BIOLOGICAL BEHAVIOUR OF ^{237}Np AFTER INHALATION OF NpO_2 IN THE RAT: PRELIMINARY RESULTS.

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INTRODUCTION

Numerous studies have been reported on the biological behaviour of different masses of ^{237}Np or ^{239}Np administered under various chemical forms and valency states by intravenous or intramuscular injections and by ingestion. In contrast with Pu, some important Np speciation informations are still lacking as well as an appropriate treatment for Np decorporation (1). To our knowledge, only three main studies have concerned the behaviour of Np after inhalation and were confined to soluble forms such as Np-oxalate of unknown valency state and Np (V) nitrate (2, 3, 4). This paper presents preliminary results obtained in rats on the behaviour of Np after inhalation of $^{237}NpO_2$ for which no experimental data is available. This physico-chemical form might be potentially used in the nuclear industry.

MATERIAL AND METHODS

Female Sprague-Dawley rats were used. Two groups of 30 animals were exposed at 3 months of age to $^{237}NpO_2$ aerosols (actual diameter 0.40 μm, σg 2.02) as previously described (5). Four to five animals per group were killed under pentobarbital anaesthezia 7, 21, 48 and 92 days after exposure. The lungs, the liver, the kidneys and the femurs were taken off for α counting by liquid scintillation. This was performed after heat mineralization, solubilization in nitric acid and specific extraction of Np reduced into Np(IV) within the organic scintillation phasis.

At this time, some animals are still alive for further studies up to 300 days after NpO_2 exposure.

RESULTS

The Np lung burden, measured 7 days after exposure were 110 Bq (n=5, sd=10) and 200 Bq (n=5, sd=15) in the 2 animal groups respectively.

Figure 1 shows the evolution of the Np lung burden as a function of time following exposure. The observed curve fits to a single exponential function of time with a half-life at about 68 days.

Figure 2 shows the relative amount of Np retained in the skeleton, the liver and the kidneys as a function of time following exposure expressed as the fraction of the Np lung burden measured on day 7. Maximal retention at about 1 % was observed in the skeleton which remained nearly constant from day 7 to day 92 after exposure. An about two-fold decrease of Np liver retention was observed between days 7 and 21 but this retention remained nearly at a constant value from day 21 to day 92 which corresponded to about 20 times less than the skeleton retention value. The Np kidney retention seemed to gradually decrease by a factor of 2 from 0.003-0.002 % to 0.002-0.001 % from day 7 and to day 92 respectively.

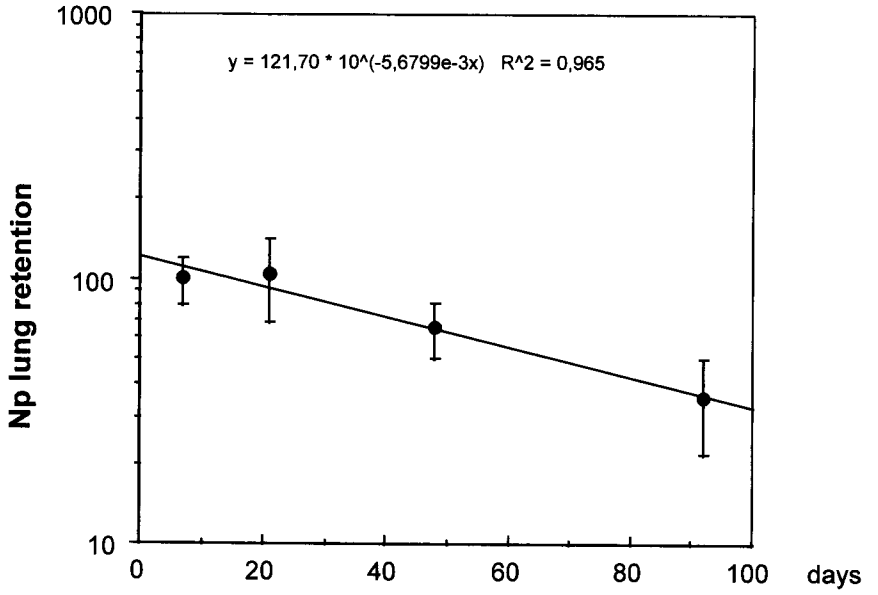

Figure 1: Np lung retention expressed as percent of the retention measured on day 7. Mean values ± sd.

