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GALLEGO SELLES ANGEL

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Authors: GALLEGO SELLES, A., GALVAN ALVAREZ, V., MARTINEZ CANTON, M., PEREZ REGALADO, S., SANTANA, A., Dorado GARCIA, C., MARTIN RODRIGEZ, S., GARCIA PEREZ, G., MORALES ALAMO, D., MARTIN RINCON, M., CALBET, J.
Institution: UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA and, Complejo Hospitalario Universitario Insular-Materno Infantil de Las Palmas de Gran Canaria
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ECSS president

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26th Annual Congress of the

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Dela, F., Helge, J.W., Müller, E., Tsolakidis, E.

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the prevention of falls/injury. Resistance training (RT) can over time elicit profound improvements in physical and neuromuscular function, including strength, power and rate of force development, and is thus widely recommended for competitive athletes, prevention and rehabilitation of injury and illness, as well as healthy ageing. RT guidelines typically recommend 'slow-type' RT i.e. a slow controlled lift over 2-seconds. However there is extensive evidence that the adaptations to resistance training are specific to the nature of the training task undertaken, and thus conventional slow-type RT may not be ideal for the development of explosive strength/RFD. In fact there remains some debate over the efficacy of slow-type RT to enhance RFD, whereas there is evidence that 'explosive-type' RT i.e. increasing force as quickly as possible, has been found to be significantly more effective for developing RFD (Tillin & Folland, 2014; Balshaw et al., 2016).
This presentation will review recent evidence for the enhancement of RFD through training, the importance of explosive-type contractions and the underpinning adaptations that may account for the task specificity of RT.

MOTOR UNIT POPULATION BEHAVIOR AND RATE OF FORCE DEVELOPMENT

DEL VECCHIO, A.

IMPERIAL COLLEGE LONDON

The rate of force development of a muscle depends on 1) neural and muscular properties of the motor units, and2) the synaptic input strength from efferent supraspinal and spinal pathways that determines the all-or-none responses of the motoneurons. Studying the behaviour of the discharge timings from the human motor unit pool during fast motor actions provides direct information on the neural strategies of force control. Recent studies suggest that the discharge timings from the human motoneuron pool behaves in a non-linear way when compared to slow isometric contractions and that this non-linear behaviour is not uniformly distributed across the motoneuron pool. This lecture will discuss recent results obtained from high-density surface and intramuscular EMG recordings during fast contractions. Moreover, the motor unit responses after strength training during contractions at maximal rate of force development will also be discussed, including novel data obtained with motor unit computational models

OP-PN07 Muscle

NEAR INFRA-RED SPECTROSCOPY ESTIMATION OF COMBINED SKELETAL MUSCLE OXIDATIVE CAPACITY AND O2 DIFFUSION CAPACITY IN HUMANS

PILOTTO, A.M.1, ADAMI, A., MAZZOLARI, R., BROCCA, L., CREA, E., PELLEGRINO, M.A., BOTTINELLI, R., ZUCCARELLI, L., GRASSI, B., ROSSITER, H.B., PORCELLI, S.

UNIVERSITY OF UDINE

INTRODUCTION:
Muscle oxygen uptake (mV'O2) depends on both O2 supply (convective and diffusive O2 delivery) and O2 demand (ATP utilization rate and mitochondrial function). The diffusing capacity for O2 (DmO2) may limit O2 supply where the apposition muscle capillary red blood cells to endothelium is low. Capillary-to-fiber ratio (C:F) is therefore a proxy for DmO2. The mV'O2 recovery rate constant (k) measured by near-infrared spectroscopy (NIRS), in the presence of non-limiting O2 availability, provides a non-invasive assessment of muscle oxidative capacity in vivo. The comparison of k in conditions of non-limiting (tissue saturation index TSI>50%;HIGH) and limiting (TSI<50%;LOW) O2 availability may therefore allow for non-invasive assessment of DmO2 in vivo. The aim of this study was to: i)compare k obtained at HIGH and LOW TSI conditions with ex-vivo mitochondrial function; ii)evaluate the association between C:F and the difference in k between HIGH and LOW conditions.
METHODS:
12 moderately trained participants (28±5yrs;64.3±10.2kg;173±7cm;V'O2peak from 34.6 to 47.2ml*kg-1*min-1) visited the lab on four non-consecutive days. On day 1, they performed a cycle ergometer incremental exercise test to the limit of tolerance. On days 2 and 3, k of the vastus lateralis (VL) was measured twice using NIRS during 10-15 repeated arterial occlusions performed immediately after moderate intensity constant work-rate exercise tests. The duration and timing of the repeated occlusions were defined by the investigator to maintain TSI in a range of 10% change both below (LOW) and above (HIGH) the 50% of functional range obtained during a prolonged occlusion. On day 4, muscle samples from the VL were collected for measurement of C:F and of maximal O2 flux using saturating substrates for complexes I+II by high-resolution respirometry (HRR).
RESULTS:
O2 flux in biopsy samples was 37.7±10.6 and 56.8±19.8 pmol*s-1 per mg wet weight in maximal ADP-activated state of oxidative phosphorylation and maximal noncoupled state respiration, respectively. C:F ratio ranged from 2.15 to 2.49. k measurements performed on different days were significantly correlated (r=0.67,ICC=0.68). In HIGH, k was significantly greater (3.15±0.45min-1) than in LOW (1.56±0.79min-1,p<0.0001). The difference in k between HIGH and LOW ranged from 0.19 to 3.19min-1, and was significantly inversely correlated with C:F ratio (r= –0.68). In HIGH, k was significantly associated with both HRR measurements (r=0.69–0.72), but not in LOW (r=0.06–0.08).
CONCLUSION:
These preliminary data show that mV'O2 recovery rate constant (k) does not reflect muscle oxidative capacity under conditions of limited O2 availability, i.e.TSI<50% of the functional range. Moreover, the difference in k obtained between O2 non-limiting and O2-limiting conditions was associated with C:F ratio, a proxy of DmO2. Thus, assessment of muscle k by NIRS under HIGH and LOW TSI conditions provides a non-invasive window on both muscle oxidative capacity and muscle O2 diffusive capacity.

