ORIGINAL ARTICLE

Effect of elastic stockings on biomarkers levels of muscle soreness in volleyball players after exercise

Efeito do uso de meia elástica sobre os níveis dos biomarcadores de lesão muscular em atletas de voleibol após atividade física

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Abstract

Objective: To assess plasma levels of muscle soreness biomarkers, namely creatine kinase, lactate dehydrogenase, and myoglobin, in professional volleyball players following anaerobic exercise with and without the use of elastic stockings.
Methods: Ten female volleyball players aged 18 to 25 years-old were assessed with and without below-knee 20 to 30 mmHg compression stockings (Sport Active®, Venosan, Abreu e Lima, Brazil). Biomarker levels were assessed at three different moments: M0, early in the morning, with the athletes at rest, not using elastic stockings; M1, early in the morning, following a bout of exercise using elastic stockings; M2, seven days later, following the same bout of exercise, however not using elastic stockings. The Borg scale was used after each series of exercise to evaluate the physical effort.
Results: The means values obtained for creatine kinase and lactate dehydrogenase were, respectively, 117.7±40.2 and 134.2±11.3 U/L at M0; 138.2±47.2 and 157.9±10.1 U/L at M1; and 161.3±59.9 and 177.2±18.8 U/L at M2. The mean values obtained for myoglobin were 31.5±6.5; 34.9±5.6 and 38.6±12.6 µg/L at the moments M0, M1 and M2, respectively. Statistically significant differences were observed between M1 and M2 (Tukey) for creatine kinase (p=0.0007) and lactate dehydrogenase (p=0.000), but not for myoglobin (p=0.1135). Borg scale scores obtained at M1 and M2 were, respectively, 17.8 and 18.2, without statistically significant differences between them (Wilcoxon).
Conclusion: The use of elastic stockings was associated with lower plasma levels of biomarkers of muscle injury after exercise.

Keywords: elastic stockings; athletic performance; motor activity.

Resumo

Objetivo: Avaliar os níveis plasmáticos dos biomarcadores de lesão muscular, a saber, creatina quinase, lactato desidrogenase e mioglobina, em atletas profissionais de voleibol após exercícios musculares anaeróbicos, com e sem uso de meia elástica.
Métodos: Foram avaliadas dez jogadoras profissionais de voleibol, com idades entre 18 e 25 anos, utilizando ou não meia elástica (Sport Active®, Venosan, Abreu e Lima, Brasil), com compressão de 20 a 30 mmHg abaixo do joelho. As dosagens foram feitas em três momentos: M0, início da manhã, com as atletas em repouso sem uso de meia elástica; M1, início da manhã, após a realização de atividade física com uso de meia elástica; M2, sete dias depois, após a realização dos mesmos exercícios, porém sem uso de meia elástica. Aplicou-se a escala de Borg após cada série de atividade física para avaliação do esforço.
Resultados: Os valores médios obtidos para creatina quinase e lactato desidrogenase foram, respectivamente, de 117,7±40,2 e 134,2±11,3 U/L, em M0; 138,2±47,2 e 157,9±10,1 U/L, em M1; e 161,3±59,9 e 177,2±18,8 U/L, em M2. Os valores médios obtidos para mioglobina foram de 31,5±6,5; 34,9±5,6 e 38,6±12,6 µg/L nos momentos M0, M1 e M2, respectivamente. Houve diferenças estatisticamente significativas (Tukey) entre M1 e M2 para os valores de creatina quinase (p=0,0007) e lactato desidrogenase (p=0,000), mas não para os valores de mioglobina (p=0,1135). Os escores da escala de Borg em M1 e M2 foram, respectivamente, de 17,8 e 18,2, sem diferença estatisticamente significante entre eles (Wilcoxon).
Conclusão: O uso da meia elástica foi associado a menores níveis plasmáticos dos biomarcadores de lesão muscular após exercício físico.

Palavras-chave: meias de compressão; desempenho atlético; atividade física.

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Introduction

The use of elastic stockings is well established in clinical practice, in the context of evidence-based medicine, for prophylaxis and the treatment of lymphatic and venous disease[1]. In addition, the benefit of elastic stockings has been expanded to sports, providing higher comfort to athletes of some sports[2,3]. In sports, the main purpose of wearing stockings is to improve the athlete's performance and provide good recovery after practice.

Regarding the use of elastic stockings in sports, the literature suggests an indirect benefit, with lower levels of lactic acid after practice, reduced muscle trauma and improved performance and venous return[4-10].

