Radiation Hormesis Update: Medical Imaging is still not dangerous – and the radiation doses are likely healthful!

Radiation hormesis\(^6\) can be described as the positive biological effects (i.e. cancer prevention, longevity) from low levels of radiation (well above x-ray exposures) while negative biological effects (i.e. cancer and death) are seen at the high levels of radiation exposures (Atomic bomb levels). \((\text{Figure 1})\) Recently radiation hormesis was presented to the chiropractic profession.\(^9\) There is continued concern that exposure to radiation from diagnostic imaging creates irreversible mutations to DNA, predisposing damaged cells to become cancerous causing future death for some individuals. This is referred to as the 'single hit theory.' That is, the concept that cancer is initiated by a single genetic mutation, which can be induced by a single particle of radiation; therefore, the number of initiating events is then proportional to the number of particles of radiation, which is proportional to the dose.\(^9\) This is referred to as the Linear-No-Threshold or LNT model \((\text{Figure 1 and 2})\) and infers that all radiation is harmful, regardless of the dosage (straight line marked 'linear'). Using the LNT model and using data on atomic bomb survivors from Nagasaki and Hiroshima, researchers have performed analyses to project hypothetical future cancers and deaths from possible cancer resulting from medical imaging. This has been done recently for ionizing radiation from x-rays\(^6\) and CT scan use.\(^5\) Here, I will discuss only the recent studies on CT scans as these exposures are much greater than that for x-rays.\(^9\)

In 2009, Smith-Bindman et al.\(^9\) investigated the health risks associated from exposure to CT scans. They collected actual data on radiation dosages from four California clinics. They found a 13-fold variation between the highest and lowest radiation doses for each CT type, as well as a median effective dose of 22mSv (2200mrem @ 100 cervical series \(\{\text{AP} + \text{Lateral}\}\)) or @ 17 lumbar series \(\{\text{AP} + \text{Lateral}\}\) for a CT coronary angiogram and 31mSv (3100mrem @ 141 cervical series or @ 24 lumbar series) for a multiphase abdomen-pelvis CT scan. According to their predictions, 1/270 Forty-year old women receiving a CT coronary angiogram will theoretically develop future cancer from the procedures. The reader should note the key words I've emphasized here (predictions and theoretically).

Also in 2009, Berrington de Gonzalez et al.\(^9\) used a large commercial insurance database to determine CT scan use frequency. They determined that there were approximately 72 million CT scans

\[\text{Figure 1. The LNT Model and the Hormesis Model are nearly identical EXCEPT at Low Doses. Until recently (40 years) there was no data in the low-dose region, so the LNT Model was 'assumed.'}\]
The doses range given to patients receiving x-rays, or more in range from CT scanning (higher doses), one should see a decrease in risk of cancer and death BELOW the spontaneous level.18,20

How can this be? This is because any assessment of the biologic effect of radiation cannot be determined by the number of mutations it creates, but by its effect on the biosystem that controls the relentless enormous burden of oxidative DNA damage.19

That is, we are living beings and not zombies - we have antioxidant prevention, enzymatic repair of DNA damage, and removal of persistent DNA alterations by apoptosis, differentiation, necrosis, and the immune system to keep us healthy.21 The DNA mutations that are caused from radiation exposure are but a minuscule fraction of the mutations that occur in our bodies every day spontaneously.21 Since cellular repair takes place, permanent damage usually does not result from exposing tissue to radiation.21 In fact, assuming the IRT model, Biller estimates that exposure to 1 Gy (1000mrem @ 46 cervical series or @ 8 lumbar series) of radiation could produce rare radicals that may result in about 20 potential mutations, however, this is in contrast to the 10,000,000 potential mutations/cell/day that result from intrinsic reactive oxygen species metabolites and free radicals produced in our bodies regularly.21

It is after consideration of the human bodies' adaptive healing system and the understanding of how incredible it is in correcting the never-ending bombardment of cellular damage occurring every second of our very existence that helps us only begin to appreciate our innate power. The LNT model should not be used for risk assessments at low levels of radiation exposures such as given from medical imaging. At exposure levels from diagnostic x-rays, use of the LNT for risk assessment is "not scientifically justified and should be banned."21

Scott et al. state: "There is no credible evidence to support the contention that current usage of CT scans in clinical settings in the US will cause future cancers. Rather, the available data indicate that occasional exposure to diagnostic x-rays could possibly reduce the risk of future cancers among irradiated adults."21

**SUMMARY**

The latest research regarding the novel application of the principles of hormesis for human health and treatment for chronic disease and cancers is nothing but fascinating and will be discussed in a future article. I conclude by giving you this analogy: 'Red-flag' restrictions on radiography use for Chiropractors is like imposing restrictions on essential trace elements in our diet because they are poisonous in large quantities.21

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**References**

19. Tibbals M. JIBC. 2003;11(1).