BLOOD FLOW RESTRICTION THERAPY APPLIED TO SPORTS TRAINING

TERAPIA DE RESTRIÇÃO DO FLUXO SANGUÍNEO APLICADA AO TREINAMENTO ESPORTIVO

TERAPIA DE RESTRICCIÓN DEL FLUJO SANGUÍNEO APLICADA AL ENTRENAMIENTO DEPORTIVO

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ABSTRACT

Introduction: Blood flow restriction therapy, also known as KAATSU pressurization training or ischemic exercise training is a controlled method of vascular occlusion combined with resistance training, with the great growth of its research in recent years. Regular strength training, prevention of lean mass loss, and post-operative rehabilitation are some areas in which the therapy has been prominent. It is believed that it can also be beneficial in sports performance. Objective: Study the effects of an intervention with blood flow restriction therapy on athletes during training. Methods: 32 college athletes with more than two years of experience in sports training, free of injuries, and 20±3 years old were volunteers. They were randomly divided into groups A (no pressure), B (training pressure), C (intermittent pressure), D (full compression). Results: The athletes in the no pressurization group, intermittent pressurization group, training pressurization group, and full-time pressurization group showed significant differences (P<0.05). It can be considered that there is a significant difference in the muscular endurance indexes of the athletes in the non-compression group before and after training, while the athletes in the non-compression group achieved a significant increase in muscular endurance after 6 weeks of training Conclusion: Blood flow restriction therapy can effectively enhance the training effect with various strength qualities, and play a role as a promoter of hypertrophy and vascularization. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Blood Flow Restriction Therapy; Sports; Resistance Training.

RESUMO

*Introdução: A terapia de restrição do fluxo sanguíneo, também conhecida como treinamento de pressurização da KAATSU ou treinamento de exercício isquêmico é um método controlado de oclusão vascular combinado ao treino de resistência, com grande crescimento de suas pesquisas nos últimos anos. Treinos regulares de força, prevenção de perda de massa magra e reabilitação pós-operatória são algumas áreas em que a terapia tem se destacado. Acredita-se que possa ser benéfica também no desempenho esportivo. Objetivo: Estudar os efeitos de uma intervenção com terapia de restrição do fluxo sanguíneo nos atletas durante o treinamento. Métodos: Foram voluntários 32 atletas universitários com mais de dois anos de experiência em treinamento esportivo, livres de lesões e com 20±3 anos de idade. Foram divididos aleatoriamente em grupos A (sem pressão), B (pressão de treinamento), C (pressão intermitente), D (compressão integral). Resultados: Os atletas do grupo sem pressurização, do grupo de pressurização intermitente, do grupo de pressurização de treinamento e do grupo de pressurização em tempo integral, mostraram diferenças significativas (P<0,05). Pode-se considerar que existe uma diferença significativa nos índices de resistência muscular dos atletas do grupo sem compressão antes e depois do treinamento, enquanto os atletas do grupo sem compressão conseguiram um aumento significativo na resistência muscular após 6 semanas de treinamento Conclusão: A terapia de restrição do fluxo sanguíneo pode efetivamente melhorar o efeito de treinamento com várias qualidades de força, além de desempenhar um papel como promotor de hipertrofia e vascularização. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Terapia de Restrição de Fluxo Sanguíneo; Esportes; Treinamento de Força.*

RESUMEN

Introducción: La terapia de restricción del flujo sanguíneo, también conocida como entrenamiento de presurización KAATSU o entrenamiento de ejercicio isquémico es un método controlado de oclusión vascular combinado con entrenamiento de resistencia, con gran crecimiento de su investigación en los últimos años. El entrenamiento regular de la fuerza, la prevención de la pérdida de masa magra y la rehabilitación postoperatoria son algunas de las áreas en las que la terapia se ha destacado. Se cree que también puede ser beneficioso para el rendimiento deportivo. Objetivo: Estudiar los efectos de una intervención con terapia de restricción del flujo sanguíneo en atletas durante el entrenamiento. Métodos: 32 atletas universitarios con más de dos años de experiencia en el entrenamiento deportivo, libres de lesiones y con 20±3 años de edad fueron voluntarios. Se dividieron aleatoriamente en los grupos A (sin presión), B (presión de entrenamiento), C (presión intermitente), D (compresión total). Resultados: Los atletas del grupo sin presurización, del grupo con presurización intermitente, del grupo con presurización de entrenamiento y del grupo con presurización a tiempo completo mostraron diferencias significativas (P<0,05). Se puede considerar que existe una diferencia significativa en los índices de resistencia muscular de los atletas del grupo sin compresión

antes y después del entrenamiento, mientras que los atletas del grupo sin compresión lograron un aumento significativo de la resistencia muscular después de 6 semanas de entrenamiento Conclusión: La terapia de restricción del flujo sanguíneo puede mejorar eficazmente el efecto del entrenamiento con diversas cualidades de fuerza, y desempeñar un papel como promotor de la hipertrofia y la vascularización. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Terapia de Restricción del Flujo Sanguíneo; Deportes; Entrenamiento de Fuerza.*