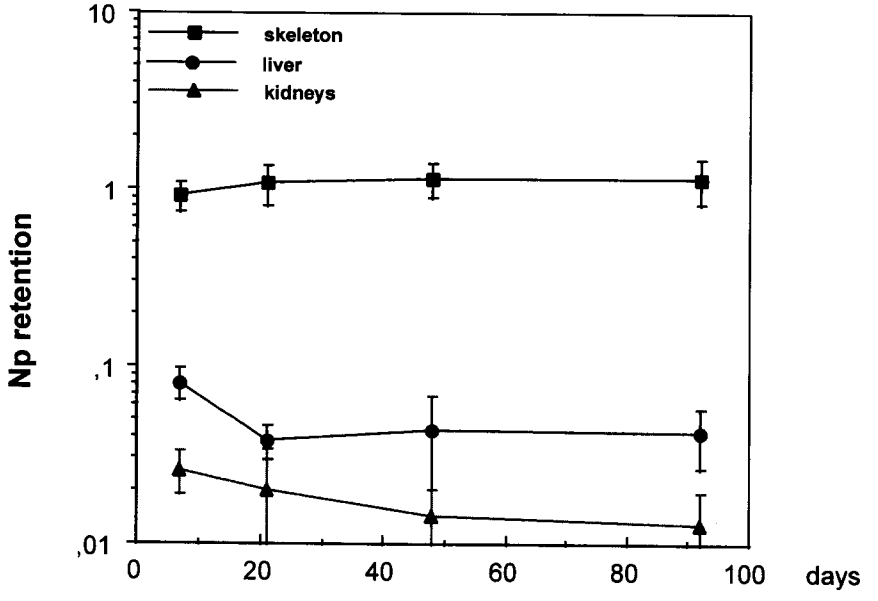

Figure 2: Np retention in different organs expressed as percent of the lung retention measured on day 7. Mean value ± sd.

DISCUSSION

Translocation of Np from inhaled NpO_2 to the other parts of the organism and Np lung clearance appear much slower than those reported for the different Np soluble forms (2, 3, 4). Our results can be directly compared to those obtained in our Laboratory after inhalation of PuO_2 or (UO_2,PuO_2) mixed oxyde containing 20 % Pu which had used the same inhalation device, the same sex, age and strain of rats and a similar α emitter counting method (6).

The half-life of Np retention in the lungs (68 days) was nearly the same as that reported for Pu after exposure to PuO_2 or (UO_2,PuO_2) mixed oxyde (66 days). These Pu exposures were performed at initial lung deposits which are not known to alter lung clearance parameters, especially alveolar macrophage motility involved in the removal of particles by cell migration via the broncho-tracheal tree on the epithelial surface. Thus, our preliminary results suggest that, for the low initial lung deposits studied, between 100 and 200 Bq, $^{237}NpO_2$ is non-toxic for alveolar macrophages and do not alter early lung clearance parameters. Further studies are in progress to characterize these lung clearance parameters as a function of the initial Np lung deposit in order to visualize a potential chemical toxicity of this actinide as compared with Pu.

The fraction of the Np initial lung burden retained in the skeleton was between those reported for Pu after inhalation of PuO_2 and (UO_2,PuO_2) mixed oxyde but close to the Pu value for PuO_2. Moreover, the retention ratio for the skeleton versus the liver appeared very similar at 15 and 20 for Pu and Np respectively. Our results suggest that Np from inhaled NpO_2 might be slightly more translocated to the extrapulmonary compartments than Pu from inhaled PuO_2. Nevertheless, the actinide distributions in the extrapulmonary compartments studied appeared similar for Pu and Np.

In conclusion, these preliminary results suggest that the biological behaviours of Np and Pu after inhalation of NpO_2 or PuO_2 are similar. Further studies are in progress to complete this work and to explain why, in these experimental conditions, Np and Pu have a similar behaviour.

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