



Original article

Isokinetic muscle performance and salivary immune-endocrine responses in handball players by Fourier transform infrared spectroscopy

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ARTICLE INFO

Article history:

Received 21 February 2015
Accepted 16 November 2015
Available online xxx

Keywords:

Infrared spectroscopy
Fourier transform
Athletic performance
Sports medicine

ABSTRACT

Objective: Evaluate isokinetic muscle performance of the hamstring and quadriceps muscles in male handball players, as well as verify the effect of handball match on salivary cortisol and immunoglobulin A by Fourier transform infrared spectroscopy.

Method: The isokinetic parameters evaluated were peak torque, fatigue index, and hamstring/quadriceps peak torque ratio. Saliva samples were collected before and after a simulated handball match, as well as after 2 h of recovery. Analysis of saliva by Fourier transform infrared spectroscopy was based on infrared region of the pure substances (cortisol and human salivary cortisol and immunoglobulin A).

Results: No significant difference was found between the non-dominant and dominant lower limb at 60 and 180°/s, in extension and flexion for variables of peak torque and fatigue index. The hamstring/quadriceps ratio at 60°/s was lower than at 180°/s. The main absorption bands of cortisol are in the region (1180–955 cm⁻¹) and human salivary cortisol and immunoglobulin A bands in the region (1584–1489 cm⁻¹). The saliva samples collected before and after match showed no significant difference. The variation of cortisol per playing positions was positively correlated with session rate of perceived exertion.

Conclusions: The handball players had good muscle performance of the lower limbs in the isokinetic evaluation. The Fourier transform infrared spectroscopy analysis identified the main absorption bands of cortisol and salivary cortisol and immunoglobulin A, as well as playing positions that demand higher stress levels, through changes of bands related to salivary cortisol.

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Rendimiento muscular isocinético y respuestas inmuno-endocrinas salivales en jugadores de balonmano por espectroscopía infrarroja con transformada de Fourier

RESUMEN

Objetivo: Evaluar el rendimiento muscular isocinético de los isquiotibiales y los cuádriceps en jugadores de balonmano masculino, así como examinar el efecto de un partido de balonmano en el cortisol salival y la inmunoglobulina A por espectroscopía infrarroja con transformada de Fourier.

Método: Los parámetros isocinéticos evaluados fueron el torque máximo, el índice de fatiga y la razón de torque máximo isquiotibial/cuádriceps. Las muestras de saliva se recogieron antes y después de un partido de balonmano simulado y tras 2 h de recuperación. El análisis de la saliva por espectroscopía infrarroja con transformada de Fourier se basó en las regiones de infrarrojos de sustancias puras (cortisol, cortisol salival y la inmunoglobulina A humana).

Palabras clave:

Espectroscopía infrarroja
Transformada de Fourier
Rendimiento deportivo
Medicina del Deporte

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<http://dx.doi.org/10.1016/j.ramd.2015.11.007>

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Resultados: No hubo diferencias significativas entre los miembros inferiores dominante y no dominante a 60 y 180°/s, en extensión y flexión para torque máximo e índice de fatiga. La razón isquiotibial/cuádriceps a 60°/s fue inferior que a 180°/s. Las principales bandas de absorción de cortisol se encuentran en la región (1180–955 cm⁻¹) y cortisol salival e inmunoglobulina A en la región (1584–1489 cm⁻¹). Las muestras de saliva recogidas antes y después del partido no muestran diferencias significativas. La variación de cortisol por la posición de juego se correlacionó positivamente con la tasa de esfuerzo percibido en la sesión.

Conclusiones: Los jugadores de balonmano mostraron buen rendimiento muscular de los miembros inferiores en la evaluación isocinética. El análisis por espectroscopia infrarroja con transformada de Fourier identificó las principales bandas de cortisol y cortisol salival e inmunoglobulina A, así como las posiciones de juego que requieren mayores niveles de estrés, por medio de los cambios en las bandas relacionadas con el cortisol salival.