The purpose of this study was to evaluate plasma levels of muscle injury biomarkers, namely creatine kinase (CK), lactate dehydrogenase (LDH), and myoglobin (B), in professional volleyball players following anaerobic exercise performed with and without elastic stockings.

Methods

This study is in compliance with Resolution 196/96 of Conselho Nacional de Saúde (the Brazilian Health Council), of October 10, 1996.

Ten female professional volleyball players from the same team, aged 18 to 25 years, were evaluated with and without below-knee 20 to 30 mmHg compression stockings (Sport Active®, Venosan, Abreu and Lima, Brazil) (Figure 1). None of them presented any muscular injury, as it would exclude them from the study.

The muscular injury biomarker levels were assessed in peripheral venous blood at three different moments (M0, M1 and M2). Moment M0 was always early in the morning, with the athletes at rest, not wearing elastic stockings. Moment M1 was also early in the morning, with the athletes wearing elastic stockings, after a bout of exercise, as follows: 8-minute stretching; 8-minute warming-up period comprised of specific movements of volleyball; six 30-m sprint sessions at maximum speed, with 15-second interval between each session, being: 9 m forward running, 3 m backward running, 6 m forward running, 3 m backward running and 9 m forward running, using the volleyball court delimitations. Moment M2 access was performed seven days later, following the same bout of exercise, but not wearing elastic stockings. The athletes were instructed to stay at rest seven days before M1 and during the seven-day period between M1 and M2. The Borg[5] scale was used after two series of exercise to evaluate the physical effort.

Figure 1. Below-knee 18 to 23 mmHg compression stockings.

The normality analysis regarding the value distribution for the variables considered in the study was performed using the Shapiro-Wilk test. The levels of CK, LDH and MB measured at the different moments were compared using the analysis of variance (ANOVA) and the Tukey's test. The Borg scale scores were compared using the Wilcoxon test.

Results

The ten athletes participated in the three phases of the study. The values of CK, LDH and MB collected at the three moments passed the Shapiro-Wilk normality test. The mean values of CK and LDH were, respectively, 117.7±40.2 and 134.2±11.3 U/L at M0; 138.2±47.2 and 157.9±10.1 U/L at M1 (after exercise wearing elastic stockings); and 161.3±59.9 and 177.2±18.8 U/L at M2 (after exercise not wearing elastic stockings). The mean values of MB foram de 31.5±6.5; 34.9±5.6 e 38.6±12.6 μg/L were 31.5±6.5; 34.9±5.6 and 38.6±12.6 μg/L at M0, M1 and M2, respectively. Statistically significant differences were observed between M1 and M2 (Tukey's test) in the values of CK (p=0.0007) and LDH

(p=0.000), but not in MB (p=0.1135). Figure 2 shows the results obtained at the different moments for the three assessed biomarkers.

Borg scale scores obtained at M1 and M2 were, respectively, 17.8±0.74 (n=10, minimum: 16, median: 18 and maximum: 19) and 18.2±0.84 (n=10, minimum: 17, median: 18 and maximum: 20), without any statistically significant difference between the two moments (p=0.3016).

Discussion

The benefits of wearing elastic stockings in sports have been the subject of several studies. Armstrong[11], for instance, suggests that the mechanism that causes post-practice muscular pain is the mechanical force of elastic fiber contraction, resulting in structural trauma of the cell. The sarcolemma is injured, leading to calcium homeostasis derangement, a process followed by cell necrosis. The presence of cell residues and immune cells lead to inflammation, characterized by edema and muscle pain. The purpose of wearing elastic stockings is to reduce or alleviate such injury condition.

There are many methods to evaluate the use of elastic stockings in sports[3,4,6,10]. In this study, the evaluation was performed using the dosage of plasma levels of CK, LDH and MB. Increased plasma levels of these muscle biomarkers after intense exercise are associated with injury and, consequently, muscle pain[4].

The three biomarkers assessed in this study play important roles in energy generation via muscle metabolism, and can remain elevated for up to four days after intense exercise[11]. Considering that the magnitude of elevated levels varies according to the exercise intensity and frequency and the athlete's age and sex, among other factors, this study recruited a group of athletes of the same sex and close in age, evaluated at two distinct moments, observing a seven-day interval between these moments, with each athlete acting as a self-reference in terms of wearing elastic stockings. These parameters were defined to prevent the interference of any external factor in the result assessment.

