SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medical Care for Humans in Space (3)

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PROPOSAL OF A NEW COUNTERMEASURE FOR RED MUSCLE ATROPHY IN SPACE AND AGED PEOPLE: A KEY MOLECULAR CHAPERONE ALPHA B-CRYSTALLIN AS A PIVOTAL PLAYER FOR CELLULAR SUSTAINABLE DYNAMICS

Abstract

Space biology contributes to health science especially in aging peoples, described as "The G-Connection" showing disuse atrophy (Joan Vernikos). In space we cannot utilize well own life system having large adaptability evolved under the gravity, of which clear property is endurance ability. Coactivator PGC1α facilitates both transcriptions of slow muscle proteins to keep endurance and tonic contraction and mitochondrial genes supporting oxidative metabolism under the gravity. Aerobic exercise, which is mainly produced by slow muscle, induces PGC-1α, which is beneficial for protection of life-related diseases. Interestingly, microtubule destabilizing small molecules, like nocodazole/taxol are identified as regulators of PGC1α (SS 2008). Our body temperature is about 37 deg. In our study, the increased temperature to 39 deg induces PGC1α in cultured myoblasts to myotubes (Yamaguchi et al., 2009). All biological system has developed molecular chaperone/stress protein system, which helps keeping protein structure normally, refolding denatured form or breaking down it to proteasome and/or autophagy, most of them are spacio-temporally regulated by the cytoskeleton. We have studied molecular chaperone, αB-crystallin, which is constitutively expressed most in type I, more in type IID/IIA but less in type IIB fibers in

soleus/plantaris muscles (Atomi et al., 2000). Recent studies show αB-crystallin has multi-functions working as chaperone for protein sequences to transfer mechanical stress from adhesive area to nucleus, keeping dynamics those pathways, maintaining integrin, and inhibiting caspase 3 activation against mitochondrial apoptosis, and also facilitating protein degradation associating with denatured proteins to proteasome machinery. We have identified αB-crystallin as key molecule to solve mechanism of slow muscle atrophy (Atomi *et al*, 1991) and shown important roles of αB-crystallin keeping tubulin/microtubule dynamics (Fujita *et al*, 2004; Sakurai *et al*, 2006; Ohto *et al*, 2007). In this study, we try to visualize molecular chaperone-supportive dynamics of striated muscles. Using beating cultured cardiac myocyte, we show dynamic striated patterns of GFP-αB-crystallin, of which localization at Z-bands disappeared after microtubule-destabilizing drug treatments. This indicates αB-crystallin is deeply related to keeping dynamics under endurance tonic contraction. Some applied methods have been developed to induce αB-crystallin and/or factors consisting of slow muscle like mechanical stretch, mild heat stress, and use of avian eggshell membrane (Ohto *et al*, 2011). From these basic biological adaptive mechanism evolved on the earth, we propose strategy of gravity health science to protect against anti-gravitational muscle atrophy induced long journey to Mars by the human being and aged people.