A heart to heart
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Jim Irwin at the Lunar Roving Vehicle during the Apollo 15 flight on which he suffered severe heart complications.

At a relatively small NASA meeting in Washington DC, in the late 1990s, Harrison Schmitt, Lunar Module Pilot of Apollo 17, invited me to sit down and have a chat. I didn’t know him at the time. Although I hadn’t been invited to present a paper, I had made several comments following some of the presentations, regarding the published space flight cardiovascular complications in addition to my own. I gave him a couple of my papers [1, 2]. He later mailed me several personal unpublished experiences of quite a few astronauts.

Schmitt emphasized that it was his opinion that in the previous 20 years NASA had accomplished very little in addressing the medical hazards of space flight and stressed his frustration with NASA’s restrictive policy, identified as withholding from an independent researcher medical information – even when it pertains specifically to a mission – until an astronaut is deceased. He emphasized this in his book Return to the Moon [3] as I have done in my papers, numerous times.

Because of the Freedom of Information Act, here we are, learning in just the past few years that four Moon walkers returned with abnormal stress tests, namely Irwin, Shepard, Armstrong, and Scott. The latter, although still alive, only through a NASA publication [4]. Only now, do we learn that Armstrong had probable acute heart failure on the Moon [5] and that Irwin returned with extremely high stress test-hypertension in excess of 275/125 [6] and cyanosis of the finger nail beds. Having supervised over 5,000 hospital based symptom-limited maximum stress tests, I have never seen either of these extraordinary complications.

When NASA complied with my request, after Neil Armstrong’s death in 2012, for detailed information regarding his cardiovascular data before and after his lunar mission, I asked Joan Vernikos PhD, former Director of NASA Life Sciences, to drive to my home from her city, nearby, and to come armed with a magnifying glass. Since Armstrong’s fame might persist for many years, I wanted a scientist to share the responsibility in determining the critical difference between Armstrong’s diastolic blood pressure before his lunar mission and on his return, in order to confirm an abnormality in cardiovascular function.

Despite the numbers, having faded after 45 years, we indeed, found a highly significant difference between Armstrong’s diastolic blood pressure before his lunar mission and on his return, in order to confirm an abnormality in cardiovascular function.

Because of my concern that eventually there would be an EVA fatality, with long missions with progressively increasing loss of protective magnesium (Mg) storage sites in bones and skeletal muscles [8], I sent several emails to Richard Williams MD, NASA director of medicine. He invited NASA headquarters physician, Dr. Victor Schneider, to discuss my concern by telephone; this led to two, half hour ‘phone conversations, with Schneider’s insistence that there is, in space, no evidence of reductions in Mg – despite my 25 years of publications and presentations to the contrary.

Apparently, NASA was in the process of completing their paper, published in late 2015. This paper [9] emphasizes that tissue Mg levels are well maintained during 4-6 month space missions; but there is a severe discrepancy here, because it has been published that the serum Mg levels are significantly reduced (p< .0001) in 196 space shuttle crew members [10]. Furthermore, at the 11th Man in Space Symposium in Toulouse, France in 1995, it was shown that in 143 cosmonauts, the serum Mg, was also reduced to similar levels. Instead of providing a page and table number in the reference text book [10] which shows that the serum Mg levels were significantly reduced, (p 11) the NASA paper [9] provides the reference textbook only on the last page.

Testing the test
Although this is entirely speculative, the NASA authors may have an agenda to support their conclusion because they were misled by Dr. Silver’s very reliable tissue “EXA Test” study. The NASA paper, fits the definition of “junk science” i.e., “faulty scientific research, especially when used to advance special interests”. The paper [9] attempts to support their case, that the tissue Mg levels were unchanged, by using the published results (on Earth) of a highly sensitive method of determining tissue Mg levels, correlating quite well with tissue Mg levels obtained at open heart surgery [11]. This technique of Dr Burton Silver’s is of considerable importance, particularly because routine serum Mg levels lack sensitivity.

Silver’s unique method is to obtain cells from the roof of the mouth and then quantitate the levels by electron microscopy. But, in microgravity, since the specimens are obtained from the head, with a shift of blood flow there, this would, in turn, bring an excessive (unreliable) quantity of tissue Mg to the head, from progressively depleted Mg storage sites in the bones and skeletal muscles, along with invariable impairment of Mg absorption through the gastrointestinal tract. In addition, there would be a loss of Mg with sweating, as well as renal Mg loss, with invariable impairment in exercise thermoregulation in Space – with the necessity of exercise for at least 1-2 hours a day [7].

This microgravity shift of blood to the head, is the mechanism which causes in microgravity, a reduction of the thirst mechanism [12, 13], contributing to dehydration, along with leaks of plasma through defective capillaries [5]. With Silver’s method, in space, the tissue Mg levels would appear “normal”, which is inconceivable. After reading this NASA paper [9], I contacted Dr Silver’s lab and was informed that he was rechecking the results; I assume that his studies were correct. I must conclude that, with
Silver’s method of obtaining the samples from the head, it cannot be utilized with space flight, in the presence of microgravity. This problem would not occur if exact Earth gravity can be duplicated both in transit and while exploring the Moon, Mars, or an asteroid.

A search of the medical literature was conducted and only one other similar NASA study was found [14] with again the assertion that there were no significant changes in tissue Mg concentrations in the 12 subjects who had measurements with Dr. Silver’s technique. Furthermore, this was a bed rest “head-down” study, for convenience and with far less cost, in an attempt to simulate space studies by keeping the head below body level, thereby forcing higher cranial blood flow.

However, I have maintained for many years that these bed rest studies are unsatisfactory, because the adrenaline levels have not been shown to duplicate those in space at twice Earth levels when supine. I believe that the combination of invariable deficits of both Mg ions and plasma are responsible for these adrenaline elevations exemplified, for example, by Armstrong’s lunar heart failure [5].

When I presented a paper at the 11th Man in Space Symposium in 1995, I insisted that, based on my studies of extraordinary endurance athletes and the Russian animal studies in space, in microgravity the adrenaline levels must be significantly elevated. About eight years later, my insistent argument was supported [5]. Finally, although six of the 25 crewmembers in the other NASA study [9], took a bisphosphonate during flight, which would reduce bone deterioration, with 60% of Mg stored there, this would have no effect in offsetting the progressive deterioration of skeletal muscles, another Mg storage site, nor would bisphosphonates offset the Mg deficits from impairment of Mg absorption through the GI tract.

It is very disturbing that these two NASA papers [9, 14] with the misleading conclusion, pertaining to assumed unchanged tissue Mg levels, provide a good example of a subject addressed by Dr. Marcia Angell, a physician and longtime editor of the New England Journal of Medicine, one of the most trusted journals in the world. She states, “It is no longer possible to believe much of the clinical research that is published or to rely on the judgement of trusted physicians or authoritative medical guidelines. I take no pleasure in this conclusion, which I reached slowly and reluctantly over my two decades as an editor.”

References