How Can Biodosimetry Measurements be Used to Improve Radiation Epidemiologic Studies?

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Abstract

Biodosimetry measurements can be used potentially to improve radiation epidemiologic studies by providing a means to corroborate analytical or model-based dose estimates, to assess bias in models and their dose estimates, and reduce uncertainty in individual or group-average doses. Radiation epidemiologic studies typically rely on accurate estimation of doses to the whole body or to specific organs for numerous individuals in order to derive reliable estimates of risk of cancer or other medical conditions. However, dose estimates whether based on analytical dose reconstruction (i.e., models) or personnel monitoring measurements, e.g., film-badges, are associated with considerable and varying degrees of uncertainty. Uncertainty is a product of many factors; persons were exposed many years or decades earlier and usually only inadequate data or measurements are available. While biodosimetry has begun to play a more significant role in long-term health risk studies, its use is still limited in that context, primarily due sometimes to inadequate limits of detection, inter-individual variability of the signal measured, and high per-sample cost. Presently, the most suitable biodosimetry methods for epidemiologic studies are chromosome aberration frequencies from fluorescence *in situ* hybridization (FISH) of peripheral blood lymphocytes and electron paramagnetic resonance (EPR) measurements made on tooth enamel, with detection limits of approximately 0.3 to 0.5 Gy, and as low as 0.03 Gy for FISH and EPR, respectively. Presently, both methods are invasive and require obtaining either blood or teeth. Though both FISH and EPR have been used in a variety of large long-term health risk studies including those of a-bomb survivors and various occupational and environmental exposures, only recently has considerable thought been given to how these data can be used in epidemiologic studies in any but rudimentary ways. Key issues to consider are the representativeness of the persons sampled relative to the overall study population, limits of detection, effects of body shielding as well as external shielding, how to extrapolate from the tissue sampled to tissues of interest, and how to adjust dosimetry models applied to large populations based on sparse biodosimetry measurements. These various issues will be discussed.

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