The Effects of Passive Warm-Up With Ultrasound in Muscle Performance

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摘要

研究目的：比較淺層熱敷及超音波等兩種不同被動暖身方式與不暖身，對離心運動後肌肉表現的影響。**實驗方法：**8 位受試者皆接受三組不同的實驗內容：一組爲控制組(CON)，另一實驗組分爲熱敷(HP)及超音波(USD)兩組。控制組於離心運動前並未接受任何暖身活動；熱敷組於離心運動前肱二頭肌接受十五分鐘之淺層電毯熱療，超音波組於離心運動前肱二頭肌肌腹接受 7 分鐘之超音波深層熱療。受試者於不暖身或被動暖身後接受肱二頭肌 80%之最大等長肌力之離心收縮運動共 30 次。將測驗所得資料，經整理統計分析結果，獲得結論如下：立即性的肌力表現上，超音波組於離心運動後肌力下降的情形最少，其次是熱敷，控制組肌力下降較多。離心運動後肌肉損傷及恢復的情形方面，超音波組及熱敷組的血清肌酸激酶值曲線較控制組低；超音波組主動關節活動度恢復的情形較好，其次是熱敷組，控制組恢復的情形組較差；超音波組等長肌力恢復的較快，其次是熱敷組，控制組恢復的較慢；超音波組及熱敷組肌肉腫脹恢復的情形較控制組佳。

關鍵字：離心運動，肌肉損傷，被動暖身，肌酸激酶，超音波

INTRODUCTION

Sports injuries are common problems in clinic, especially for muscle damage. The clinical features of muscle damage include increased activation of creatine kinase (CK), muscle dysfunction, decreased muscle power, muscle fatigue, decreased range of motion of involved joint, muscle swelling and delayed onset muscle sorenessoccured.[1,2] Many evidences revealed that adequate warm up before exercise, not only decreased muscle damage occurred but also elevated skin and body temperature through increased whole blood volume in athletes, and improve exercise performance .[3-7] Active warm up means use sub-maximal intensity before exercise to elevate deep muscle temperature, such as jogging, yoga, swimming. And passive warm up means elevate muscle and core temperature by external modality, without cause energy diminish, such as hot pack, bath or massage. [4,6,8] So it is interesting to discuss that passive warm up could increase blood flow in major muscle group and prevent energy consumption. Hot pack and ultrasound are common heat modalities in clinics, but few studies investigate the recovery effect when apply in muscle damage. The goals of our study are to compare the effect of different heat modality in recovery after muscle damage..[9-16]

Method

There are 8 college students involved the study. All of them need to accept 3 different intervention, which included control group(CON), ultrasound intervention before eccentric exercise(USD), and hot pack apply before eccentric exercise(HP). The interval between each session was 18 days to make sure total recovery.[24,25] All of the subjects were examined the upper arm circumference of nondominant side(CIR),we measured 4 cm above elbow joint (CIR-4), and maximal voluntary isometric contraction (MVIC) of biceps, active range of motion(AROM) of elbow joint, and blood sample analysis before test. The eccentric exercise mode included that subjects eccentric elbow flexor with 80% load of maximal voluntary isometric contraction of biceps, and repeat 30 times. The contraction time of each eccentric exercise was 5 seconds and the rest interval between each contraction was 45 seconds. [26] Subjects were examined the upper arm circumference of nondominant side, MVIC of biceps, AROM of elbow joint immediately after eccentric exercise, repeat the above measurements and CK analysis on 2^{nd},4^{th},7^{th},10^{th} day after exercise to examined the recovery state after muscle damage.

Result

CK. There were no significant difference between 3 groups at each time ($p>0.05$)(fig.1), and all the groups showed elevation the concentration of CK after 2^{nd} day post exercise, and peak on 4^{th} day then gradually recovery. CK on 4^{th} day post exercise had significant difference from pre-test in CON and HP groups, but not revealed in USD group.

MVIC. It sowed significant less MVIC post exercise in 3 groups ($p < 0.05$) (fig.2), especially in CON group, and less in USD group. It recovered after 2^{nd} day post exercise, but had significant difference from pre-test. The MVIC of USD showed significant higher than CON group at post exercise immediately and 2^{nd} day after exercise.

