05 - THE MUSCULAR STRESS INDEX: A PROPOSAL FOR THE QUANTIFICATION AND DIAGNOSIS OF THE LOCATED OVERLOAD IN THE SKELETAL MUSCULATURE

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Introduction

In the sporting field and in the daily work activities , the people demand every minute some work level in the voluntary musculature. If that demand goes too much strong for the adaptative capacity of the requested muscle, they will appear indications that it is having some incompatibility type between the applied load and the possibilities of the muscle involved.

Commonly, only after feeling the symptoms that something doesn't walk well with some muscle is that the individuals try to take providences to avoid an aggravation of the problem.

However, when the symptoms appear the lesions are installed already in a gravity degree that, in no rare opportunities, forces the people to stop the regular use of the musculature. In other words, they are impeded of accomplishing movements that can be of great importance for their performances in the life.

It is very important, therefore, to detect as soon as possible any minimum indication of excessive muscular stress, so that it is possible to avoid that a lesion, still incipient, reach a state of larger gravity and unfortunately will request more drastic measures and impeditives of the continuity of the normal daily performance.

Though, this detection is not very easy when the traditional ways, as the classic functional proofs of the musculature are used, because when one of these evaluations identifies a loss of functional income, the problem exists already in early state.

Considering that when a muscle is used in a level capable to stimulate adaptative processes, it happen, among other, biochemical and hematological, enzymatic and no enzymatic alterations , that can be observed through biochemical-hematological analyses, the clinical exams blunt as a refined instrument that can contribute indeed to the control of the muscular stress.

Objective

This research had for purpose the obtaining of a reference scale for the categorization of the level of muscular stress presented by men and women, starting from the model of Cosendey (1997), known like Biochemical-hematological Monitoration of the Physical Conditioning" (BHMPC)®.

Materials and methods

The study was based on a database composed by 1037 cases, being 460 athletes (305 men and 155 women), 530 no-athletes (290 men and 240 women) and 77775 analyses made during a period of five years in the Laboratory of Biochemistry of the Sport, in Rio de Janeiro.

So that it was possible to check the intern validity of the variables that more specifically are influenced by the muscular stress, the relationships among 75 of them, being 56 biochemistries and 19 hematological, indicative of the physiologic behavior of the organism were quantified and transformed in a numeric index, representative of the stress degree imposed to a person's musculature in certain time.

It is an adimentional numeric representation , that was designated as "Muscular Stress Index" (MSI) and whose normality strip was defined for four different categories of individuals: men athletes, women athletes, men no-athletes and women no-athletes.

The considered variables as for their dosages in the individuals' blood that composed the sample for the quantification of the muscular stress were: Glucose, Urea, Creatinine, Cholesterol, Col. HDL, Col. LDL, Triglycerides, Uric acid, TGO, TGP, GGT, Alkaline Fosfatase, CK-NAC, CK-mb, LDH, Calcium, Match, Iron, total Bilirrubin, direct Bilirrubin, indirect Bilirrubina, total Protein, Albumin, Globulin, Leucometry, Hematimetry, Hemoglobin, Hematocrite, VCM, HCM, CHCM, RDW, Plaquetocrite, PDW, Lymphocyte, Monocyte, Granulocyte, Eosinofile, Segmented, Stick, Basofile, LDH isoenzime 1, LDH isoenzime 2, LDH isoenzime 3, LDH isoenzime 4, LDH isoenzime 5, alkaline Fosfatase (hepatic isoenzime), alkaline Fosfatase (bone isoenzime), alkaline Fosfatase (intestinal fraction), Folic acid, B12 Vitamin, C Vitamin, B6 Vitamin, THE Vitamin, AND Vitamin, Vanilmandelic acid, Adrenaline, Calcitonine, Cortisol, free Cortisol, Ferritina, Glicosilade Hemoglobin, Homocisteine, Osteoclacine, Free radicals, Superoxid dismutase, free T3, total T3, total T4, free T4, Transferrine, TSH and Troponine I.

Besides these, they were still considered original information of anamnesis, nutritional inventories, training diaries (when it was the case) and life habits.

