RETENTION OF MOLYBDENUM-99 IN ADULT MAN

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The ^{99}Mo has been used, in water-soluble forms such as sodium and ammonium molybdate, in radionuclide investigations (5;6) and it is present as an impurity in eluates from molybdenum-technetium generators (1), extensively used in nuclear medicine.

The metabolism of molybdenum, which plays a essential role in flaving-dependent metalloenzyme systems, has been studied and transport, storage and excretion of this element are known (2;7): there is a rapid uptake of orally ingested Mo by all tissues with preferential accumulation in the liver, kidney and bone. Intravenously administered molybdenum disappears from circulatory system very rapidly (3). The available data, however, are not expressible in convenient mathematical form to represent retention with acceptable accuracy for radiological protection.

In the present note retention data obtained by measuring the levels of molybdenum-99 in excreta of 10 patients injected intravenously are reported and the whole body retention function derived by multicompartmental analysis of these data is proposed.

METHODS AND MEASUREMENTS

Subjects were patients of the Department of Medicine of the Sassari University, who have been investigate using sodium pertechnetate-^{99m}Tc. Table 1 lists the age, sex, weigth and pathology of these patients and administered doses.

Measurements of urinary and fecal excretion of ^{99}Mo were carried out with the method of the gamma-spectrometry, using NaI(Tl) crystals and multichannel analyzer, during the first 2 weeks after injection. Attempts to measure whole body radioactivity did not give good risults because of the low level of the ^{99}Mo. For the same reason, also the results of measurements carried out on samples of plasma and whole blood are poorly meaningful. Rosoff and Spencer (3), who carried out studies on the fate of molybdenum in man injecting tracer doses of 50-100 μCi, refer that 1 h

after injection the concetration of Mo in plasma and in whole blood ranges from 2.5 to 5% of the initial dose.

TABLE 1. Patients and administered doses

Patient	Age	Sex	Weigth	Diagnosis	Mo-99 Dose (μCi)
1	39	F	73	Carcinoma of the breast with metastases	0.2
2	47	M	57	Multiple myeloma	0.4
3	54	F	58	Carcinoma of the breast with metastases	I.2
4	60	M	60	Carcinoma of the lung with metastases	0.8
5	70	M	78	Metastatic epydermoid carcinoma	1.7
6	50	F	63	Carcinoma of the breast with metastases	1.0
7	49	M	68	Carcinoma of the kidney with metastases	0.1
8	66	F	60	Perivasculitis	0.5
9	54	F	55	Carcinoma of the breast with metastases	1.3
10	77	F	62	Carcinoma of the breast with metastases	2.0

RESULTS

Estimates of the retained molybdenum during the first 2 weeks, calculated from the difference between the initial dose and cumulative urinary and fecal excretion, are given in Table 2 and are reported in graph of Fig. 1. Fecal excretion was very low: the ratio of urinary to fecal excretion was between 25 and 30 for every patient. In Table 2 is also indicated the number of patients to whom the data refer.

The fractional retention, R, for ^{99}Mo can be represented accurately by a four-component exponential function of time:

$$R=\sum_{i=1}^{n} A_i \exp(-\lambda_i t) \qquad (1)$$

The parameters of equation (1) are reported in Table 3. Fig. 1 shows the fitting of the experimental data by this function.

TABLE 2. Retention of injected ^{99}Mo

Days after injection	Number of measurements	Whole body retention
1	10	89.8
2	10	86.4
3	8	83.4
4	8	81.3
5	7	78.9
6	7	76.4
7	7	74.6
8	5	73.4
9	5	72.1
10	3	70.3
11	2	69.4
12	2	68.3
13	1	67.3

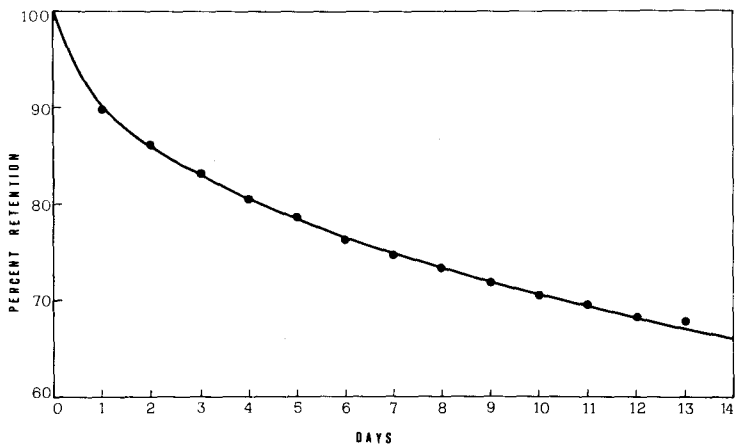

Figure 1. Whole body retention of ^{99}Mo in the first 13 days after injection. Data are fitted by function (1) with parameters of Table 3

TABLE 3. Results of four-component exponential analysis of retention data for 99-Mo between days 1 and 13. (See also Fig. 1)

Component no	Percentage of injected dose	Biological half-life (days)
1	9.5	0.58
2	17.8	5.33
3	8.2	25.67
4	64.5	86.62

Retention data of Table 2 and Fig. 1 are in good agreement with those of Rosoff and Spencer (3). They found that cumulative urinary excretion of Mo in 10 days was 29% and 24% of the injected in 2 subjects. The cumulative fecal excretion in the same period was less than 1% for the first subject and 6.8% for the second one. The higher value was due to the passage of 4% of the initial dose in only one stool specimen on day 4.

Internal exposure for 5, 15 and ∞ days after injection of 1 μCi of Mo-99, calculated by the proposed retention function, is of 2.52, 3.28 and 3.34 μCi.days. The corresponding dose, calculated from the data of Snyder et al. (4), is 0.85, 1.10 and 1.12 millirads.

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