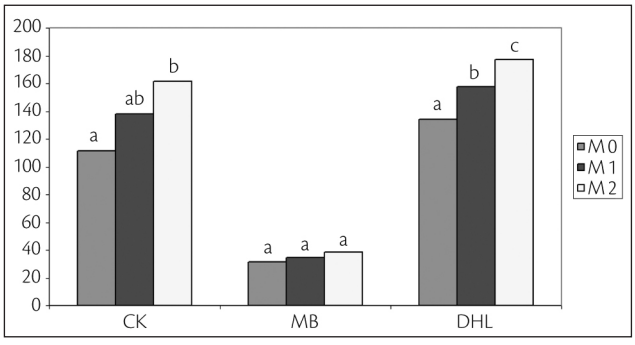

Figure 2. Mean values obtained for creatine kinase (CK), lactate dehydrogenase (LDH) and myoglobin (MB) at the three assessment moments (M0, M1 and M2).

The plasma levels of muscle injury biomarkers CK, LDH and MB at M0 were significantly lower than the levels obtained at M1 and M2, which shows the stationary values of these biomolecules in the athletes' blood at M0.

In contrast, the lower levels of CK and LDH at M1 when compared to those at M2 suggest that the use of 18 to 23 mmHg compression stockings was associated to lower degrees of muscle injury in a high-intensity practice. It should be noted that the values obtained may not considered a result of different practice loads between the two moments, as no statistically significant difference was observed between the Borg scale scores achieved by the athletes at the two moments. In addition, the increased plasma levels observed at M2 may not be considered as resulting from the levels at M1, as the biomarkers return to normal stationary levels of enzyme activity in the blood four days after intense practice[11].

The results obtained in this study are in agreement with the findings of Kraemer et al.[7], which reported lower plasma values of CK with the use of elastic stockings, and Ali et al.[3], who demonstrated that the use of 18 to 23 mmHg compression stockings by 10-km runners promoted lower pain and fatigue 24 hours after practice. The mechanism that caused such improvement observed by Ali et al.[3] is probably related to reduced levels of CK and LDH, muscle trauma and/or local ischemia[3].

The search for a better quality of life, including the regular practice of physical activities, has increased in the last decades. The use of elastic stockings in sports has the purpose of improve comfort to professional or non-professional athletes in general. Although relevant studies have not been conducted to demonstrate the benefits of wearing elastic stockings during practice, this study suggests the occurrence of lower levels of muscle injury after high-intensity practice in volleyball athletes, and the extrapolation to other types of physical activity would be speculative.

In this pilot study, the sample was small and, evidently, the results do not consolidate the indication of this type of stockings to all physical activities. Additional studies in different sports and other physical activities should be conducted to reach more solid conclusions.

References

1. Partsch H, Flour M, Smith PC. Indications for compression therapy in venous and lymphatic disease consensus based on experimental data and scientific evidence. Under the auspices of the IUP. Int Angiol. 2008;27:193-219.
2. Simao R, Farinatti Pde T, Polito MD, Maior AS, Fleck SJ. Influence of exercise order on the number of repetitions performed and perceived exertion during resistance exercises. J Strength Cond Res. 2005;19:152-6.
3. Ali A, Caine MP, Snow BG. Graduated compression stockings: physiological and perceptual responses during and after exercise. J Sports Sci. 2007;25:413-9.
4. Berry MJ, McMurray RG. Effects of graduated compression stockings on blood lactate following an exhaustive bout of exercise. Am J Phys Med. 1987;66:121-32.
5. Borg GA. Psychophysical bases of perceived exertion. Med Sci Sports Exerc. 1982;14:377-81.
6. Kraemer W, Bush J, Bauer J, Triplett-McBride NT, Paxton NJ, Clemson A, et al. Influence of compression garments on vertical jump performance in NCAA Division I volleyball players. J Strength Cond Res. 1996;10:180-3.
7. Kraemer WJ, Bush JA, Newton RU, Duncan ND, Volek JS, Denegar CR, et al. Influence of a compression garment on repetitive power output production before and after different types of muscle fatigue. Sports Med Train Rehabil. 1998;8:163-84.
8. Kraemer WJ, Bush JA, Wickham RB, Denegar CR, Gómez AL, Gotshalk LA, et al. Continuous compression as an effective therapeutic intervention in treating eccentric-exercise-induced muscle soreness. J Sport Rehabil. 2001;10:11-3.
9. Doan BK, Kwon YH, Newton RU, Shim J, Popper EM, Rogers RA, et al. Evaluation of a lower-body compression garment. J Sports Sci. 2003;21:601-10.
10. Bringard A, Perrey S, Belluye N. Aerobic energy cost and sensation responses during submaximal running exercise--positive effects of wearing compression tights. Int J Sports Med. 2006;27:373-8.
11. Armstrong RB. Mechanisms of exercise-induced delayed onset muscular soreness: a brief review. Med Sci Sports Exerc. 1984;16:529-38.

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