Each one of the variables was studied as for the importance of participation in the amount of individual muscular stress and it received a respective weight in the evaluation process. They were, then, deduced decisive equations of the level of muscular stress.

In a second phase, so that the indicator of the muscular stress could be compared among different individuals and it could still be inserted in comparative graphs of the stress in different components of the organism, such as the bones, the liver and the kidneys, the numeric values resultants of the first equations were converted in percentile of the maximum possibility and normalized, allowing the graphic visualization of the individual positioning in relation to an advisable ideal strip.

Results

Like this, it was established that the MSI can vary in a width from the level 44 to the maximum level of 18402, that it was observed in athletes submitted to exhausting trainings.

The calculated ideal strips were those understood among the values from 150 to 210 for male athletes and from 138 to 193 for female athletes. For no-athletes or people that don't practice systematic exercises the ideal strips was located

between 110 and 170 for men and between 101 and 156 for women.

The ideal MSI varies between individuals and, in a same individual, with each training phase. It is also influenced for: medications; dietary chemical products; quality, amount and schedules of assimilation of nutrients, moisturizers and rest; presence of pathologies, presence of biochemical unbalances, besides other factors.

The illustrations 1 and 2 show results of biochemical-hematological monitoration, with a clear visualization of the individual situations that MSI it allows for an easy interpretation during an entire training season.

In a study still no published, accomplished at the Laboratory of Biochemistry of the Sport and including five years of daily attendance, it has been observed, comparatively with analyses of images for Magnetic Nuclear Resonance that, it only appeared positive result in the image diagnosis, when the MSI crossed the level 800 (eight hundred) in the told scale.

Fig. 1 - Graphic representation of the results of biochemical-hematological monitorations, with the indication of MSI. and the desirable ideal strip during a training season.

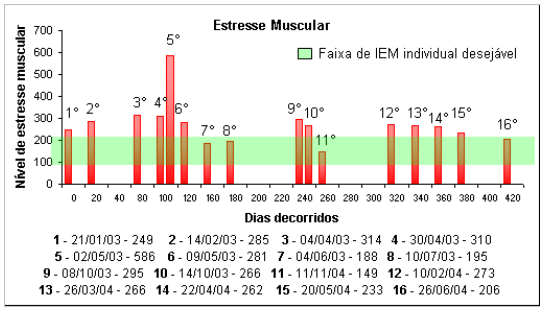
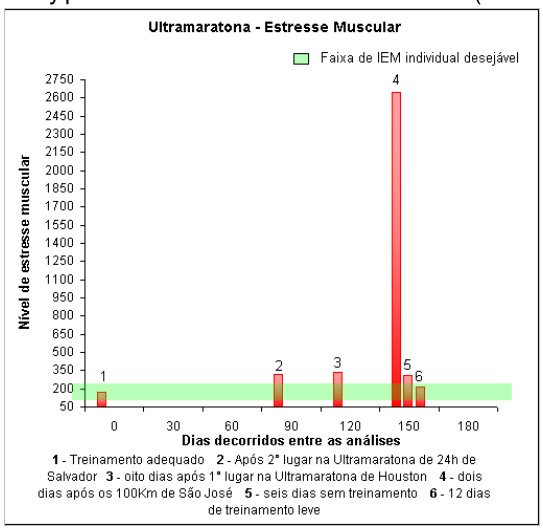


Fig. 2 - Example of a MSI graph in an ultramaraton athlete in training phase (columns 1, 2 and 3), two days after competition (column 4) and in the recovery process under attendance of BHMPC® (columns 5 and 6).



Conclusion and recommendations

Starting from the results obtained in the study, it was evident that the adoption of an index of muscular stress allows to detect and to accompany better the physical condition of anybody, athlete or no, supplying a reliable quantitative die and of great praticity for the preservation of the health and the quality of individual performance, larger purposes of BHMPC®.

It is recommended, however, that the researches continue for a refinement always growing of the quantification on the agenda, because the more accurate goes this instrument, larger they will be the benefits that can be gained of him.

