Effects of intermittent loading combined with astaxanthin on capillary regression of disused muscle.

Miho KANAZASHI¹, Masayuki TANAKA¹, Minoru TANAKA¹, Shinichiro MURAKAMI², Hiroyo KONDO³, Fumiko NAGATOMO⁴, Akihiko ISHIHARA⁴, Hidemi FUJINO¹

¹Kobe University, ²Himeji-Dokkyo University, ³Nagoya Women’s University, ⁴Kyoto University

Purpose: The overexpression of ROS and the reduction of PGC-1α expression levels associated with hindlimb unloading resulted in capillary regression in skeletal muscle. The purpose of the present study was to identify the effect of intermittent loading combined with astaxanthin on capillary regression of hindlimb unloading induced muscle atrophy. Methods: Thirty-five adult male SD rats were randomly divided into five groups: 1) control, 2) hindlimb unloading, 3) hindlimb unloading with astaxanthin (Ax), 4) hindlimb unloading with intermittent loading (IL), and 5) hindlimb unloading with Ax and IL groups. Ax was orally administered 100mg/kg/day. IL groups were released from hindlimb unloading and allowed to perform normal cage activity for 1 hour daily. Results and Discussion: Hindlimb unloading resulted in the muscle atrophy and capillary regression. Intermittent loading attenuated muscle atrophy, but could not improve the disuse-induced changes in the expression of ROS and PGC-1α, and capillary architecture. In contrast the combination of Ax and IL treatment not only attenuated muscle atrophy but also maintained capillary architecture in atrophied soleus muscle. Furthermore, the combination of Ax and IL attenuated the expression levels in ROS and PGC-1α due to chronic unloading with Ax treatment. Key Words: muscle atrophy, capillary, loading, astaxanthin

Combined effect of electrical stimulation and eccentric contraction on disuse atrophy in rat calf muscles

Minoru TANAKA¹, Miho KANAZASHI¹, Masayuki TANAKA¹, Shinichiro MURAKAMI², Hiroyo KONDO³, Fumiko NAGATOMO⁴, Akihiko ISHIHARA⁴, Hidemi FUJINO¹

¹Kobe Univ, ²Himeji Dokkyo Univ, ³Nagoya Women’s Univ, ⁴Kyoto Univ

Purpose: The purpose of the present study was to investigate the preventive effects of combined electrical stimulation (ES) and eccentric contraction on the deep portion of atrophied calf muscle. Methods: Rats were randomly divided into control, hindlimb unloading for 2 weeks (HU), and HU plus ES combined concentric (HU+cES), isometric (HU+iES), or eccentric (HU+eES) contraction group. The animals in the ES groups were stimulated electrically using middle frequency current twice a day during the unloading period. The soleus muscles were removed and their transverse sections were stained for ATPase activity. Results and Discussion: The HU, HU+cES, and HU+iES group exhibited significantly decreased cross-sectional areas (CSAs) of type I and IIA fibers compared with the control group. The CSAs of type I and IIA fibers in the HU+eES group were significantly larger than those in the HU group. Additionally, the CSAs in the HU+cES group were significantly larger than those in the HU+eES and HU+iES group. The electrical stimulation combined eccentric contraction was more effective to prevent atrophy in the deep portion of the muscle than other types of contraction. Eccentric contraction caused larger tension in muscle fibers than other contraction types. These results indicate that the combination of electrical stimulation and eccentric contraction might cause higher preventive effects on muscle atrophy in the deep portion of calf muscle. Key words: Muscle atrophy, Electrical stimulation, eccentric contraction