

Biological Effects of Inhaled $^{238}\text{PuO}_2$ in Beagles

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Beagle dogs exposed to $^{238}\text{PuO}_2$ aerosols (136 dogs, 13-22 per group, mean initial lung depositions of 0.0, 0.13, 0.68, 3.1, 13, 52 and 210 kBq) were observed throughout life to determine tissues at risk and dose-effect relationships. The pulmonary retention of ^{238}Pu was represented by the sum of two exponentially decreasing components of the initial lung deposition; about 84% cleared with a 174-day half time; the half time of the remainder was 908 days. The average percentages of final body burden found in lung, skeleton, liver and thoracic lymph nodes in the 30 longest surviving dogs (mean survival 14 years) were 1, 46, 42 and 6%, respectively. Of 116 beagles exposed to plutonium, 34 (29%) developed bone tumors, 31 (27%) developed lung tumors, and 8 (7%) developed liver tumors. Although lungs accumulated a higher average radiation dose than skeleton, more deaths were due to bone tumors than to lung tumors. Deterministic effects included radiation pneumonitis, osteodystrophy, hepatic nodular hyperplasia, lymphopenia, neutropenia and sclerosing tracheobronchial lymphadenitis. Hypoadrenocorticism was also observed in a few dogs. Increased serum alanine aminotransferase, indicative of liver damage, was observed in groups with ≥ 3.1 kBq initial lung deposition. Estimates of cumulative tissue dose in a human exposed to airborne $^{238}\text{PuO}_2$ for 50 years at a rate of one annual limit on intake each year were derived based on a comparison of the data on metabolism of humans and beagles. The 50-years dose estimates for humans are an order of magnitude lower than doses at which increased incidence of neoplasia was observed in these dogs, whereas the projected doses to humans from 50-year exposure at the annual limit of intake are of similar magnitude to those at which deterministic effects were seen in the beagles. © 1997 by Radiation Research Society

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