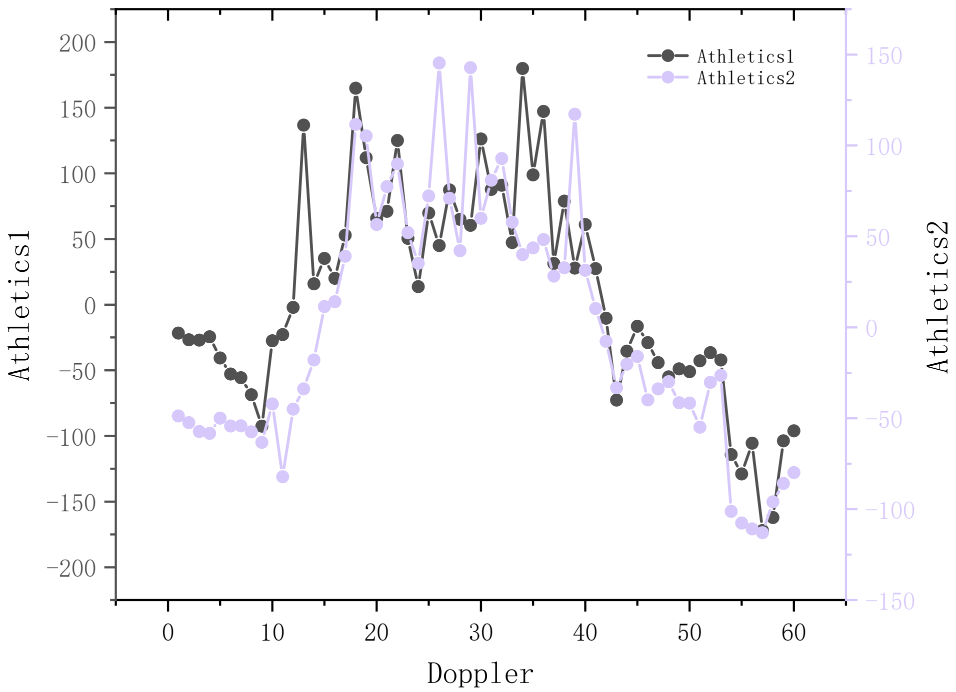

Figure 8 Doppler monitoring of exercise capacity

Good nutrition is essential for the physical development of young athletes, contributing to overall development and providing the energy and substances needed for training. Studies have shown that athletes need to consume large amounts of meat and eggs, which are rich in protein and other nutrients, in their daily diets. Athletes' nutritional level is closely related to their level of performance, and high-performance athletes, in particular, have a higher dietary protein intake. Therefore, it is essential to provide young athletes with adequate and high-quality protein and other nutrients to increase muscle mass moderately and effectively by improving body utilization.

Providing proper nutrition and nourishment to the best athletes is an essential safeguard for intense athletic training. However, this alone is not enough. In addition to scientific training, nutritional supplements should be administered using intensive methods. Sports supplements are becoming more popular in professional sports as technology advances. Studies have shown that youth teams consume relatively little sports food because most coaches are not familiar enough with sports nutrition labels and use them at a low rate. Therefore, during training, basketball players can use dietary supplements to stimulate the metabolism of free radicals, promote physical recovery, reduce fatigue, and improve athletic performance. The study noted that young basketball players usually train in simple gyms where the primary materials are concrete and plastic floors, wooden floors are rarer, and lighting conditions could be better. Athletes in these venues often experience dislocations and skin abrasions. In basketball, contact with the ball occurs frequently, such as diving to save the ball, skating to save the ball and dropping the ball to the ground. Due to the hardness of the soil, contact with the soil can have a significant impact during training and competition, negatively affecting human joints and bones.

5. Conclusion

This study provides a series of meaningful results through an in-depth exploration of anterior and posterior pulse Doppler imaging in basketball, providing essential insights into the application of sports medicine techniques in basketball. The following is a summary of the main findings of the study: first, the study observed that the athletes' anterior and posterior portal blood flow velocities underwent significant changes during basketball exercise. Prior to exercise, portal blood flow velocity was relatively low, reflecting the hemodynamic baseline of the athlete at rest. However, once in the exercise state, portal blood flow velocity increased dramatically to a peak state. This phenomenon suggests that basketball exercise produces a solid stimulus to the athlete's portal hemodynamics, driving blood more rapidly through the portal system. Second, the portal blood flow velocity after exercise gradually dropped back to the baseline level before exercise. This trend may reflect the physiologic recovery process that athletes experience after exercise. The gradual decrease in postexercise portal blood flow velocity suggests that the cardiovascular system of athletes is able to adapt and return to a normal state after exercise rapidly. This is an essential guideline for the prevention of post-exercise cardiovascular problems and provides a sure guarantee for the safety and health of athletes. In addition, through the observation of the resistance index, it was found that the portal blood vessels underwent a specific process of stress and adaptation during basketball. Changes in the resistance index reflected the physiological response of the vessels to exercise stimuli, and its fluctuations were coordinated with changes in blood flow velocity. This emphasizes the importance of the portal system for exercise adaptation and provides a direction for further in-depth exploration in future studies. Taken together, these results lead to the conclusion that basketball exerts a significant effect on the cardiovascular system of athletes, and portal Doppler imaging provides a powerful tool to gain a deeper understanding of this effect. These findings not only make a significant theoretical contribution to the field of sports medicine but also provide practical guidance for the development of scientific training programs and the improvement of cardiovascular health in athletes. In the future, the scope of the study can be further expanded by combining other physiological parameters and sports medicine techniques to comprehensively explore the effects of basketball on the overall health of athletes, contributing more in-depth understanding to the development of the field of sports medicine.

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