Fetoplacental Dosimetry of Plutonium Burdens Incurred Prior to Pregnancy

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Concern with determining and controlling radiation doses associated with exposure of potentially pregnant women to radioactive materials in the workplace and in the environment have led to studies of fetoplacental disposition in several species of experimental animals. These studies have quantified placental transfer from the maternal blood circulation to the fetus and the results were used to derive gestational-stage-related kinetic models and dosimetric tables such as those in NUREG/CR-5631 Rev. 2. The biokinetic models considered the limited data on plutonium concentrations in human fetoplacental tissue, which were obtained using tissues from members of the general population and so contained only background or environmental levels. The Registries have reported results from analyses of placental samples from a woman with a work history that involved an accidental plutonium intake 12 years before her pregnancy as well as placental samples from a non-industry worker. Despite the low actinide levels in these tissue samples, two independent blind comparisons using the ultra sensitive fission track analysis technique were able to identify marked differences in plutonium concentrations in the two cases. The concentration of plutonium in placental tissue from the exposed woman is about 8-fold higher than concentration in reference woman but concentration in placental tissues from the control was much lower than reference values. The placental concentration in the USTUR case was about 150 times higher than that in the control case. The body burden in the woman at the inception of pregnancy and blood levels at each month of pregnancy were calculated on the basis of ICRP metabolic models. These values were used as basis to evaluate the various recommended approaches to dosimetry of the embryo/fetus in women who have a body burden of plutonium at the beginning of pregnancy. Although there are quantitative differences, the calculated values are in general accord with those predicted by published biokinetic models used for dosimetric estimations.

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