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EDITORIAL

Brake Iron Dust Inhalation, Magnesium Deficiencies and Hypertension

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A major reward, almost 50 years ago, of our going to the moon, is the knowledge that inhalation of highly toxic IRON laden lunar particulate matter,--- with studies conducted using magnets--- is conducive to impairment in cardiac function, hypertension, and arrhythmias; this is exemplified by Neil Armstrong's diastolic hypertension, the extraordinary stress test- hypertension of James Irwin after his Apollo 15 mission and arrhythmias, complicating particularly the Apollo 15 missions; it has led to 2 additional space flight syndromes: "Apollo 15 Space Syndrome" and the "Neil Armstrong Syndrome" [1-6].

Armstrong returned with extraordinary diastolic hypertension (160/135) and Irwin, after his Apollo 15 mission, with blood pressure of 275/125 after only 3 minutes of exercise. Having supervised over 5000 symptom-limited maximum, treadmill hospital based stress tests, I have never seen such extraordinary blood pressure levels. I have shown that the invariable magnesium (Mg) deficiencies of space flight and dehydration with angiotensin and catecholamine elevations, leaking of plasma through defective capillaries, and lack of thirst, stemming from impairment of the thirst mechanism in Space, are important contributing factors.

Recently, it has been determined by the American Heart Association, that using the cutoff of 130/80, half of those living in the U.S. have hypertension, rather than a third of the world population using the cut-off of 140/90. Furthermore, Mg deficiencies are common world - wide and exist in at least 60% of those in the U.S. and are important contributing factors to hypertension; this stems from endothelial dysfunction, apparently very common in Space and exemplified by both Armstrong and Irwin [7,8].

A study of 12-year-olds in the Netherlands, the PIAMA study, showed that exposure to particulate matter constituents, in particular iron, may increase blood pressure in children and portends hypertension in adulthood [9]. Where is this iron coming from? One very common source may be from iron dust, released from brakes. Most brakes are made of iron because it is both strong and relatively cheap [5]. Furthermore, just as the magnetic effect of iron was used in lunar studies, magnetic particles in indoor dust has been used as a marker of pollution released by various outdoor sources [10]. If this is supported by further studies, it is indeed very disturbing because it suggests that living indoors, does not provide the protection, one would expect.

Not only is urban pollution conducive to hypertension and elevations of diastolic blood pressure with in turn a cardiovascular risk, but transient exposure to traffic may increase the risk of a myocardial infarction in those who are susceptible [11].

Furthermore, Bartoli, et al. [12] have shown not only the adverse effects on hemodynamic function as in Neil Armstrong's case but the mechanisms conducive to arrhythmias with numerous examples shown during the Apollo mission; clearly this would also intensify urban pollution complications. Since these studies have shown that sympathetic nerve activity is a catalyst, triggering various cardiac events, it should be kept in mind that catecholamine levels in Space have been shown to be

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Figure 1: This shows that the extremely steep road, necessitating frequent braking, from the paved top of the mountain is brown from dust, whereas the road going up is gray.

twice Earth levels when supine [4,5]; it would involve those related to running for example --- even those exercising indoors and exposed to traffic [10].

What can be done to eliminate this universal source of iron? Perhaps, sealing the brakes can't be used as a solution [13] because it would contribute to the devastating build-up of heat. Apparently, legislation will then be required to use some metal for brakes --- other than iron; unless there is strong public support, this alternative may require decades before it is universally accepted.

Finally, a major component contributing to the "Neil Armstrong Syndrome", is dehydration with in turn, elevations of angiotensin and catecholamines. Apparently, dehydration played a major role in Irwin's myocardial infarctions, with his first, only 21 months after his lunar mission. In Irwin's autobiography, [14] he stresses the fact that his in-suit water device didn't function during all 3 lunar excursions. With the impairment in thermoregulation in the presence of a Mg deficiency with increased Mg loss in sweat and renal loss of Mg along with an inadequate air-conditioned suit, this would intensify the Mg, angiotensin, catecholamine vicious cycles conducive to heart failure, Irwin encountered [3,15]. With dehydration, there would be a reduction of a vasodilator, atrial natriuretic peptide, intensifying the degree of hypertension [1,16]. The combination of inhalation of iron dust, dehydration, Mg deficiencies is indeed deadly.

Although oxidative stress may trigger hypertension, antioxidant supplementation has not been shown consistently to be effective [17]; this may be due to the fact that an underlying Mg deficiency, conducive to oxidative stress, has not been corrected [7,18].

It should be kept in mind that iron particulate matter --- simulating lunar iron dust hazards [1-6] is released both from brakes and tires [19]. The Figure 1 shows that brakes are the source of dust with the necessity of frequent braking.

Dedicated to the memory of Astronauts James Irwin, Apollo 15 and Neil Armstrong.

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