UNCERTAINTY AND RELATIVE RISKS OF RADIATION EXPOSURE

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My task is to discuss uncertainties in the risks associated with unintended radiation exposure and to place these risks in relation to other hazards. I will do this in the framework of a physician called upon by a patient or the family to provide prognostic information following radiation exposure from a nonmilitary radiation incident. Two underlying questions can be used to structure the discussion: (1) Is there significant uncertainty in the estimate of risks associated with radiation exposure? (2) Will physicians have difficulty in explaining these risks to patients and their families?

The answer to both questions is affirmative. With regard to the first, there are considerable uncertainties at both high and low levels of exposure. The risks will probably be difficult to explain for several reasons, including the fact that the perception of risk is contextual and the probabilistic nature of these risks is not easy to convey. I will outline three approaches to the explication of long-term risks: (1) the additional carcinogenic and genetic risks associated with radiation exposure; (2) the relative risks of other fatal occurrences; and (3) the comparison of risks with those from intended exposures and medical radiation procedures.

UNCERTAINTY IN SHORT-TERM OUTCOME

A contemporary text[1] on the medical effects of ionizing radiation discusses the hematopoietic impact of radiation exposure as follows: with less than 100 rad, survival is essentially certain; with 100 to 200 rad, survival is probable; with 200 to 450 rad, survival is possible; with more than 500 rad, survival is virtually impossible. However, a close examination of the data introduces some uncertainty. For instance, an early report from Chernobyl stated that all of the 53 individuals exposed to 200 to 400 rad survived. In contrast, estimates of the human mean lethal dose ($LD_{50/60}$) of low LET ionizing radiation that appear in the literature range from 155 to 350 rad (Table 1).[2,3] The principal reason for these discrepancies is not hard to find: these data were not obtained as part of controlled clinical trials on healthy individuals. In the case of the atomic bomb exposures, the victims were burned and blasted and were often in a poor nutritional state due to wartime rations, and in the case of patients undergoing transplants, these people were severely ill. Actually, these estimates are no more discrepant than those for other toxic substances; for example, the average lethal dose of cyanide (as HCN) is cited as between 30 and 90 mg.[4]

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