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INTRODUCTION

Blood flow restriction training, also known as KAATSU pressurization training or ischemic exercise training. However, due to the lack of comprehensive and objective understanding of the generation mechanism and application efficacy of blood flow restriction training, the positive response effect of this exercise training method has been severely limited, and it may lead to the one-sided and blind use of this method, resulting in a decline in sports performance instead of a rise, and the occurrence of sports injuries.[1] Therefore, the author attempts to review the blood flow restriction training method in terms of its application and its effects, aiming to provide practical guidance and theoretical support for the correct understanding and application of this training method.[2] For the general public with no training experience, injured athletes, and the elderly, it is very difficult to perform high-intensity training, and the risk of muscle damage is significantly increased. Blood flow restriction training can replace large-load exercise methods to a certain extent through low-load resistance walking, cycling, basketball and other projects to achieve the effect of improving muscle size and strength.[3] At present, the research on KAATSU training focuses on the comparison between the effects of KAATSU training and traditional training methods, while it is still unclear when the compression intervention is applied during the training and how it works, by comparing the training effects of different KAATSU time courses, it can provide corresponding theoretical and practical basis for the application and promotion of KAATSU training. It is helpful to explore ways to reduce the discomfort of athletes, and on the other hand, it can provide a practical basis for further research on the principles and effects of KAATSU training at the physiological level.[4]

METHOD

Research object

Thirty-two college athletes with more than two years of sports training experience were recruited, all athletes were required to be healthy and free of injuries and aged 20±3 years. Of the 32 athletes, 20 were boys and 12 were girls. 32 college athletes were randomly divided into A (no pressure group), B (training pressure group), C (intermittent pressure group), according to the participation of training pressure and intermittent pressure, D (full-time compression group) four groups, 8 people in each group, as shown in Table 1.

One-way analysis of variance was performed on the height and weight of the four groups of athletes using Spss software, there was no significant difference in height and weight among the four groups of athletes ($P>0.05$).[5]

Table 1. Morphological indicators of experimental subjects in each group.

Group	Height (cm)	Weight (kg)
A (no compression group)	174.6±6.9	68.1±9.0
B (training pressure group)	173.9±8.1	70.9±9.5
C (intermittent compression group)	172.1±7.6	65.5±11.3
D (full compression group)	169.8±8.8	64.4±11.8

Experimental Design

The athletes were divided by gender and then randomly divided into four groups: A, B, C, and D, a group of eight people, including 3 girls and 5 boys. Before the training intervention, the athletes were tested for the first time, the test indicators included muscular endurance, maximum bench press power, average power of quantitative load bench press, and maximum power of quantitative load bench press. Then the athletes added high-intensity interval training 3 times a week for the next 6 weeks, and the training chose the method of throwing the battle rope.[6] During the training intervention, the athletes in group A performed the training tasks normally without compression; athletes in group B performed upper body compression during the training content and relieved pressure during training intervals; athletes in group C performed upper body compression during training intervals and released pressure during training content; athletes in group D performed the entire training process and during training intervals with upper extremity compression performed. In the experiment, a 30s maximum effort rope throwing exercise was used, with a rest interval of 90s, a total of 4 sets, and the total time was about 8 minutes, the training pressure adopts the air pressure of 1 times the systolic blood pressure of the athlete, and the selection of other factors such as compression time is strictly in accordance with the recommended amount of previous research to ensure the safety of the athlete. The training is arranged for a total of 6 weeks, 3 times a week, and the interval between each training time is guaranteed to be more than 48 hours. After the experiment, the second test was conducted, and the test requirements and content were the same as the first test. By analyzing the data of the four groups of athletes in two tests, the effect of the two intervention factors in training was dissected, so as to know the effect of different compression time courses on the upper limb muscle endurance and strength quality of athletes.[7,8]

Battle rope exercises stimulate the upper limbs more comprehensively, and battle rope training combined with high-intensity interval training (HIIT) can more effectively improve athletes' various functional qualities. According to the relevant definitions and training recommendations of HIIT by the American Physical Fitness Association, the final HIIT implementation method of this experiment was determined.[9] According to the pressure recommended by Dr. Yoshiaki Sato, the inventor of KAATSU training, the KAATSU value of this experiment was determined. The test uses the form of the bench press to assess the upper body strength of the athlete.

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Taizhou Vocational College of Science and Technology and Taizhou University following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS

Comparison of muscular endurance indexes of four groups of athletes before and after training during pressurization

