

Kidneys And Athletic Performance

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Kidneys' performance in vertebrates is not only limited to the plasma filtration process in the body. Rather, they regulate the body fluids through renal function in the form of urine during or after exercise, which is practically waste substances, water, and electrolytes. This article analyzes the kidney-exercise relationship and the response of renal function to ensure optimal athletic performance. It also explores how metabolic imbalances impact athletic performance during and after exercise or any power sport.

Kidneys' Metabolic Role during Exercise

Kidneys' metabolic role and renal function during exercise are double because of the derivation of the blood and renal flow towards active territories. Many researchers have argued the unintended consequence of renal flow bypass during exercise, which minimizes the renal plasma flow (RPF), filtration fraction (FF), renal blood flow (RBF), and glomerular filtration rate (GFR) during any power explosive sport or exercise (Poortmans, 1984). This reduction process of the renal flow bypass is an "intelligent" response to cardiac regulation, and the redistribution mechanism of sufficient blood to the cells and tissues in one minute is necessary to maintain the blood and renal flow in the body that was expelled during exercise.

Homeostatic Mechanism to Ensure Athletic Performance

The double organ, the kidneys, plays a significant role in maintaining the homeostatic mechanisms of the body. The homeostatic function of the body is defined as the steady and constant body environment despite external changes a body goes through, such as athletic performance. The increased demand for nutrients and oxygen during exercise by the muscle cells of the body increases the metabolism rate. The heart provides the necessary flow of blood to the parts of the body that have increased metabolic demand for nutrients and oxygen during exercise. Through the regulation of blood flow to keep body parts oxygenated, homeostasis is restored and maintained by eliminating the toxins in the body, which are regulated by kidneys in the form of urine (Poortmans, 1984). Thus, bean-shaped kidneys maintain a relatively stable internal environment for the body to ensure optimal athletic performance during exercise and after the recovery process despite the changes in the outside world.

Electrolytic, Acid-base, and Fluid Balance

Electrolytic, fluid and acid-base balance is a dynamic mechanism in the body that is significantly crucial to restoring and maintaining homeostasis. Electrolytic and fluid balance during any form of exercise or power explosive sport proves to be significant aspects of the proper functioning of all the systems in the body. On the other hand, high-intensity sports produce a large number of hydrogen ions that exert a powerful impact on the body's metabolism rate as higher levels of hydrogen ions can alter the healthy enzymes functioning, which can have detrimental effects such as decreasing the metabolism activity (Halperin and Goldstein, 2010).

If the body fails to maintain acid-base homeostasis during the sport, hydrogen ions produced during exercise hinder the contractile mechanism by competing with calcium ions and interfering with the metabolic pathways, which can lead to impaired performance. Kidneys, during this process, come into play as they decrease and increase the bicarbonate concentration in the body, which regulates hydrogen ion concentration. When the concentration of hydrogen ions increases in the body during exercise, the kidneys reduce the excretion rate of bicarbonate. (Halperin and Goldstein, 2010) Therefore, by increasing or decreasing the hydrogen ions through adequate bicarbonate concentration, kidneys aid in the regulation of acid-base, electrolytic, and body fluids during exercise.

Hormones and Mechanism of Action

Hormone action exists through a tiny chemical messenger, the hormone itself, to keep the internal environment of the body balanced in the homeostasis state. The mechanism of hormone action to keep the body balance and regulate cellular metabolism is grouped into two major classes:

Mobile Receptor Mechanism

This type of mechanism possesses intracellular receptors through lipid-soluble hormones which bind to their specific target receptors. Such hormones are steroids and fatty acids that pass through the cell membrane of the vertebrates and activate several enzymatic reactions in the body, which lead to biochemical changes inside the cell.

Fixed Membrane Receptor

Such a mechanism cannot pass through lipid formation and has a target receptor on the cell membrane of the vertebrates, which is where water-soluble hormones bind. When the specific hormone binds to the target receptor, cyclic AMP (cAMP) is produced, which activates an enzyme named adenyl cyclase in the cell membrane. cAMP activates different biochemical changes while diffusing through the cell membrane, in return, activates many enzymatic changes and reactions in

the body (Zhang and Lazar, 2000).

Physiological Consequences of Renal Failure

Renal failure causes higher risks of volume overload and increased levels of acidosis and uremic retention. All these factors in renal failure contribute detrimentally in the form of decreased immunity and dysregulated inflammatory response that intervenes with many normal functions happening in the body, leading to multiple organ dysfunction in the body. In renal failure, renal responsiveness capacity to absorb water decreases, and the ability of kidneys to reabsorb water for regulating body fluid volume decreases. Physiological consequences a patient with renal failure may face include body pain, fatigue, easy bruising, bone pain, weight loss, itchy skin, nail changes, drowsiness, nausea, and inability to urinate. A patient with renal failure must receive transplantation of the kidney or dialysis to combat physiological consequences as well as to survive for more than a few weeks. (Poortmans, 1984)

How do Metabolic Imbalances Impact Athletic Performance during Power Sports?

To achieve optimal athletic performance, the balance between workload and after the recovery process is of vital significance as hormonal conditioning regulates energy metabolism during any form of physical exercise or power explosive sport. The priority of an endurance athlete is to maintain body balance during and after any form of physical exercise, which requires nutrition in order to meet the energy needs of the athlete's body. For instance, an endurance athlete who is a cyclist has excess electrolyte cells in his/her body, which kidneys are unable to excrete from the body. Thus, the increasing capacity of electrolytic cells and acid-base imbalance affect the fitness and performance of athletes and result in aerobic and anaerobic dysfunction. This irregular mechanism of kidneys failing to maintain an acid-base buffer system and electrolytic cells results in delayed muscle fatigue in the body of a cyclist. During cycling, if an athlete burns more calories due to the body failing in faster removal of hydrogen ions from the muscle cells and releasing more metabolic energy than the body has produced, it results in excess weight loss. (Lombardo, et al. 2019)

Conclusion

The double organ intervenes in the extracellular fluids from the vertebrates' bodies and controls acid-base balance during the formation of dilute or concentrated urine with great precision. The same function of controlling extracellular fluids in the body is performed by this double organ during physical exercise as a "silent" organ. Last but not least, they do not intervene in the process of obtaining energy and supplying oxygen during exercise.

References

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