LONG TIME CONTAMINATION FROM PLUTONIUM

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Introduction

Plutonium is known to be carcinogenic in animals, with tumours of bone, lung and liver representing the cancers of primary concern (Voelz 1991). The distribution of ^{239}Pu in a human whole body is reported in the research program of the United States Transuranium Registry (USTR) (Voelz et al. 1979, J.F.McInroy et al. 1991). Some cases of osteogenic sarcoma have been observed among the workers with plutonium (Voelz and Lawrence 1991) and the lung cancer, too (Wiggs et all. 1994).

Everyone can know the cases of the mortality after accident of Nuclear power plant in Chernobyl, but nothing was published about the health of the workers who have been contaminated by plutonium.

The reason, why we are busy with this problem was the request of the chief of the Nuclear Medicine Clinic in Martin to perform a control analysis of the content of the plutonium in the urine of a patient S.R.. It concerns a former citizen of the Ukraine (year of birth 1959), who had participated in the liquidation works after the Chernobyl accident. For three month he had stayed in the epicentre, where he acted as a chauffeur driving a radioactive material to the place of destination.

Until the year 1986 he had never been ill, consequently he has not any health card. S.R. hasn't undergone give any health control since the finish liquidation works in the Chernobyl. For patient's repeated complaints , about headache and a loss of muscular strength in the extremities, he was examined at the clinic of the Nuclear Medicine in Charkov in the 1990. In the year 1991 he was submitted to a blood dialyse for removing radionuclides. At the present time the patient is citizen of the Slovak Republic.

Materials and methods

We have determined plutonium in the organism of the patient from urine. To determine the concentration of $^{239,240}Pu$ in urine a modified radiochemical method was used. After mineralization the sample was separated as an anion-nitrate complex with contact by the anion form of the resin in the column. The resin was washed by 8 M-HNO_3, then 8M-HCl-0.3M-HNO_3 for removing the other radionuclides. The solution 0.36M-HCl - 0.01M-HF was used for the elution of Pu. Using the lanthanum fluoride technique (Joshi 1985), the sample was filtrated through a membrane filter. The plutonium was detected in the dry sample. The ^{239}Pu tracer was used for the evaluation of the plutonium separation efficiency.

The alpha - spectrometric measurements were carried out with a large area silicon detector PD-900-100-AM Canberra. The samples were measured and evaluated in the energy region 4.98 - 5.18 MeV. The detection limit of alpha-spectrometry measurements has been 10^{-2} Bq $.l^{-1}$.

Results and discussion

The concentration of plutonium in the 24-hour urine we determined three times in the quarter year intervals. The results are: 54mBq, 63,2 mBq, 53 mBq, with average 56,7 mBq. Because the urine of patient S.R. contained a lot of saline, the results are determined with relative large error of about 20%.

From the results of the analyses of plutonium depositions calculated according to ICRP [ICRP 54] the intake of this radionuclide for our patient was 56.7 kBq . To estimate a committed effective dose (50 years) from the intake of plutonium we used a conversion factor $6.8.10^{-5}$ $Sv.Bq^{-1}$ (class W) (IAEA 1994). So the expressed committed effective dose received from the plutonium intake is 3.8 Sv.

This number is relatively high and all the effective dose will be higher, because the patient was exposed to the other radionuclides too. For example the determination of the rate radionuclides $^{241}Am/^{239,240}Pu$ was 32-36 % in the fallout after the Chernobyl accident, so the activity of ^{241}Am calculated on the basis of the plutonium activity will be 19 kBq, with the committed effective dose 1.3 Sv.

The result from the last examination of the patient at the Clinic in Martin is :

- Encephalopathy with a psychoorganic syndrome and less psychomotoric function, damage of CNS as consequence irradiation and acroparestesia of the legs
- Diabetes insipidus with a tubular damage of the kidney
- Diffusion lesion of the liver in the s. steatosis
- A subclinic form of the hypothyreosis
- Muscular hypertonicus.

The results of the biochemical tests are in normal range except of the liver test where the result is increased.

To conclude, for calculation it will be necessary to modify the effective dose, respectively the absorbent dose when we take all sources of radiation, with which the patient was contaminated.

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