THE IN VITRO DECREASE OF MAGNESIUM DUE TO PROLONGED SPACE EXPLORATION

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ABSTRACT

Urinary magnesium excretion is significantly lower after 4-6 months of space flight compared to before flight; however the implications of the change in magnesium status are not well understood. Magnesium has an essential role as part of the activated MgATP complex. Magnesium may also bind the enzymes directly (eg, RNA and DNA polymerases) and alter their structure. If magnesium status is decreased, as it is after long duration space flight, then the energy charge of the cell may also be altered such that would activate AMP kinase (AMPK). The activation of AMPK inhibits mRNA translation initiation and subsequent protein synthesis. Magnesium supplementation has been shown to increase muscle strength in young subjects. The primary aim of our study was to determine the implications of a decrease in magnesium status on muscle cells, and to determine the effects of altered magnesium status on AMPK. C₂C₁₂ myoblasts were differentiated into myotubes, and incubated in serum- and antibiotic-free DMEM containing four different concentrations (0.814, 0.611, 0.407, and 0 mM) of MgSO₄. The cells were processed, and protein concentration was determined. Cell homogenate total protein was resolved on a 4-20% gradient acrylamide gel, transferred to PVDF membrane, and then probed for phospho-AMPK, total AMPK, and various targets in the mTOR pathway. Data showed a decrease in magnesium leads to a decrease in protein synthesis through an increase in phosphorylation of AMPK and a decrease in the mTOR signaling pathway by the reduction of 4E-BP, S6 phosphorylation, Raptor and TSC2.