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Effects of power resistance exercise and feeding on the expression of putative mechanosensing proteins in skeletal muscle of resistance-trained men

Stefan Wette[1],Heather K Smith[1],Graham D. Lamb[2,2,2],Robyn M Murphy[3,3,3]
1.Department of Biochemistry and Genetics， La Trobe Institute for Molecular Science， La Trobe University，Melbourne， Victoria 3086， Australia
2.Department Exercise Sciences， The University of Auckland， Auckland 1142， New Zealand，
3.School of Life Sciences， La Trobe University， Melbourne， Victoria 3086， Australia

Objective Power resistance exercise involves high intensity (load and velocity) dynamic muscular contractions and is frequently performed by athletes to enhance performance via improved muscle function. To investigate the remodelling processes that contribute to improved muscle function, we investigated the expression of putative mechanosensing genes implicated in this process (Kojic et al., 2011): titin-linked Muscle Ankyrin Repeat Protein (MARPs) family CARP, Ankrd 2 and DARP, and the Z-disc associated muscle-LIM protein (MLP) in healthy, resistance-trained men (n = 7) following 90 min of rest (Rest) or power resistance exercise, with (Ex + Meal) or without (Ex only) feeding during recovery.
Methods Percutaneous needle biopsy samples were obtained from the vastus lateralis of resistance-trained males using local anesthetic (2% Xylocaine), 3 h after performing each of the three experimental trials on separate days.
Previously, we presented results from this study showing that the mRNA levels of CARP (~15-fold) and MLP (~2.5-fold) were upregulated in human skeletal muscle 3 h post power resistance exercise (Wette et al., 2012). Based on these results, we performed protein analyses on the same muscle samples to determine the protein levels of all MARPs and MLP in whole muscle homogenates after Rest, Ex only and Ex + Meal. To assess whether the exercise elicited a stress response in these resistance-trained individuals, the level of phosphorylated heat shock protein 27 at serine 15 (pHSP27-Ser15) was measured at Rest and 3 h after Ex only and Ex + Meal. The levels of pHSP27-Ser15 are typically upregulated 3 h after eccentric exercise in human skeletal muscle (Frankenberg et al., 2014).
Results The 90 min exercise session consisted of 180 intermittent muscular contractions at high intensity (70-96% maximal strength). Compared to Rest, there were ~5.8- and 12.6-fold increases in pHSP27-Ser15 levels at 3 h post Ex only and Ex + Meal (both $P = 0.049$, one-way ANOVA) respectively. CARP protein levels were elevated ~2.7-fold after Ex only ($P = 0.049$, one-way ANOVA) and ~7.6-fold after Ex + Meal ($P = 0.326$), due to markedly higher levels (6-40-fold) in three of the seven participants. Pearson correlation analysis revealed a significant positive correlation between the levels of pHSP27-Ser-15 and CARP protein ($r = 0.56$, $P = 0.008$). Ankrd 2, DARP and MLP protein levels were unchanged (all $P > 0.05$) following Ex only and Ex + Meal.
Conclusions These findings indicate that CARP is highly responsive to increased mechanical loading because the protein levels in skeletal muscle can be substantially increased as early as 3 h after stressful resistance exercise. This suggests a specialised role for CARP protein during the early phases of muscle remodelling that occur as a consequence of performing high intensity resistance exercise.