

Effect of Space Environment, Especially Microgravity, on Humans

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On April 12, 1961 the first earthling escaped the gravity well of planet earth. In the spaceship Vostok 1, Senior Lieutenant Yuri Alexeyevich Gagarin orbited earth one time at an altitude of 302 km for 108 minutes. The problems, hidden in the short flight appear with elongation of the flight time, including space motion sickness, orthostatic intolerance, myatrophy, or osteoporosis. The order of the deconditioning is; space motion sickness within several hours, cardiovascular deconditioning proceeds 1 to several days, myatrophy in 10 days, and osteoporosis in 14 days. The purpose of "Space Medicine" is to analyze the developing mechanisms, and make the countermeasure to the problems.

When an astronaut is exposed to microgravity, he experiences motion sickness including nausea, vomiting, headache, anorexia, pale face, generalized fatigue. The incidence was reported up to 67.1% in space shuttle mission. The mechanism and countermeasure to space motion sickness will be explained.

After space flight and return to the earth, orthostatic hypotension or orthostatic tachycardia are easily induced due to orthostatic intolerance, namely cardiovascular deconditioning. This is induced by the readaptation of hemodynamic homeostasis to 1 G condition after adaptation to the microgravity. We have been investigated the changes in sympathetic nerve activity innervating skeletal muscles (muscle sympathetic nerve activity, MSNA) during simulated and actual microgravity conditions using microneurography. The changes in MSNA during various kinds of simulated and actual microgravity will be reported. More exposure to microgravity causes myatrophy, especially slow twitch muscles were catabolized quickly. The mechanism has been investigated at the genetic level, and it has been postulated that uncontracted skeletal muscle receives less myosynthesis. Osteoporosis is vulnerabilization by increased catabolism of bone mineral metabolism. Microgravity exposure is considered to accelerate the osteoclastic activation. Pharmacotherapy and gravity load are the countermeasure for osteoporosis. All these problems were called "space deconditioning."

We have been proposing a device using centrifuge-induced artificial gravity with ergometric exercise for space deconditioning. The effectiveness of the device will be discussed.