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Desempenho muscular isocinético e respostas salivares imuno-endócrinas em jogadores de handebol por espectroscopia no infravermelho com transformada de Fourier

R E S U M O

Objetivo: Avaliar o desempenho muscular isocinético dos flexores e extensores do joelho em jogadores de handebol do sexo masculino, bem como verificar o efeito da partida de handebol sobre o cortisol salivar e imunoglobulina A por espectroscopia no infravermelho.

Método: Os seguintes parâmetros foram avaliados com dinamômetro isocinético: o torque máximo, índice de fadiga e razão agonista/antagonista. Amostras de saliva foram coletadas antes e depois de uma partida de handebol simulada, bem como depois de 2 horas de recuperação. Análise de saliva por espectroscopia no infravermelho foi baseada na região do infravermelho das substâncias puras (cortisol e imunoglobulina A humano).

Resultados: Não foi encontrada diferença significativa entre dos membros inferiores não-dominante e dominante em 60 e 180°/s, em extensão e flexão para variáveis do torque máximo e índice de fadiga. A relação flexores/extensores do joelho a 60°/s foi inferior a 180°/s. As principais bandas de absorção do cortisol estão na região (1180–955 cm⁻¹) e bandas de imunoglobulina A humana na região (1584–1489 cm⁻¹). As amostras de saliva coletadas antes e depois do jogo não apresentaram diferenças significativas. A variação do cortisol por posições de jogo foi positivamente correlacionada com a taxa de percepção subjetiva de esforço da sessão.

Conclusões: Os jogadores de handebol tiveram bom desempenho muscular dos membros inferiores na avaliação isocinética. A análise espectroscopia no infravermelho identificou as principais bandas de absorção de cortisol e imunoglobulina A, bem como as posições de jogo que exigem níveis mais elevados de estresse, através de mudanças de bandas relacionadas com cortisol salivar.

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Palavras-chave:

Espectroscopia infravermelho
Transformação de Fourier
Desempenho atlético
Medicina esporte

Introduction

Research on professional sports has examined parameters to establish muscle function,^{1,2} as well as the association between physical fitness level and overtraining biomarkers, such as cortisol, salivary cortisol and immunoglobulin A (SIgA), and α -amylase, among others.^{3,4} In collective sports, evaluation of the knee joint is very important due to the demand imposed on it during training and competition. Isokinetic testing enables precise assessment of athletes' muscle strength; therefore, this method allows evaluation of quadriceps and hamstring muscle strength, to determine the magnitude of generated torque, as well as the hamstring to quadriceps (H/Q) strength ratio. This evaluation is also widely used in injury prevention programmers.^{1,5,6}

In addition, the evaluation of athletes' skeletal muscle, psychological and physiological stress levels, from training and sports competitions, has also been extensively studied by salivary biomarkers, which reflect the impact of stress and physical exercise on the most important body regulatory systems.^{3,4,7} Cortisol and SIgA are widely studied to investigate the response of the endocrine and immune systems, which are commonly analyzed by chromatographic and mass spectrometry techniques, as well as colorimetric and immunoassay methods.^{3,9–11} However, these laboratory tests

are relatively expensive and laborious to be routinely applied in teams without financial support.

In this context, new analysis tools have been studied in order to reduce expenditure. Fourier transform infrared spectroscopy (FT-IR) technique has great potential for analysis of body fluids,^{12,13} to quantify the biochemical components of a biological sample. This quantification is done by the absorption bands of the vibrational modes of molecular radicals in the infrared spectral region of 4000–700 cm⁻¹.¹⁴ The main advantages of FT-IR are the small quantity of sample required and the real-time information provided without the use of reagents.^{15–17} Several studies have shown the effect of acute stress and the impact of sustained periods of stress on salivary cortisol concentrations and SIgA in athletes.³ To the best of our knowledge, there are no records in the literature about the effects of a handball match on immune-endocrine system using FT-IR for diagnosis. Monitoring these responses could help coaches to plan appropriate training loads and recovery time, to reduce health risks and increase athletic performance. Thus, the purpose of this study was to evaluate isokinetic parameters of the hamstring and quadriceps muscles of male handball players, as well as changes in salivary cortisol and SIgA by FT-IR, during a simulated handball match.

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