Preventing an EVA Fatality

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Ever since I was informed of the year’s mission on the International Space Station with an American and a Russian, I have been concerned about an EVA-cardiovascular fatality, with the risk, progressively increasing with the duration of the mission. Although apparently, Valeri Polyakov didn’t experience serious complications during his record stay of 437 days, my concern is primarily based on the vulnerability of high adrenaline-related injuries to the cardiovascular system because it is conducive to oxidative stress and calcium overload of both the blood vessels and the energy-producing machinery of the heart (mitochondria) and cells; the heart is particularly vulnerable because of its dense mitochondrial network [1].

Based on my extensive studies over long periods [2] and the Russian experimental animal studies showing space-related vascular injuries [3], I emphasized my concerns with my very first space-related presentation at the 11th IAA Man in Space Symposium in 1995 [4] and subsequently, stressing the risk of acute heart failure in 2002 [5].

Both men are over 50; it is well established that the lining of the blood vessels is not adequately repaired after age 30 [6]. This vulnerability can be triggered by high adrenaline levels which have been shown to be twice Earth levels in the supine position [1]. High adrenaline-heart rates, particularly during EVAs, can reach very dangerous levels, published up to 174/minute; when this rate climbs above 85% of one’s maximum, based on age, it can trigger a chaotic heart rhythm disturbance with sudden death. A contributing factor to this adrenaline-related effect is dehydration, with invariably at least a 10% reduction of the plasma volume in microgravity [1].

Neil Armstrong’s lunar heart rate reached 160. In addition, high adrenaline could have triggered a rare type of acute temporary heart failure, exemplified by his lunar ‘shortness of breath’ after only five days since lift-off. This was probably triggered by dehydration from inadequate air conditioning, limited access to water, only 32 ounces, and sweating in turn, loss of a vitally important mineral, magnesium (Mg), invariably diminished in space; in both large groups of astronauts and cosmonauts, serum Mg is significantly reduced, (p < .0001) even though only 1% of Mg is in the serum, with 99%, intracellular [1].

Some may argue, that Armstrong’s possible heat-triggered lunar heart failure can’t be used as support but it has been known since the 90s, that with exercise in microgravity, there is invariably an increase in core body temperature [1]. Furthermore, it is impossible to determine the proper amount of exercise, because it has been shown that both too much and too little exercise has the potential of damaging our genes. The aging process in space is accelerated by a factor of 10 [7].

I believe there is only one way to reduce this dangerous level of adrenaline, particularly during an EVA i.e. by administering subcutaneous magnesium, just before an EVA. I have emphasized the vicious cycles between low Mg and high adrenaline; the lower the Mg, in turn the higher the adrenaline levels [8]. Correcting this invariable Mg deficit, will temporarily break this cycle. Furthermore Mg is a powerful antioxidant and will offset the adverse vascular effects from hypoxia with the necessity of 100% oxygen prior to an EVA. Also, it can offset potential injuries to blood vessels and energy-producing machinery, triggered possibly by high CO2 levels [8] since Mg is also a Ca- blocker. There is no toxicity with the proper dose of Mg provided kidney function remains normal. My Mg mentor for 10 years, (the late Mildred Seelig MD) stressed this.

Because of space flight invariable malabsorption [9]. Mg must be given subcutaneously. It should be administered just prior to an EVA, with its effect completely lost in 8 hours — totally excreted by then.

References