DOSE ESTIMATION OF ENRICHED URANIUM IN TESTES ON INDUCTION OF DOMINANT LETHALITY AND SKELETAL ABNORMALITIES

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INTRODUCTION

Enriched uranium is one of the principal fuels of nuclear power stations (1). Since now in the sphere of radiological medicine what is concerned about the environmental pollution and damage to human beings by nuclear fuels and its fission products released by nuclear tests and plants. Especially in recent years nnuclear power stations are increasing rapidly, the production and consume of enriched uranium expand year by year. Consequently, observations of its harming effect on environment and in the body become a significant task. Especially its action on induction of dominant lethality and skeletal abnormalities showed a close relation on retentive peculiarity in testes. So we paid attention to the relationship between the cumulative absorption dose and the incidence of the dominamt lethality and skeletal abnormalities in the offsprings.

EXPERIMENTAL METHODS

(1) Radiation dose estimation of enriched uranium in testes.

According to the retention function rs(t), with respect to time accumulation of 28d, the cumulative activities $A_s(t)$ (Bq) of enriched uranium in testes were obtained:

$$A_s(t) = \int_0^t A_0, s. rs(t).dt$$

Here A_0, S=early radioactivities of enriched uranium in testes.

Again from the cumulative radioactivities of enriched uranimm in testes calculated the absorption dose (2,3). Dose estimation may be according to the formula as follows:

$$D_r = 1.6\times10^{-10}\sum_s\sum_j [A_s \Sigma SE(T\leftarrow S)_i] \text{ (Gy)}$$

Here $$SE(T\leftarrow S)_i = \frac{Y_i E_i AF_i(T\leftarrow S)}{M_T} \text{ [(MeV/g/nucleus conversion)}$$

Y_i=produce of α radiation

E_i=average energy of α particles

M_T=mass of the organs

$AF_i(T\leftarrow S)$=absorption fraction=1

So that the cumnlative absorption dose may be calculated by contribution of three uranium radionuclides.

(2) The rate of dominant lethals and skeletal abnolmalities induced by enriched uranium.

Sexually mature male and virgin female BACB/c strain mice, 10 weeks old and weighing 21±1g, were used in this study, Experimental animals received intratesticular internal irradiation by enriched uranium with doses of 0.4, 2, 10, 20, 40 and 60ug. After 13 days treatment,each male was allowed to mate with 2 virgin females for a period to 49 days. The females were killed 18-20 days after the beginning of the mating, and the number of corpora lutea, as well as living and dead embryos were counted. So that the rate of dominant lethals were calculated.

Then living and dead embryos are taken out of the mating females, and are fixed in 95% ethyl alcohol for 7 days. One after another are turned into 1% KOH solution for 6 days (5). After a while embryos are stained with 0.05% of alizarin red for 1 day. Experimental specimen are infiltrated with a miscible liquid with ethyl alcohol-glycerin-KOH for 8 days. Dominant skeletal mutations were detected in the skeleton specimen.

EXPERIMENTAL RESULTS

(1) Contribution of the cumulative absorption dose in testes by three uranium radioisotopes

Uranyl fluoride containing ^{235}U of 18.9% (60mg/ml) was used in this study. Sexually mature male BALB/c mice,10 weeks old and weighing 21±1g,were randomly divided into 6 experimental groups. There were 5 mice in each group. Animals treated by single intratesticular injection(4) with different doses of enriched UO_2F_2 ranging from 0.4 to 60ug.We estimate the cumulative absorption dose of the three radioisotopes of the experimental enriched uranium with 18.9% abundance through 28d. It was deducted from the data shown in Table 1.

Table 1. Contribution of the cumulative absorption dose through 28d in testes by three uranium radioisotopes after injection of enriched uranium with different doses.

Injected	Cumulative absorption dose in testes, Gy			
doses, ug	^{234}U	^{235}U	^{238}U	Total
0.4	8.639×10^{-5}	2.903×10^{-6}	2.103×10^{-6}	9.140×10^{-5}
2	4.320×10^{-4}	1.451×10^{-5}	1.052×10^{-5}	4.570×10^{-4}
10	2.160×10^{-3}	7.257×10^{-5}	5.257×10^{-5}	2.851×10^{-3}
20	4.320×10^{-3}	1.451×10^{-4}	1.052×10^{-4}	4.570×10^{-3}
40	8.639×10^{-3}	2.903×10^{-4}	2.103×10^{-4}	9.140×10^{-3}
60	1.304×10^{-2}	4.354×10^{-4}	3.154×10^{-4}	1.380×10^{-2}

It should be noted, that the contribution of total α radiation by ^{235}U was only <5% and >90% fraction of total α radiation came from ^{234}U.Although the content of ^{234}U in natural uranium is less, but physical half life of ^{234}U is comparatively shorter, and then the α radioactivity is higher. Therefore the contribution of α radiation is chiefly by ^{234}U.

(2) The rate of dominant lethals induced by enriched uranium

Experimental results indicated, that therateofdominant lethals induced byenriched uranium was elevated with the increasing doses of enriched uranium.

Table 2 gives the distribution of the females according to the number of living and dead embryos induced by different doses of enriched uranicum. It shows that the increase in the mean number of dead embryos is the result of an increase of the radiation dose of enriched uranium. Our present results show that doses of euriched uranium given to mouse mainly increase the rate of intrauterine deaths. Whereas the mean number of implantations is only slightly altered.

Table 2. The rate of dominant lethals induced by different doses of enriched uranium

Injected doses, ug	Pregnant females(%)	Live embryos/♀	Dead embryos/♀	Ratio with 1 dead embryos/♀	Ratio with >2 dead embryos/♀
0	83	7.00	0.63	0.5	0.13
0.4	100	7.50	1.25	0.75	0.38
2	100	6.22	1.33	1.00	0.33
10	100	5.73*	1.63	0.81	0.36
20	83	4.80*	3.20**	1.00	0.80
40	77*	5.63*	4.88**	1.00	0.88
60	71*	4.60*	2.60**	1.00	1.00

*p>0.05 **p<0.01

(3) The rate of dominant skeletal abnormalities induced by enriched uranium. In mutation-rate experiments, dominantskeletal mutations were confirmed by breeding tests. Skeletal abnormalities were detected in the skeletons of some of the sons of irradiated males. Table 3 summarizes certain parts of the skeleton appear to be especially subject to change by dominant mutations such as ribs fusion, extra rib on one side, and extra ribs on both sides,as well as extra point ribs. Especially gaps in skull, and spine defect, were foundby large doses of enriched uranium.

Table 3 The rate of dominant skeletal abnormalities induced by different doses of enriched uranium

Injected doses, ug	Total embryos	Embryos with dominant skeletal abnormalities				Rate of sheletal abnormalities
		Extra rib on one side	Extra ribs on both sides	Extra point ribs	Other	
0	55	2	8	0	0	18.2
0.4	66	7	6	7	1	31.9
2	59	5	5	6	0	27.1
10	66	12	9	4	1	39.4**
20	43	3	9	8	0	46.5**
40	41	2	23	3	0	68.3**
60	17	1	9	0	3	76.5**

**p<0.01

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