FAST ACTIVATION/DEACTIVATION OF THE NFKB SIGNALLING PATHWAY IN HUMAN SKELETAL MUSCLE: ROLE OF OXYGENATION AND METABOLITE ACCUMULATION.

GALLEGO SELLES, A., GALVAN ALVAREZ, V., MARTINEZ CANTON, M., PEREZ REGALADO, S., SANTANA, A., DORADO GARCIA, C., MARTIN RODRIGEZ, S., GARCIA PEREZ, G., MORALES ALAMO, D., MARTIN RINCON, M., CALBET, J.

UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA AND, COMPLEJO HOSPITALARIO UNIVERSITARIO INSULAR-MATERNO INFANTIL DE LAS PALMAS DE GRAN CANARIA

INTRODUCTION:

The NFκB signalling pathway plays a critical role in inflammation, immunity, cell proliferation, apoptosis and muscle metabolism and is activated by extracellular signals and intracellular changes in Ca2+, Pi, H+, metabolites and reactive oxygen and nitrogen species (RONS). Studies in rodents have reported NFκB activation by exercise, with the scarce data in humans reporting contradicting findings. Cell culture experiments have shown that NFκB and STAT3 are stimulated by hypoxia, which exacerbates RONS production. However, it remains unknown whether metabolite accumulation, muscle oxygenation and hypoxia influence NFκB signalling in response to acute exercise in human skeletal muscle. We hypothesized that RONS production during incremental exercise to exhaustion (IE) would upregulate NFκB signalling depending on metabolite accumulation, with a more exacerbated response in Hypoxia (Hyp) than normoxia (Nx).
METHODS:
Eleven active men performed IE to exhaustion in Nx and Hyp (PIO2:73 mmHg). Immediately after IE, the circulation of one leg was instantaneously occluded (300 mmHg). Muscle biopsies from m. vastus lateralis were taken before (PRE), and 10s (POST, occluded leg) and 60s after exercise from the occluded (OC1M) and non-occluded (nOC1M) legs simultaneously, and blood samples were taken throughout from the femoral vein. Protein expression of key markers in the NFκB and MAPK signalling pathways (Western Blot) and muscle metabolites (fluorometry) were measured. Statistical analysis was performed with repeated-measures ANOVA.
RESULTS:
At post, muscle lactate augmented 25% solely in OC1M ($P<0.05$) while PCr was reduced by 94 and 48% in OC1M and nOC1M, respectively ($P<0.005$) regardless of PIO2. PO2 in the femoral vein was 21.1±2.0 and 10.6±2.8 mmHg at Wmax, in Nx and Hyp, respectively ($P<0.001$). The ratios pTyr705/Total STAT3 and pSer176-180/Total IKKβ, pSer536 NFκB p65, and the total amount of NFκB p65, p50 and p105 NFκB were significantly elevated at POST, collectively indicating activation of NFκB. This was facilitated by the phosphorylation of IkBb at Thr19-Ser23, which releases its inhibitory action on NFκB. Post-exercise ischemia maintained these changes (OC1M), while these signals were reverted to the pre-exercise condition after one minute of recovery with free circulation. The expression of IL-6 and the phosphorylation state of ERK1/2 and p38 did not change significantly. All responses were similar regardless of exercise PIO2.
CONCLUSION:
This study shows that NFκB signalling is activated in human skeletal muscle to a similar degree during incremental exercise to exhaustion in normoxia and severe hypoxia. The fact that post-exercise ischemia maintained the activation of NFκB suggests that reoxygenation after exercise is necessary to deactivate NFκB. Our results indicate that the metabolites accumulated during the exercise or the lack of O2 may play a role in maintaining NFκB signalling.
Grants: DEP2015-71171-R; DEP2017-86409-C2-1-P

