

骨格筋の虚血プレコンディショニングは実用可能なのか： 食餌性硝酸塩併用も含めた検討

北 翔 大 学 沖 田 孝 一
(共同研究者) 北 海 道 大 学 高 田 真 吾
北海道教育大学 森 田 憲 輝

Validation of Ischemic Preconditioning for Skeletal Muscle: Combined by Dietary Nitrate

by

Koichi Okita

Department of Sport Education, Hokusho University

Shingo Takada

Cardiovascular Medicine,

Hokkaido University Graduate School of Medicine

Noriteru Morita

Sports Education, Hokkaido University of Education

ABSTRACT

The ischemic preconditioning phenomenon was introduced in a study that demonstrated that repetitions of short-term ischemia and reperfusion of coronary arteries could reduce the myocardial damage following prolonged ischemia (direct effect). Moreover, it was later demonstrated that the ischemic preconditioning of coronary arteries also protects remote cardiac tissue that is not directly exposed to ischemic preconditioning (remote effect). Because of the intermittent nature of the blood flow during intense muscle actions, it was proposed that ischemic preconditioning prior to exercise could increase muscular performance. Although

most of the exercise studies employed an ischemic preconditioning protocol involving four cycles of 5-min circulatory occlusion followed by a 5-min reperfusion period, the optimal number of repetitions of ischemic preconditioning remained unclear. First, we examined the effective repetition numbers (from one to four) of direct and remote ischemic preconditioning in lower leg on exercise performance and fatigability. Contrary to previous reports, the results showed that any repetition of ischemic preconditioning did not affect the maximum strength and fatigability in knee extension. Concerning those negative results, we examined effects of ischemic preconditioning in a practical exercise of repeated-jump and combined ischemic preconditioning with dietary nitrate (donor of nitric oxide). However, we could not demonstrate significant effects of ischemic preconditioning on exercise performance and muscle damage even with dietary nitrate.

Keywords

ischemia; reperfusion; skeletal muscle; fatigability; performance; preconditioning

要 旨

虚血プレコンディショニングとは、長時間の心筋虚血の前に短時間の虚血再灌流操作を繰り返し行うことによる虚血耐性の獲得であるが、近年、この手技がスポーツ科学領域に応用され、骨格筋に施行することで、運動持続時間、最大酸素摂取量、最大パワーおよび最大筋力が増加するなどの複数の報告がみられる。本研究では、まず直接的虚血プレコンディショニングが下肢最大筋力と筋疲労に与える効果と必要回数を検証したが、回数によらず明らかなパフォーマンス向上効果は認められなかった。問題点を考察し、実践的な運動(連続跳躍)において両足の虚血プレコンディショニングを施行し、効果を検証した。また、効果の機序と推定される一酸化窒素発生を助長する食餌性硝酸塩の併用効果も検討した。しかしながら、いずれのプロトコールにおいても統計学的に有意なパフォーマンス向上効果は認められず、この手技の有効性に疑問を提起する結果となった。