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THE INDEX OF MUSCULAR STRESS: A PROPOSAL FOR THE QUANTIFICATION AND DIAGNOSIS OF THE LOCATED OVERLOAD IN THE SKELETAL MUSCULATURE

Abstract

One of the most present problems for athletes, trainers or sport physicians is the evaluation of the load imposed to the musculature. Usually the people only notice that they were exceeded in muscular works when they feel pains and have an installed lesion. Evaluate in a refined way the muscular overload is, therefore, a longing of all those that work with physical activities. This study aimed to establish an index capable to serve as a reference tool of the wear and tear state imposed to the musculature. For this, 1037 diagnoses accomplished according to the Biochemical-hematological Monitoration of the Physical Conditioning (BHMPC®) method (Cosendey, 1997) were selected. The sample was composed by 990 adults (460 athletes and 530 no-athletes), appraised in a period of five years in the Laboratory of Biochemistry of the Sport, in Rio de Janeiro. The relationships among 75 indicative variables of the physiologic behavior of the organism and intervening in organic biochemical processes linked to the of level of muscular stress, were quantified and transformed in an adimentional numeric index, that allows to represent the stress degree imposed to a person's musculature. Like this, it was established the Index of Muscular Stress (IME), that can vary in a range of 18358 levels, from the minimum (44) until the maximum (18402). The calculated ideal strips, corresponding to appropriate muscular requests, was those located among the values from 150 to 210 for male athletes and from 138 to 193 for female athletes. For no athletes, the calculated ideal strip was located between 110 and 170 for men and between 101 and 156 for women. It was concluded that the adoption of IME allows to detect and to accompany better the physical condition of anybody, supplying a reliable quantitative data for the health and individual performance quality preservation.

L'INDEX DE STRESS MUSCULAIRE: UNE PROPOSITION POUR LA QUANTIFICATION ET DIAGNOSTIC DE LA SURCHARGE LOCALISÉE DANS LA MUSCULATURE SQUELETTIQUE

Résumé

Un des problèmes les plus présents pour les athlètes, entraîneurs et médecins du sport est l'évaluation de la charge imposée à la musculature. Habituellement, les gens s'aperçoivent qu'ils ont exageré dans les travaux musculaires quand ils sentent des douleurs et ont déjà une lésion installée. Évaluer de forme raffiné la surcharge musculaire est, par conséquent, une aspiration de tout ce qui travaillent avec les activités physiques. Cette étude a eu l'intention d'établir un index capable à servir comme un outil de référence de l'état d'usure imposé à la musculature. Pour ceci, 1037 diagnostics, accomplis d'après la méthode de Monitoration Biochimique-hématologique du Conditionement Physique (MBHCF®), de Cosendey (1997), ont été sélectionnés. L'échantillon a été composé par 990 adultes (460 athlètes et 530 non-athlètes), avaliés dans une période de cinq années dans le Laboratoire de Biochimie du Sport, à Rio de Janeiro. Les rapports parmi 75 variables indicatives du comportement physiologique de l'organisme et capables d'intervenir dans les processus biochimiques organiques liés au niveau de stress musclulaire, ont été quantifiés et transformés en un index numérique adimensionele qui représente le degré du stress imposé à la musculature. Comme ça, il a été établi l'Index de Stress

Musculaire (ISM), qui peut varier dans une gamme de 18358 niveaux, du minimum (44) jusqu'au maximum (18402). Les bandes idéales calculées était celles localisés parmi les valeurs de 150 à 210 pour les hommes athlètes et de 138 à 193 pour les athlètes féminins. Pour les non- athlètes, la bande idéale calculée a été localisée entre 110 et 170 pour les hommes et entre 101 et 156 pour les femmes. On a conclu que l'adoption du ISM permet détecter et mieux accompagner la condition physique, et fournir des données quantitatives fiables pour la santé et conservation de la qualité de performance individuelle.