ASSOCIATIONS OF IRON STATUS RELATED TMPRSS6 RS855791 T/C POLYMORPHISM WITH MUSCLE FIBER COMPOSITION AND PHYSICAL PERFORMANCE

TAKARAGAWA, M.1, MIYAMOTO MIKAMI, E.1, TOBINA, T.2, SHIOSE, K.3, ICHINOSEKI SEKINE, N.4, KAKIGI, R.5, TSUZUKI, T.6, MURAKAMI, H.7, MIYACHI, M.8, KOBAYASHI, H.9, NAITO, H.1, FUKU, N.1

1 JUNTENDO UNIV., CHIBA, JAPAN, 2 NAGASAKI PREF. UNIV., NAGASAKI, JAPAN, 3 MIYAZAKI UNIV., MIYAZAKI, JAPAN, 4 THE OPEN UNIV. JAPAN, CHIBA, JAPAN, 5 JOSAI INTL UNIV., CHIBA, JAPAN, 6 MEIJO UNIV., AICHI

INTRODUCTION:
Human muscle fiber composition, a critical physiological characteristic that influences physical performance such as endurance and sprinting, is determined by genetic and environmental factors. A previous study has reported that experimentally induced iron deficiency in rats increases the distribution of fast-twitch muscle fibers and decreases that of slow-twitch muscle fibers (Esteva et al, 2008). Reportedly, iron status is affected by genetic factors, and a previous genome-wide association study has revealed that rs855791 T/C polymorphism in transmembrane protease, serine 6 gene (TMPRSS6) is associated with iron status (Seiki et al, 2018). Therefore, in the present study, we aimed to examine the associations of iron status related TMPRSS6 polymorphism with muscle fiber composition together with physical performance.
METHODS:
Study 1: To examine the association between TMPRSS6 rs855791 T/C polymorphism and muscle fiber composition, a total of 211 healthy individuals, comprising 104 males and 107 females, were recruited in the study. Biopsy samples were obtained from the vastus lateralis muscle to analyze the proportion of myosin heavy chain (MHC) isoforms (MHC-I, MHC-IIa, and MHC-IIx) as indicators of muscle fiber composition. Study 2: To examine the association between rs855791 T/C polymorphism and iron status in athletes, a total of 149 male athletes were recruited in the study. Study 3: To examine the association between TMPRSS6 rs855791 T/C polymorphism and elite athlete status, a total of 540 healthy individuals, comprising 405 controls and 135 international athletes (57 sprint/power and 78 endurance athletes), were recruited in the study. For all studies, rs855791 T/C polymorphism was analyzed using TaqMan SNP Genotyping Assay.
RESULTS:
Study 1: For all subjects, the proportion of MHC-IIa was significantly lower in subjects with T allele than in those with C allele under the additive genetic model ($P = 0.032$). This trend was stronger in females, with a lower proportion of MHC-IIa ($P = 0.025$) and a higher proportion of MHC-IIx ($P = 0.012$). Study 2: Serum iron and mean corpuscular hemoglobin (MCH) levels were significantly lower and hepcidin/ferritin value was significantly higher in subjects with T allele than in those with C allele under the additive genetic model ($P = 0.005$, 0.046, and 0.030, respectively). Study 3: Low serum iron and fast fiber related T allele frequency was significantly higher in elite sprint/power athletes than in controls ($P = 0.044$) and tended to be higher in elite sprint/power athletes than in elite endurance athletes ($P = 0.081$) under the additive model. This trend was stronger in females ($P = 0.003$ and 0.011, respectively).
CONCLUSION:
rs855791 T/C polymorphism in TMPRSS6 is associated with not only muscle fiber composition but also elite sprint/power athlete status, especially, in females.

MUSCLE DAMAGING EXERCISE INCREASES MYOFIBRILLAR CA2+ SENSITIVITY

HANDEGARD, V., SCHEIE, A.W., PAULSEN, G., SEYNNES, O., ØRTENBLAD, N., RAASTAD, T.

NORWEGIAN SCHOOL OF SPORT SCIENCES

INTRODUCTION:
Unaccustomed eccentric contractions induces long-lasting force depression, spanning several days. The mechanisms driving this force depression are not fully elucidated, but sarcomere disruptions, impaired excitation-contraction coupling and altered myofibrillar Ca2+ sensitivity are all contributing. Ca2+ sensitivity is influenced by oxidative stress in a seemingly bell-shaped relationship (1). Consequently,