UTILIZING BLOOD-BASED BIOMARKERS TO ENHANCE RECOVERY AND PERFORMANCE OF HOCKEY PLAYERS: A NARRATIVE REVIEW

Miss. Khushbu Sisodiya, Ph.D. Scholar,
Dr. Brij Kishore Prasad, Associate Professor,
Lakshmibai National Institute of Physical Education, Gwalior, (M.P.)

Abstract

This study is focused on examining the potential of blood-based biomarkers for enhancing hockey players' performance and recovery. Blood biomarkers may provide significant data about an athlete's state of muscle damage, hydration, aerobic and anaerobic capacity, and risk of injury. The study utilized a panel of biomarkers including creatine kinase (CK), interleukin-6 (IL-6), lactate, urea, myoglobin, cytokines, enzymes, and inflammatory markers. These biomarkers were measured at various time points after exercise to assess their utility in tracking muscle damage, hydration status, aerobic fitness, and injury risk. The study also integrated biomarker data with other performance metrics, such as GPS monitoring, subjective wellness questionnaires, and injury monitoring, to create a comprehensive athlete monitoring system. The purpose of this narrative review research extends beyond the exploration of biomarker implications for players' well-being and performance. It also involves examining potential solutions to mitigate the challenges and limitations associated with their utilization in sports.

Keywords: Creatine Kinase (CK), Interleukin-6 (IL-6), Lactate, Urea, Myoglobin, Cytokines and Inflammatory markers.

Introduction

Athletes participating in sports commonly strive to achieve peak performance and emerge victorious. However, this relentless pursuit of excellence can lead to chronic fatigue, overtraining, and a higher risk of injury. Effectively managing an athlete's load is crucial for optimizing performance while minimizing injury risk; however, conventional methods often rely on subjective criteria and may not accurately reflect an athlete's physiological state.

Blood-based biomarkers have become an effective method for tracking athletes' training load, exhaustion, and recovery. Training and recovery strategy selections can be made with greater knowledge thanks to these biomarkers, which can offer insightful information about the physiological reactions to exercise. Although biomarkers have been examined extensively in individual sports, team sports are becoming more and more in need of research due to the demanding nature of their sport and the team atmosphere.

In order to lower the risk of injury and increase performance, blood-based biomarkers can offer an objective, personalized assessment of training stress, recovery, and health state. The use and interpretation of biomarkers can lead to several difficulties despite their immense potential, particularly in light of current technological advancements such as point-of-care testing, and benefits like as objectivity and avoiding interference with the training process.

The range in resting levels can be caused by confounding factors such as individual chronic workloads, interindividual variances, or preanalytical circumstances.(Haller, Reichel, et al., 2023).

Methodology

The purpose of this study is to better understand how team sport players could utilize blood-based biomarkers to improve their performance and recovery. The aim is to offer a unique and evidence-based method for load optimization by identifying new biomarkers while building an adequate biomarker profile, which will eventually improve the health and performance of team sport players. For athletes and other people who are physically active regularly, proteins, metabolites, or electrolytes, and other minor molecules may act as biomarkers. New advances in big data-based approaches to athlete health and performance evaluation point to the potential benefits of combining the most advanced technology with subjective data, such as biochemical and hematological data, to determine each individual's ideal balance between the training and rest.(Lee et al., 2017) The use of biomarkers in testing and analysis is associated with challenges: (a) single biomarkers may not be accurate in diagnosing broad physiological functions, such as "recovery" in sports; (b) single biomarkers are weren't frequently sensitive enough to identify overtraining or injury risk; (c) reference ranges for athletes and particular subgroups of athletes are not ever well defined; (d) individual variation in absolute values plus relative changes in biomarkers; and (e) biomarker testing and analysis are highly contextualized.

