Rulemaking1CEm Resource

From: RulemakingComments Resource
Sent: Thursday, November 19, 2015 9:50 AM
To: Rulemaking1CEm Resource
Subject: FW: Comments on Hormesis Rulemaking

From: Dennis Nelson [mailto:dennis_nelson@att.net]
Sent: Wednesday, November 18, 2015 10:45 AM
To: RulemakingComments Resource <RulemakingComments.Resource@nrc.gov>
Subject: [External_Sender] Comments on Hormesis Rulemaking

Please add these comments from my organization Support and Education for Radiation Victims (SERV) to your Rulemaking agenda on the Hormesis question. These comments were also made to the EPA Radiation Science Board for their consideration on changing their radiation exposure standards.

Thank you,

Dennis Nelson, Ph.D.

Comments on NRC Rulemaking: Petition to adopt "hormesis" in their radiation exposure standards.

My name is Dennis Nelson and I am a Director of SERV. I hold a Ph.D. degree in Biophysical Chemistry with a background in thermodynamics and bioenergetics. I have done independent research in the areas of hemoglobin-oxygen binding, oxygen toxicity and immunology, measuring the affinity of antibody-antigen bonds and hormone binding sites in the cells.

From my perspective as a Physical Biochemist I see the interaction between ionizing radiation and biological systems completely differently from the dose models which have been developed and promulgated by the health physicists. Those models were borrowed, inappropriately, from the disciplines of Pharmacology and Toxicology and do not apply to the physical damage done by ionizing radiation in the human body. Chemical damage caused by toxic materials is targeted to specific biochemical and physiological pathways and is based on toxin concentrations, and the activation energy of the toxic reaction. Such reactions are subject to a threshold effect because toxin concentrations below the activation energy do not initiate a toxic reaction. Dose can be considered to

be an appropriate construct for chemical toxicity because the chemical energies are low, in the range of just a few electron-volts.

Ionizing radiation, on the other hand, produces very high energies, even from a single nuclear disintegration, on the order of several thousand to several million electron-volts, which can produce massive, indiscriminate damage to cells or groups of cells. It is unfortunate that these comparisons have been made between chemical and radiological toxicity, because it only causes confusion in interpreting the effects of ionizing radiation on biological organisms. The photon and particle energies in the case of ionizing radiation are so much greater that those operative in biochemistry and photochemistry that there is no direct parallel between them.

With chemical toxicity such assertions as: “The Dose Makes the Poison;” and “Dilution is the Solution to Pollution” can have some validity because concentration effects apply. With the physical/mechanical damage caused by ionizing radiation such dilution arguments **do not** apply because the damage is not primarily chemically mediated. Ionizing radiation acts on a microscopic level in much the same way as projectile damage acts on a macroscopic scale. Bullets damage the whole body, its organs and tissues by kinetic energy transferred along the bullet trajectory by physical cavitation effects. Ionizing radiation interacts, in much the same way, at the microscopic level with cells, sub-cellular organelles and molecules. This damage has no threshold and must all be repaired by cellular processes.

The regulatory agencies speak repeatedly of radiation dose, but in reality one does not measure a dose of radiation at all but rather the total amount of damage caused by a given amount of exposure and how it may be repaired. What actually needs to be researched and documented is the efficiency and fidelity of biological repair following radiation exposure and damage. This is not an easy quantity to measure and it differs for every single individual. It depends on the location of the damaged cells, which sub-cellular organelles are affected such as the mitochondria, the ribosomes, the nuclei, or even the cellular scaffolding such as the actin molecules. Damage to the mitochondrion is particularly problematic since it can destroy its architecture and release molecules normally active in the electron transport chain. When these molecules are bound in proper sequence in the mitochondrial architecture they become key elements on the step-wise oxidation of glucose and acetate. This step-wise cascade is coupled to the formation of multiple high energy molecules such as ATP which are very important in cellular energetics. When released from their proper position in the electron chain from oxygen to water, these heme-based molecules can act as free radical generators within the cell. This can result in a severe oxidative stress load on the cell and explains why radiation is known to potentiate oxygen toxicity

Radionuclides released into the environment are taken up and incorporated into body tissues just like non-radioactive elements. There they lie hidden until they disintegrate and act like microscopic time bombs or land mines at a cellular or molecular level. All this damage must be repaired and not all is repaired correctly. Damage to quiescent pluripotential stem cells is particularly problematic because they can lie hidden for years until those cells are recruited into the dividing cell pool and the damage is expressed. Damaged stem cells also represent a great loss to the repair capacity of the body since their numbers are limited and they give rise to large clonal expansions of reserve cells.

Any reference to radiation damage as a “dose” should, therefore, be viewed with suspicion and any attempt to predict radiation risk based on a hypothetical “dose” level should also be rejected because the model for measuring radiation damage is incorrect. Thus, in the case of radiation toxicity and environmental contamination with radionuclides, “The Dose does **NOT** Make the Poison,” and “Dilution is **NOT** the Solution to Pollution,” because radionuclides cannot be diluted below an activation or damage threshold as is the case with chemical toxins.

Thank you,

Dennis Nelson, Ph.D.
SERV

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