EL ÍNDICE DE ESTRÉS MUSCULAR: UNA PROPUESTA PARA CUANTIFICACIÓN Y DIAGNÓSTICO DE LA SOBRECARGA EN LA MUSCULATURA ESQUELÉTICA

Resumen

Uno de los problemas presentes en la vida de atletas, entrenadores, o de médicos deportivos es la evaluación de la carga que puede soportar la musculatura. Normalmente las personas se dan cuenta que se han excedido en los trabajos musculares cuando sienten dolor y ya presentan una lesión. El poder evaluar de una forma refinada la sobrecarga muscular es un deseo de todos los que lidian con actividades físicas. En este estudio busco establecer un índice para servir como referencia al estado de desgaste impuesto en la musculatura. Para eso, han sido seleccionados 1037 diagnósticos realizados según el método de Monitorización Bioquímico-hematológico de Condición Física (MBHCF), de Consendey(1997). La muestra fué compuesta por 990 adultos (460 atletas y 530 no-atletas), evaluados durante un período de cinco años en el Laboratorio de Bioquímica del Deporte, en Rio de Janeiro.

Las relaciones entre 75 variables indicativas del comportamiento fisiológico del organismo y los procesos bioquímicos orgánicos relacionados al nivel de estrés muscular fueron cuantificadas y transformadas en un índice numérico adimensional, que permite representar el grado de estrés impuesto a la musculatura. Así, se ha establecido el Índice de Estrés Muscular (I.E.M.), que puede variar en una amplitud de 18358 niveles, desde el más bajo, de valor 44, hasta el máximo de 18402. Las franjas ideales calculadas fueron las comprendidas entre 150 hacia 210 para atletas del sexo masculino y de 138 hacia 193 para atletas del sexo femenino. Para no-atletas la franja ideal quedó comprendida entre 110 y 170 para hombres y entre 101 y 156 para mujeres. Hemos llegado a la conclusión que la adopción del I.E.M. permite detectar y acompañar mejor la condición física, facilitando un dato cuantitativo fiable y práctico para la preservación de la salud y la cualidad en el desarrollo individual.

O ÍNDICE DE ESTRESSE MUSCULAR: UMA PROPOSTA PARA A QUANTIFICAÇÃO E DIAGNÓSTICO DA SOBRECARGA LOCALIZADA NA MUSCULATURA ESQUELÉTICA

Resumo

Um dos problemas mais presentes na vida de atletas, treinadores e médicos do esporte é a avaliação da carga imposta à musculatura. Geralmente as pessoas só percebem que se excederam em trabalhos musculares quando sentem dores e já apresentam uma lesão instalada. Poder avaliar de uma maneira refinada a sobrecarga muscular é, portanto, um anseio de todos aqueles que lidam com atividades físicas. Este estudo objetivou estabelecer um índice capaz de servir como referencial do estado de desgaste imposto à musculatura. Para tal, foram selecionados 1037 diagnósticos realizados segundo o método da Monitoração Bioquímico-hematológica do Condicionamento Físico (MBHCF®), de Cosendey (1997). A amostra foi composta por 990 adultos (460 atletas e 530 não-atletas), avaliados num período de cinco anos no Laboratório de Bioquímica do Esporte, no Rio de Janeiro. As relações entre 75 variáveis indicativas do comportamento fisiológico do organismo e intervenientes em processos bioquímicos orgânicos ligados ao de nível de estresse muscular foram quantificadas e transformadas em um índice numérico adimensional, que permite representar o grau de estresse imposto à musculatura de uma pessoa. Assim, ficou estabelecido o Índice de Estresse Muscular (I.E.M.), que pode variar numa amplitude de 18358 níveis, desde o mais baixo, com valor 44, até o máximo de 18402. As faixas ideais calculadas, correspondentes a solicitações musculares adequadas, estão compreendidas entre os valores de 150 a 210 para atletas do sexo masculino e de 138 a 193 para atletas do sexo feminino. Para não-atletas, a faixa ideal situou-se entre 110 e 170 para homens e entre 101 e 156 para mulheres. Concluiu-se que a adoção do I.E.M. permite detectar e acompanhar melhor a condição física de qualquer pessoa, fornecendo um dado quantitativo confiável e de grande praticidade para a preservação da saúde e da qualidade do desempenho individual.