EFFECT OF AGING ON EXERCISE-INDUCED DNA DAMAGE IN RAT SKELETAL MUSCLE

Tadano Chigaya1, Tajima Taeko1, Shimose Ryota1, Yona Masae2, Seki Hiroyuki1, Naito Yuko3, Muro Masuo1
(Toho university school of medicine1, Tokyo university of pharmacy and life science2, Kokushikan university3, Japan)

Introduction
Acute intense exercise increases generation of reactive oxygen species (ROS) and facilitates oxidative DNA damage in skeletal muscle which is frequently observed in muscle damage indicated by circulating creatine kinase response. Senescent muscle is susceptible to oxidative damage because ROS generation increases with aging. DNA damage tends to increase with aging and recovery from damage is slowed. Moreover, reduction of muscle functions due to aging modifies a contribution of synergetic muscles to maintain a performance during exercise. These matters may affect muscular oxidative damage due to exercise. The aim of this study was to examine the effect of age related muscular oxidative stress on exercise-induced muscular damage.

Methods
Three month old (YG) and 24 month old (OD) male wistar rats were used in this experiment. In both age groups the animals were divided into non-exercise control and exercise groups. Animals in exercise groups performed a downhill exercise (16° decline, YG: 25m/min, OD: 15m/min) for 90 min (18 bouts of 5-min run separated by 2-min rest) on a treadmill. Red portion (GMR) and white portion (GMW) of medial gastrocnemius, soleus (SOL), and blood were collected under anesthesia at 24 h and 48 h post-exercise. Superoxide dismutase (SOD), glutathione peroxidase (GPX), glutathione reductase (GR) activity and lipid hydroperoxide (LH) content in the muscles were determined. DNA was extracted from the muscles and treated with enzymes to isolate the nucleoside. 8-hydroxy- 2’-deoxyguanosine (8-OHdG) and 2’-deoxyguanosine (dG) were determined with HPLC as an index of the muscular oxidative DNA damage (8-OHdG/dG). Plasma creatine kinase (CK) activity was determined as a common indicator of muscle damage.

Results
Plasma CK activity showed a 3-4 fold increase during exercise. Changes in CK were larger in YG than in OD during 48 h recovery period. Age-dependent increases were observed in SOD, GR activity and LH content in GMW, GMR and SOL. In OD, LH content, GPX and GR activity was increased with exercise in SOL. However, there is no increase in any of the muscles of YG. SOD activity of GMW, GMR and SOL increased in YG but not in OD. Post exercise 8-OHdG/dG levels in YG showed a 2-3 times increase in GMW and GMR, whereas in OD 8-OHdG/dG increased in SOL.

Discussion and conclusion
Age-dependent increase of oxidative damage was observed in lipid peroxide and was not enhanced by the downhill exercise and did not corresponded to CK response.

In both age groups, increase of DNA damage was significantly different between muscle types due to exercise. To maintain muscle performance, recruitment of motor units tends to increase during exercise. This compensational recruitment is shifted towards slow type fibers with aging. Thus, these results suggest that changes in the recruitment pattern due to ageing may alter the oxidative stress among synergists with exercise.

Keywords: Muscle Damage, Free Radicals