Four-Decade Follow-up of a Plutonium-Contaminated Puncture Wound Treated with Ca-DTPA

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Contaminated wounds are a common route of internal deposition of radionuclides for nuclear and radiation workers. They may result in significant doses to radiosensitive organs and tissues in an exposed individual's body. The United States Transuranium and Uranium Registries' whole-body donor (Case 0303) accidentally punctured his finger on equipment contaminated with plutonium nitrate. The wound was surgically excised and medically treated with intravenous injections of Ca-DTPA. A total of 16 g Ca-DTPA was administered in 18 treatments during the 2 months following the accident. Ninety-three urine samples were collected and analysed over 14 years following the accident. An estimated ^{239}Pu activity of 73.7 Bq was excreted during Ca-DTPA treatment. Post-mortem radiochemical analysis of autopsy tissues indicated that 40 years post-accident 21.6 ± 0.2 Bq of ^{239}Pu was retained in the skeleton, 12.2 ± 0.3 Bq in the liver, and 3.7 ± 0.1 Bq in other soft tissues; 1.35 ± 0.02 Bq of ^{239}Pu was measured in tissue samples from the wound site. To estimate the plutonium intake, late urine measurements, which were unaffected by chelation, and post-mortem radiochemical analysis results were evaluated using the IMBA Professional Plus software. The application of the National Council on Radiation Protection and Measurements wound model with an assumption of intake material as a predominantly strongly retained soluble plutonium compound with a small insoluble fraction adequately described the data (p= 0.46). The effective intake was estimated to be 50.2 Bq of plutonium nitrate and 1.5 Bq of the fragment. The prompt medical intervention with contaminated tissue excision and subsequent Ca-DTPA decorporation therapy reduced ^{239}Pu activity available for uptake and long-term retention in this individual's systemic organs by a factor of 38.

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