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Sports Physiology: A Soccer Striker

A soccer striker takes different positions on the pitch. Depending on the format adopted by the team at the begging of the match, strikers occupy the positions closer to the opponent's goal post. In most cases, the striker takes position 9, usually facing the opponent's defense in position 5. The striker receives the ball from his defense players located near his team's goal post. At the time of receiving the ball, the striker is running at a speed of 10 km/hr. He pauses a bit to receive the ball, which he does using his right leg. At this moment, he decelerates to about 0km/hr to take control of the ball. In the following 30 seconds, this player accelerates to a speed of 15 km/hr that rapidly rises 25 km/hr as he approaches the opponent's goalkeeper. Along with the sprints, the player pauses by decelerating and moves forward by acceleration to run with the ball. The striker eventually approaches the opponent's goalkeeper and judges that a shot at this point would yield a score. He, therefore, pauses for a moment, retracts his right leg while the left leg is left stationary, and shoots the ball by slightly flexing the left knee and swinging both arms in the 180^0 position. Various joints support kicking the ball through planting the foot force, swinging the limbs, swinging the body, contacting the ball, and the final follow-through. The player goes back to a resting position as he watches the ball past the goal post. He then dashes across the field to celebrate this score.

Metabolic System

Soccer is one of the sports that utilize the glycogen–lactic acid system. In all the aerobic phases of the scoring process, the glycogen stored in the player's liver is broken down to glucose to produce the required energy to execute the various activities. Each glucose molecule is broken down into two pyruvate molecules. Each pyruvate yield one ATP molecule. The entry of pyruvate into the mitochondria enhances the production of more ATP molecules. In this process, there is insufficient oxygen, and so there is a limited production of ATP. The second stage, therefore, kicks in to make more ATP. The pyruvate in the cells is converted into lactic acid that diffuses out of the cells (Hall and Hall 1073). The second stage produces much of the energy required for the rapid acceleration required for the player to run with the ball and make a successful kick.

Respiratory System

The resting oxygen consumption on a healthy male adult is 250ml per minute (Hall and Hall 1078). Before the striker receives the ball, his oxygen consumption is slightly above this rate due to the preceding runs. Therefore, his respiratory rate is almost normal. On seeing the ball approaching him, he certainly anticipates a higher oxygen intake, and so his respiratory rate increases. For a soccer player, this transition may increase pulmonary ventilation by 20 fold (Hall and Hall 1079). It would be expected that the arterial pressure of oxygen would reduce drastically during aerobic activity. However, the level of oxygen remains constant during this exercise, demonstrating the ability of the respiratory system to adapt to high oxygen demand (Hall and Hall 1079). The constancy is because respiratory stimulation by the brain occurs concurrently with neuromuscular stimulation. As a result, respiration increases at the same rate as the neuromuscular stimulation.

While the PO_2 remains constant throughout the striking process, the pH of the blood decreases rapidly as lactic acid is produced through glycogen catabolism. The CO_2 produced by the metabolizing cells also lowers the pH through the formation of weak carbonic acid. Through the catalysis of carbonic anhydrase, a reversible reaction occurs that dissolves carbon dioxide in water to form weak carbonic acid. This acid then dissociates reversibly to yield hydrogen ions that reduce the pH (Cooper, Jonathan, and Rod 871).

Cardiovascular System

Blood flow to the muscles increases rapidly, especially during rapid muscle contraction. Between 10 and 16 minutes of a rhythmic exercise, the blood flow to the calf muscles can increase from 1000 ml per minute to 4000ml per minute (Hall and Hall 1079). The increase in blood flow improves oxygen and glucose supply to the muscles. The cardiac output increases in the same magnitude to affect this supply. While resting, the cardiac output of the striker is approximately 5.5 liters per minute. This rate rises to 30 liters per minute during the sprints while headed to the goalpost (Hall and Hall 1079). The stroke volume increases from 105 ml to 160 ml during the same period (Hall and Hall 1079). An increase of heart rate up to 270 percent is expected during such vigorous exercise. Since the cardiac output (CO) is a function of heart rate and the stroke volume, the CO can increase by 90 percent as compared to the respiratory rate that raises to a maximum of 60 percent (Hall and Hall 1080). It follows, therefore, that the cardiovascular system limits the VO_2 Max than the respiratory system since the utilization of oxygen by the muscles cannot surpass the supply.

Neuromuscular System

The body of a sprinting striker utilizes the fast muscle fibers that possess great strength of contraction. At the same time, these muscles have a low oxygen supply to support the oxidative process while the many sarcoplasmic reticulum allows for rapid release of calcium ions. There are also adequate glycolytic enzymes to support the glycolytic process (Hall and Hall 88). The ATP synthesized through the glycogen-lactic acid pathways helps in the contraction of myosin and actin fibers in the calf and thigh muscles, which are predominantly used in running and kicking the ball. The contraction and relaxation of all muscles involved in the striking of the ball are dependent on the calcium ions released from the sarcoplasmic reticulum. The excitation of the myofibrils during the rapid sprinting and contraction of lower limb muscles causes a flux of calcium ion to 500 fold levels. The calcium ions are soon depleted from the myofibrillar fluid for relaxation to occur (Hall and Hall 98). Since the player is exhibiting rapid contraction and relaxation of muscles of the body, the sarcoplasmic reticulum and the calcium pumps are important in the entire process.

Endocrine System

It is expected that insulin levels will decrease in the blood to allow for the glucose metabolic process. Leptin also decreases in the same magnitude to enhance glucose metabolism (Kraemer et al. 701). Conversely, glucagon levels increase rapidly to promote glycogen breakdown from the liver. Stress hormones like epinephrine, norepinephrine, cortisol, and thyroxin will increase during this aerobic activity. Throughout the training, the player has produced high levels of testosterone that enhance his muscle growth and strength. Sweating that usually accompanies the rushing and dashing leads to the loss of sodium and chloride ions. The body replaces these hormones through the action of the renin-angiotensin-aldosterone system

(RAAS) (Hall and Hall 1083). Therefore, the levels of renin, aldosterone, and vasopressin will increase during the activity.

Works Cited

Cooper, Christopher A., Jonathan M. Whittamore, and Rod W. Wilson. "Ca^{2+}-driven intestinal HCO_3^- secretion and $CaCO_3$ precipitation in the European flounder in vivo: influences on acid-base regulation and blood gas transport." *American Journal of Physiology-Regulatory, Integrative, and Comparative Physiology* 298.4 (2010): R870-R876.

Hall, John E., and Michael E. Hall. *Guyton and Hall textbook of medical physiology e-Book.* Elsevier Health Sciences, 2020.

Kraemer, Robert R., Hongnan Chu, and V. Daniel Castracane. "Leptin and exercise." *Experimental Biology and Medicine* 227.9 (2002): 701-708.