

Statistical Modeling of Carcinogenic Risks in Dogs That Inhaled $^{239}\text{PuO}_2$

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Combined analyses of data on 260 life-span beagle dogs that inhaled $^{238}\text{PuO}_2$ at the Inhalation Toxicology Research Institute (ITRI) and at Pacific Northwest National Laboratory (PNNL) were conducted. The hazard functions (age-specific risks) for incidence of lung, bone and liver tumors were modeled as a function of cumulative radiation dose, and estimates of lifetime risks based on the combined data were developed. For lung tumors, linearquadratic functions provided an adequate fit to the data from both laboratories, and linear functions provided an adequate fit when analyses were restricted to doses less than 20 Gy. The estimated risk coefficients for these functions were significantly larger when based on ITRI data compared to PNNL data, and dosimetry biases are a possible explanation for this difference. There was also evidence that the bone tumor response functions differed for the two laboratories, although these differences occurred primarily at high doses. These functions were clearly nonlinear (even when restricted to average skeletal doses less than 1 Gy), and evidence of radiation-induced bone tumors was found for doses less than 0.5 Gy in both laboratories. Liver tumor risks were similar for the two laboratories, and linear functions provided an adequate fit to these data. Lifetime risk estimates for lung and bone tumors derived from these data had wide confidence intervals, but were consistent with estimates currently used in radiation protection. The dog-based lifetime liver tumor risk estimate was an order of magnitude larger than that used in radiation protection, but the latter also carries large uncertainties. The application of common statistical methodology to data from two studies has allowed the identification of differences in these studies and has provided a basis for common risk estimates based on both data sets. © 1998 by Radiation Research Society

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