As can be seen from Figure 1 and Table 2, after six weeks of training, the athletes in the no-pressurization group, the intermittent pressurization group, the training pressurization group, and the full-time pressurization group, the number of quantitative load bench presses before and after training showed significant differences, and the indicators before and after training of athletes in the non-compression group were statistically available P=0.013<0.05, it can be considered that there is a significant difference in the muscle endurance indexes of the athletes in the no-compression group before and after training, that is, the athletes in the no-compression group have achieved a significant increase in muscle endurance after 6 weeks of rope swing training. The other three groups of athletes were calculated to know that the P values were all less than 0.01, that is, there was a very significant difference between the quantitative load bench press indicators before and after the training of the athletes who had undergone pressurization. It can be considered that under the intervention of the training program designed in this study, any compression intervention can bring about a significant increase in the athlete's muscular endurance index, this shows that the combination of rope swing and HIIT can significantly improve the athlete's muscular endurance level, thereby improving the test performance of the quantitative load bench press, and any compression intervention can enhance the effect of this improvement, but the advantages are not significantly different. The training regimen adopted by the authors can bring a significant improvement in the muscular endurance capacity of athletes even without KAATSU intervention, so the training improvement effect obtained by athletes after KAATSU intervention is weakened to a certain extent.[10]

Factors of the influence of the time course difference of pressurization and its interaction on muscular endurance

It can be seen from Figure 2 that even without additional compression intervention for athletes, a high level of improvement in muscle endurance indicators can still be seen before and after training, this is consistent with previous studies on battle rope exercises, upper limb HIIT battle rope training can stimulate the upper limbs and core muscles

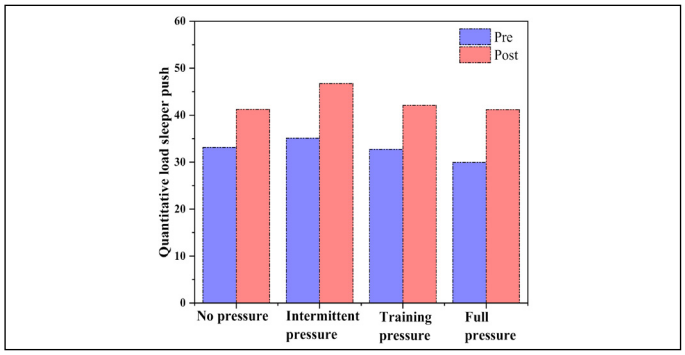

Figure 1. Comparison of muscular endurance indexes of four groups of athletes before and after training.

Table 2. Changes and comparison of the number of bench presses with quantitative load before and after training for the four groups of athletes.

	Before training (times)	After training (times)	T	Sig
No compression group	33.4±7.1	41.1±9.5	-3.33	0.013*
Training press group	35.4±11.4	46.8±10.6	-6.15	0.00**
Intermittent compression group	32.9±8.3	41.9±7.7	-9.53	0.00**
Full compression group	40.0±14.4	54.6±20.3	-4.73	0.002**

(Note: * indicates that the data before and after training is significantly different, ** indicates that the data difference is very significant).

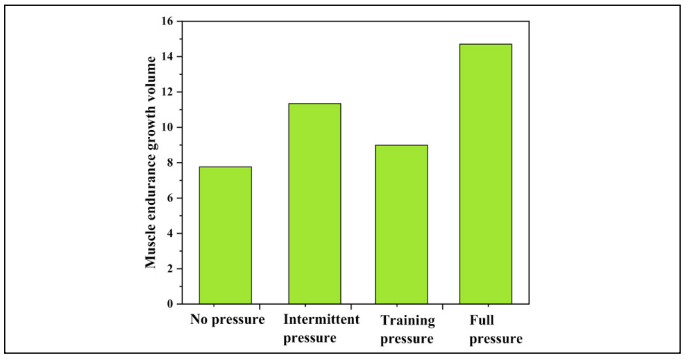

Figure 2. Comparison of the increase in the number of quantitative load bench presses before and after training for the four groups of athletes.

of athletes, and can significantly improve athletes' grip strength, upper limb explosiveness and muscular endurance. A study of 30 athletes found that HIIT was more effective in improving aerobic and anaerobic capacity than low to moderate-intensity interval training.

DISCUSSION

In this study, the training program of rope throwing combined with HIIT was used in the experiment, according to previous research, the rope throwing exercise has a high intensity and mobilizes many human functions and muscle groups, therefore, it can be used as an effective means to improve anaerobic endurance and muscle endurance of athletes, in addition, a large number of studies have shown that HIIT is an effective means of improving anaerobic exercise capacity, so the combination of the two in itself results in a significant increase in muscular endurance for the athlete. In the analysis of the effect sizes of the four groups of athletes, the athletes in the no-compression group also achieved a significant improvement in muscular endurance, so there was no more obvious effect size difference in the experimental data of the remaining three groups of athletes. A factorial design of the training compression intervention and the intermittent compression intervention in training revealed a significant difference when the main effect was intermittent compression. In general, the method of compression intervention has no obvious advantage in improving the effect of muscular endurance training under the experimental protocol adopted in this study.

CONCLUSION

Existing research shows that blood flow-restricting training can effectively induce muscle hypertrophy and strength gains. Combined with appropriate low-intensity training, it is completely helpful to improve cardiopulmonary function, and KAATSU training alone or in conjunction with rehabilitation exercises can effectively prevent disuse muscle atrophy caused by prolonged unloaded state. However, it must be noted that the blood flow restriction training method must be well-understood, and should not be blindly selected, choosing the appropriate training content for different specialties is the most important thing, only then can you get twice the result with half the effort, and it is more conducive to the improvement of sports competition ability.

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