Workload management is generally supported by established biomarkers such myoglobin, lactate, Inflammatory Markers (e.g., C-reactive Protein, CRP), urea, creatine kinase (CK), and white blood cells. Even at present, there are still significant issues with correctly interpreting these commonly used biomarkers in relation to exercise. The limited relevance of known indicators for workload management up to this point can be seen, for illustration, by discussing CK as a function of its evidence for the management of tasks.

Biomarkers of Muscle Status

The rigorous physical demands of hockey lead to injuries involving the muscles and inflammation are frequently occurring. When monitoring muscle status, creatine kinase (CK) as well as interleukin-6 (IL-6) are two widely studied biomarkers.(Brancaccio et al., 2007). An enzyme called CK is present in muscle tissue and after muscles are damaged, it diffuses into the blood. The degree of muscular damage a player has sustained following rigorous training or competition can be determined by looking for elevated CK levels. Likewise, cytokine IL-6 is pro-inflammatory and rises in response to inflammation of the muscles.(Pedersen & Febbraio, 2008)

Hockey trainers and coaches can assess a player's recovery state and decide when they're ready to return to full training or the game by keeping an eye on CK and IL-6.(Nunes et al., 2014) In particular, continuously elevated CK levels may indicate inadequate muscle recovery and suggest for altering the training program.

Biomarkers of Hydration

Since dehydration can affect aerobic capacity, mental abilities, and injury risk, maintaining proper hydration is essential for hockey performance. Blood biomarkers that show a player's level of hydration include metabolites like urea and creatinine as well as electrolytes like sodium and potassium.(Maughan, 1982) For example, elevated urea and creatinine may suggest dehydration, whereas low levels of sodium (hyponatremia) can indicate excessive fluid intake. Coaches can maximize player hydration methods prior to, during, and following games and training sessions by monitoring these biomarkers.

Biomarker of Aerobic Performance

Hockey players need to be able to maintain high-intensity efforts throughout a game, hence aerobic fitness is a significant factor in determining their performance. An athlete's endurance capacity can be measured and tracked using biomarkers such as lactate threshold and VO2 max.

The most commonly used measure for assessing aerobic fitness is known as VO2 max, which calculates the maximum amount of oxygen an individual can use when exercising. A further important measure of endurance performance is the lactate threshold, or the activity intensity at which lactate in the blood starts to build up.

By keeping an eye on these indicators, hockey coaches may create training plans that are more efficient in enhancing players' endurance and aerobic capacity.

Biomarker of Specific Time-course

The time course for measuring different biomarkers varies depending on the specific biomarker and the context in which it is being measured. Here are some general guidelines for the time course of different biomarkers:

Creatine Kinase (CK): CK is a marker of muscle damage and inflammation. It is typically measured within 24-48 hours after exercise, with peak levels occurring around 24 hours after exercise.(Rutberg, 2020),(Haller, Behringer, et al., 2023)

Lactate: Lactate is a marker of anaerobic metabolism and is typically measured within 30-60 minutes after exercise, with peak levels occurring around 30-45 minutes after exercise.(Lee et al., 2017) While [La−]b is significantly elevated (≈8–10 mM) following a progressive, incremental exercise test to volitional exhaustion, the highest [La−]b values (≈15–25 mM) are typically observed 3–8 minutes after "all-out" maximal exertion of 30–120 seconds.(Goodwin et al., 2007)

Urea: Urea is a marker of hydration status and is typically measured within 24-48 hours after exercise, with peak levels occurring around 24 hours after exercise.(Rutberg, 2020),(Souglis et al., 2015)

Myoglobin: Myoglobin is a marker of muscle damage and is typically measured within 24-48 hours after exercise, with peak levels occurring around 24 hours after exercise.

Cytokines: Cytokines are markers of inflammation and are typically measured within 24-48 hours after exercise, with peak levels occurring around 24 hours after exercise.(Haller, Behringer, et al., 2023)

Enzymes: Enzymes are markers of muscle damage and are typically measured within 24-48 hours after exercise, with peak levels occurring around 24 hours after exercise.

