CNEWS

Issue 2, Spring 2003

News and activities of the members and supporters of the Canadian Nuclear Society

Research Shows Beneficial Effects of Low Doses of Radiation

By Jerry Cuttler

Summary of the Work

Ron Mitchel, Senior Scientist in the Radiation Biology and Health Physics Branch at Chalk River Laboratories and three co-workers have just published an outstanding paper in the journal Radiation Research.[†] It presents evidence that a single radiation dose of 10 or 100 milliGray* (mGy) (1 or 10 rad) cobalt-60 gamma rays to cancer-prone, radiation-sensitive young (~50 day old) mice delayed cancer death substantially. The dose of 10 or 100 mGy is approximately 4 to 40 times the average natural radiation dose per year, but it was delivered at 0.5 mGy/min.

The research employed genetically modified Trp53+/- mice whose cells lack the cancer-fighting gene Trp53 in one of their two chromosomes. Such mice get cancer in middle age instead of old age, as would happen in normal mice (Trp53+/+ ones). Not only are Trp53+/- mice cancer prone, they are also radiation sensitive. Such mice do model cancer-prone and radiation-sensitive people including those who would be part of a workforce.

Normal mice have a mean life span of 578 ± 138 days (1.6 ± 0.4 y). Exposure of these normal mice to the large dose of 4 Gy (400 rad) at a high dose rate results in a life-span loss of 125 days or 22% of their normal life. In comparison, Trp53+/- mice with a life span of 375 ± 103 days (1.0 y), when exposed to 4 Gy, have their life reduced by 148 days or 40%. Trp53+/- mice are therefore more sensitive than normal mice to a high dose. *continued on page 4*

The Importance of This Work.

Hormesis is an adaptive response of living organisms to low levels of chemical, biological or radiological stress or damage – a modest overcompensation to a disruption – resulting in improved fitness. Observations of this reproducible phenomenon (low-dose stimulation and high-dose inhibition) have been widely reported in the scientific biomedical literature since the 1880s, and form the basis for all immunology treatment. Despite the growing body of evidence for adaptive response to low-level radiation, however, epidemiological (population) studies are generally inconclusive. The reason given is that the dose-response is lost against the noise of background cancer incidence. Public and occupational health policies, which rely on such studies, therefore revert to the Linear-No-Threshold (LNT) hypothesis. Unfortunately, misinterpretation of the LNT hypothesis, that it implies proof of a negative health effect at any level of radiation exposure, has contributed to societal radiophobia and anti-nuclear propaganda. This Chalk River paper reports on quality research carried out on radiation-sensitive animals, and demonstrates that a low dose of radiation, while neither increasing the average life span nor reducing the frequency of tumor initiation in the sample population, did provide protection against spontaneous cancer by delaying death due to cancer. This, and other related research, suggest the need to reconsider the conventional "ever lower is better" criterion for low-dose radiation limits. Such a policy shift would also enable the possible use of low-dose radiation therapy in many important medical applications.

Jerry Cuttler

CNEWS

CNEWS which appears here in this its second edition is intended as an informal, forward looking communicator of information on the interests and upcoming events and activities of the CNS. It is a guide to courses, conferences and seminars organized by the various divisions of CNS and to its publications, web sites and other information programs. CNEWS is directed to what we could think of as the broader CNS constituency including the participants and supporters of its various programs, and users of it's information resources.

CANADIAN NUCLEAR SOCIETY bulletin DE LA SOCIÉTÉ NUCLÉAIRE CANADIENNE

The CNS Bulletin is the news and technical magazine of the Canadian Nuclear Society and is published four times per year by Bulletin editor Fred Boyd, (fboyd@sympatico.ca). The Bulletin is distributed primarily to CNS members and is therefore a benefit of CNS membership. The Bulletin reports on CNS and other related conferences etc. and presents selected technical papers. It also includes the calendar of the upcoming events of the CNS and sister organizations. Be a member and benefit from receiving the Bulletin.

CANADIAN NUCLEAR FAQ

Looking for a "one-stop shopping" on-line resource that provides general information on the Canadian nuclear industry, with links to all other relevant websites? Check out "The Canadian Nuclear FAQ" (Frequently-Asked Questions) at **www.nuclearfaq.ca** an unofficial information website created in 1996 by CNS member and AECL employee Jeremy Whitlock. The website includes links to the major Canadian and international nuclear websites and the educational nature of the website makes it attractive to teachers and to students planning research projects.

CANTEACH

For the most comprehensive educational and reference library on CANDU technology including work by industry and academic contributors on plant design, construction, management, maintenance, materials and engineering, sponsored by CANDU Owners Group Inc., see the website **http://canteach.candu.org**

Canadian Nuclear Society Website

Access the CNS website at **www.cns-snc.ca** for a wealth of information about CNS programs and activities including the current Events Listing.

Research Shows Beneficial Effects of Low Doses of Radiation

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Radiation in low doses does not significantly affect the normal life span of these radiation-sensitive, cancer-prone mice; however, the effect on cancer latency (the time between spontaneous initiation and progress to malignant tumors which cause death due to cancer) is significant. Trp53+/- mice spontaneously develop a variety of cancer types. Two types that provide a good measure of latency are bone cancer in the spine (indicated by the onset of paralysis) and lymphoma (leading rapidly to death). The research demonstrated that the radiation exposures had little effect on tumor frequency, indicating no effect on tumor initiation. The 10 mGy exposure reduced the risk of both cancer types by increasing latency (by up to ~120 days for spine cancer); i.e. it reduced the rate at which spontaneously initiated cells progressed to malignancy. The effect of this adaptive response persisted for the entire life span of all the animals that developed these tumors. Exposure to 100 mGy delays lymphoma latency longer than the 10-mGy dose, however, the 100 mGy dose increased spinal cancer risk by decreasing latency compared to unexposed control mice. The higher dose is in the transition zone between reduced and increased risk; the dose at which the transition occurs varies with tumor type.

Stated more concisely, a small dose (10 mGy) did increase the latency period for lymphoma and for bone cancer; i.e., it did reduce the rate at which spontaneously initiated cells progressed to malignancy and the effect of this adaptive response persisted for the entire life span of all the animals that developed these tumors.

[*] Mitchel RE, Jackson JS, Morrison DP, Carlisle SM. Low Doses of Radiation Increase the Latency of Spontaneous Lymphomas and Spinal Osteosarcomas in Cancer-Prone, Radiation-Sensitive Trp53 Heterozygous Mice, Radiat Res 159 (3):320-7, 2003 March

* A measure of radiation dose per unit animal weight (1 Gray is 1 Joule radiation energy per kg)

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