

Calcium and other supplements to protect against internal radiation

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The Fukushima catastrophe has focused interest on the health effects of exposure to internal radionuclides. The whole of northern Japan has to a greater or lesser extent been contaminated with a range of fission-product radionuclides, neutron activation radionuclides and components of the reactors, Plutonium and Uranium isotopes. These are all the same contaminants which were released by the Chernobyl catastrophe and the long term health effects are serious, as shown by the epidemiological research into the Chernobyl-affected territories. These are described in ECRR2010, Busby et al 2011, Yablokov and Busby 2009 and Yablokov et al 2009. According to ECRR2010, the effects are all due to the enhanced genotoxicity of certain internal radionuclides, in particular, Strontium90, Strontium89, Barium140, Uranium 238, 235 and 234, Plutonium239 and 238 and perhaps Caesium 137 and 134. The reason for the enhanced genotoxicity of these contaminants is that they have significant chemical affinity for the DNA, both somatic and germline which evidence shows is the main target for radiation genotoxicity.

It should be noted that the currently used risk model of the ICRP does not add any special enhancement hazard factors for internal radionuclides and assesses health outcomes purely on the basis of absorbed dose, making no allowance for enhanced ionisation near the DNA. For this reason, people living in highly contaminated areas of Japan have been told that since their absorbed dose is not much different from background, no ill health will be found. This is the same argument employed after Chernobyl, and it is now shown by many hundreds of studies to be false.

The purpose of this short note is to suggest that taking certain elemental supplements, notably Calcium, will have a radioprotective effect and will reduce the effects of exposure to the main harmful elements contaminating the air, the food, the dairy products and the water.

The mechanism

The human body uses various elements for various purposes. Consequently, the local concentration at the cell level or below of these elements is not uniform. It is an interesting, curious and well known fact that the body does not employ any element with an atomic number greater than Zinc ($Z=30$) except for Iodine ($Z=53$) which concentrates in the Thyroid gland and circulates in the blood. Since the absorption of gamma radiation is proportional to the 5th power of the atomic number, and since most of the body is water, with an effective atomic number of $Z = 8$ (Oxygen) it is immediately predictable that the Thyroid gland, owing to its Iodine content would absorb huge amounts of radiation compared with other parts of the body. And the thyroid is, of course, the most radiosensitive organ. In order to block access of Radioactive Iodine 131 (and other radioiodines) authorities give out stable (non radioactive) iodine tablets. In fact, at Fukushima, it now turns out this did not happen. Nevertheless the idea is correct.

The structures and molecular sites in the body which bind specific chemical elements are not always completely saturated. Therefore vacant sites can be and will be attached to by elements which have access to them; if these elements are the stable elements which are normally bound to the site, the chemical equilibrium laws will ensure saturation so long as there is an excess of the particular element. There are a number of physico-chemical descriptions, adsorption isotherms, equilibrium equations and so forth but the idea is straightforward. For ionic equilibria the laws of mass action apply in dilute solution.

If there exist near the active sites radionuclide ions which mimic the natural element or ion then these will substitute at the site. The site of interest here in this discussion is primarily the phosphate backbone of the DNA which normally is stabilised by dipositive Calcium, Ca^{++} or Magnesium Mg^{++} .

Ions which mimic these but are radioactive are Ca^{45++} , Ba^{140++} , Sr^{90++} and Sr^{89++} , UO_2^{++} (uranyl) and Plutonium complex ions.

Therefore, taking supplements of stable calcium will ensure that the active sites at the DNA are filled with stable Calcium and this will inhibit the binding of the other radioactive materials. This idea is particularly attractive since

- (a) Calcium tablets are harmless and completely non toxic
- (b) Calcium tablets are available from health food shops which usually combine them with magnesium
- (c) A number of research studies with rodents carried out during the Sr90 contamination in the global weapons fallout period showed that Ca supplements drove out Strontium90 (see below). Therefore the theoretical prediction is shown to be broadly right.

The presence of Sr-90 in weapons fallout was considered at the time (1959-63) to represent a serious danger to health, and indeed we now know that these exposures were the cause of the cancer epidemic which began some twenty years after the tests. Because of the (justified) fears, a number of studies were carried out on the use of stable Calcium and Strontium to block the absorption of Sr-90 and other Calcium mimics which were radioactive. I refer to Spencer et al 1967 who showed the method worked in humans and Palmer et al 1958 and Kawin 1959 who demonstrated that it worked in rats.

The dose regime

Studies with rodents show that the main problem is with individuals which have low Calcium levels. The most important thing is therefore to ensure that the individual's Calcium levels are not below the natural or normal level. Beyond this, taking greater doses of Calcium have a diminishing effect on Strontium 90 build up as measured by the activity in bone. Therefore it is proposed that for an adult, no more than two tablets containing 800mg Calcium Lactate and 350mg Magnesium oxide are taken once day, and one tablet is probably sufficient to ensure that there is no deficiency in Calcium ionic strength at the DNA. Calcium is an important component of physiological makeup and the concentrations are regulated by various complex systems. However, loading up the Calcium at the gut level will generally ensure that there is sufficient Calcium present to reduce the effects of radioactive Calcium ion mimics in the body. For children, the doses should be reduced in proportion to the

child's weight. These substances are non toxic, but one caution is necessary. Some of the preparations sold have Vitamin D added. These should not be given to children under the age of 14 for long periods of time. Finally, following Fukushima it would be prudent to have the brand of calcium supplement tested for the presence of Strontium-90 and uranium. A number of Sr90 and U free Calcium preparations will be available on the internet soon, but it would be possible to find a company and send some tablets for analysis, and then stick to that brand.

Other supplements

I would suggest that a daily dose of 2mg of Caesium Carbonate or chloride of some soluble caesium salt would, on the same basis, reduce the concentration of radiocaesiums. These appear to concentrate in muscle, and their effects on heart muscle appears to be significant. Bandashevsky has shown that in the Chernobyl fallout territories children have suffered arrhythmias and heart attacks at Caesium loadings of 50Bq/kg. Unfortunately, the laws prohibit the sale of such tablets despite the fact that Caesium is totally non toxic at these levels.

Lastly, I would suggest taking daily selenium tablets 100ug (adult dose). Selenium is a sulphur mimic and its substitution for sulphur causes the cell to be fooled (due to the Z⁵ photoelectron effect) and increase the rate of DNA repair through reactive oxygen enzyme potentiation. This has been shown to give a large radioprotective effect in many rodent studies.

Finally

My advice is to evacuate from areas where the external gamma dose rate is greater than 0.3uSv/h at 1m above the ground. This will signal the existence of significant contamination which will represent an inhalation hazard. I have shown this by analysis of vehicle air filters. The idea of supplements is to make the best of a bad decision or a forced decision to remain. Avoid Dairy produce (milk, cheese). Avoid any shellfish or molluscs from the east coast of Japan. Fish is probably OK, especially pelagic fish. Measure radioactivity in the food you eat and avoid foods which are contaminated. Do not believe the authorities in Japan or the spokesmen of the international risk agencies (ICRP, IAEA, UNSCEAR, WHO); their advice is wrong. It is possible to measure radioactivity in food with a Geiger counter that can be stopped and started (not all of them allow this). Make up some lead shielding using roofing lead about 2 inches thick. Put the food in a shallow dish, use a long count time and compare with an equal weight of water. Anything that gives three times background is suspect.

Take control of you lives and look after yourself and your children.

No one else will.

Good luck and lots of love

Chris

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