Inflammatory Markers: Inflammatory markers such as CRP and IL-6 are typically measured within 24-48 hours after exercise, with peak levels occurring around 24 hours after exercise.(Haller, Behringer, et al., 2023)

Oxidative Stress Markers: Oxidative stress markers such as TBARS and F2-isoprostanes are typically measured within 24-48 hours after exercise, with peak levels occurring around 24 hours after exercise.

Hydration Markers: Hydration markers such as osmolality and specific gravity are typically measured within 24-48 hours after exercise, with peak levels occurring around 24 hours after exercise.(Lee et al., 2017)

Nutritional Markers: Nutritional markers such as vitamin D and omega-3 fatty acids are typically measured within 24-48 hours after exercise, with peak levels occurring around 24 hours after exercise.(Lee et al., 2017)

Stress Hormone Markers: Stress hormone markers such as cortisol and adrenaline are typically measured within 24-48 hours after exercise, with peak levels occurring around 24 hours after exercise.(Monika, 2018)

These are general guidelines and the specific time course for measuring different biomarkers may vary depending on the context in which they are being measured

Novel Biomarkers: Emerging biomarkers like creatine kinase (CK), cytokines, interleukin-6 (IL-6), lactate, urea, myoglobin, cytokines, and inflammatory markers (CRP) have shown meaningful increases in response to acute and chronic exercise. These biomarkers have the potential to improve load management by providing a more holistic assessment of the training response.

Methodological Advances: The development of minimally invasive point-of-care (POC) devices and statistical methods for evaluating biomarkers are crucial for their practical application in sports medicine. Standardized study settings and longitudinal designs can help establish the reliability and suitability of these biomarkers for regular load monitoring.

Limitation of Single Biomarker Approaches

While blood-based biomarkers may improve players' recovery and performance, it might be problematic to establish a broad assessment of the athlete's physiological status just on one biomarker. Age, genetics, and training history are a few examples of the variables that might affect an individual's biomarker level, which may fluctuate significantly between individuals. In order to get around this restriction, scientists advise utilizing biomarker panels that give a more complete view of the athlete's condition. Measures of muscle injury (CK, IL-6), hydration (electrolytes, metabolites), and aerobic fitness (VO2 max, lactate threshold), for instance, can be used to provide a more comprehensive picture of the player's overall health and preparedness.

Biomarker Data Integration with Athlete Monitoring

Integrating the data into a more comprehensive athlete monitoring system is necessary for the effective application use blood-based biomarkers in hockey. To make sound choices about training, recovery, and injury prevention, biomarker testing should be used in combination with other performance metrics, such as GPS monitoring, subjective wellness questionnaires, and injury monitoring. Hockey teams can create individualized therapies to maximize each player's health and performance on the rink by using a holistic strategy. Based on the biomarker data, this can entail changing return-to-play protocols, creating targeted recovery measures, or adjusting training loads.

Conclusion

Blood-based biomarkers have a significant amount of potential to improve hockey players' performance and recovery. Biomarker testing offers objective information on a player's muscular health, hydration, aerobic capacity, and injury risk, which coaches and trainers can use to make more individualized and evidence-based decisions.

Although a number of challenges must be addressed before biomarkers can be used effectively in hockey. These include the constraints of using a single biomarker technique and the requirement to create reference ranges unique to a given activity. To fully profit from this technology, biomarker data must be integrated with other performance variables into a holistic athlete monitoring system.

Utilizing blood-based biomarkers to hockey players will probably become a more useful tool as sports science advances in order to maximize player health, lower injury risk, and enhance performance.

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FIGURE 3 Changes in blood urea and ammonia immediately after and 13 and... (n.d.). ResearchGate. Retrieved June 14, 2024, from https://www.researchgate.net/figure/Changes-in-blood-urea-and-ammonia-immediately-after-and-13-and-37-h-after-a-competitive_fig2_271597641

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