ROM of elbow joint. All the groups showed significant decrease after eccentric exercise ($p < 0.05$) (fig.3), especially the CON group. USD and HP groups showed significant decrease after eccentric exercise only on 2^{nd} day post exercise. There were significant difference between USD and the other two groups on 2^{nd},4^{th},7^{th},10^{th} day.

CIR. There were no significant difference between CON, USD and HP group at each measurement in upper arm proximal part, and all the groups showed significant increase after eccentric exercise even on 2^{nd} day post-exercise. Only CON group had significant swelling persist on 4^{th} day post-exercise . In the distal part, it revealed significant swelling on 4^{th} day post-exercise in CON and HP groups.

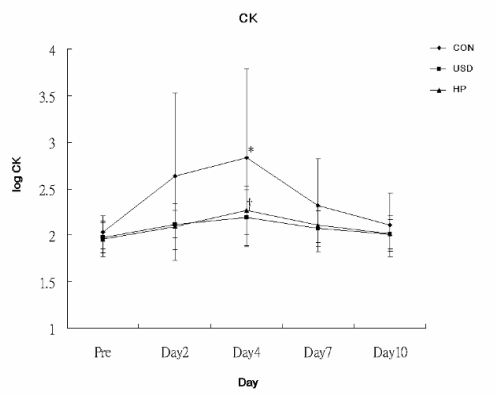

Fig.1 CK response to eccentric exercise in CON, HP and USD groups.

* means significant difference compared with pre-test in CON group ($p<0.05$), † means significant difference compared with pre-test in HP group ($p<0.05$)

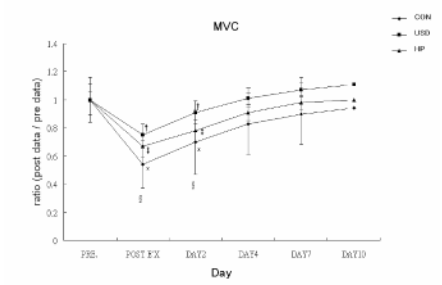

Fig.2 MVIC response to eccentric exercise in CON, HP and USD groups. * means significant difference compared with pre-test in CON group ($p < 0.05$),† means significant difference compared with pre-test in USD group ($p < 0.05$),‡ means significant difference compared with pre-test in HP group ($p<0.05$),§means significant difference between CON and USD group ($p<0.05$).

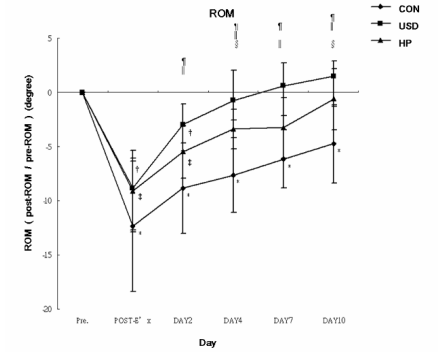

Fig.3 ROM response to eccentric exercise in CON, HP and USD groups.* means significant difference compared with pre-test in CON group ($p<0.05$),† means significant difference compared with pre-test in USD group ($p<0.05$),‡ means significant difference compared with pre-test in HP group ($p<0.05$)，§means significant difference between CON and USD group ($p<0.05$),¶ means significant difference between USD and HP group ($p<0.05$).

Discussion

USD showed significant effect in decrease muscle damage and improve muscle recovery. In our study, CK data revealed that USD applied before exercise could decrease muscle damage, but there were no significant difference between all three groups. We hypothesized that the reason was due to insufficient work load. Some studies used the mode of 100% MVIC and repeat for 12 times could lead muscle damage, [16] but 80% MVIC and repeat for 30 times in our study didn't show the result. Further study is needed to make sure how intensive eccentric exercise program will induce muscle damage. USD and HP groups showed better recovery after eccentric exercise, and it means that passive warm up before exercise could less muscle damage from exercise. Though some authors compared the effect of microwave with coldpack, and found no difference between each other. The effect of hot mechanism before exercise still be doubted.[10] More study could focus on local blood flow change after passive warm up and find the link between temperature and muscle damage. In our study we found that there were no difference persist in three conditions, and it was different from other studies. The reason may be due to insufficient precise tool to exam. The Dopplar ultrasound maybe need to consider to detail detect microchange in cross section of muscle fiber in future study.

Conclusion

USD and HP have better effect than CON. According to the recovery procedure, USD took lesser damage and swelling than HP and CON in recovery stage after exercise.

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