

# AN ESTIMATE OF DOSE TO VARIOUS BODY ORGANS FROM ADMINISTRATION OF NEOHYDRIN LABELED WITH $^{203}\text{Hg}$

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**Abstract**—Neohydrin tagged with  $^{203}\text{Hg}$  is a useful agent for brain tumor localization. However, its use in routine scanning has been questioned because it is known to deliver a relatively high radiation dose to the kidneys. Also, the question of the dose it delivers to the gonads has been posed.

Immediately following intake, the  $^{203}\text{Hg}$  will be distributed generally throughout the body. Thereafter it will be present largely in the kidneys, in the bladder, and in the ureters where its residence times will vary considerably in individual cases. For this reason, the doses to body organs, particularly to the cortex and medulla of the kidneys and to gonads, are calculated for 1 mCi·hr of source in each of the organs where the  $^{203}\text{Hg}$  resides. In this form the results may be adjusted to provide an estimate of dose in an individual case. The organs are simulated by simple geometrical configurations within a man-like tissue phantom, and they have approximately the location, dimensions, and masses of "standard man". The  $\beta$ -dose is computed by conventional methods, but the doses from  $\gamma$ -rays and X-rays are estimated by use of a Monte Carlo-type computer code.

Estimates using biological data from several patients indicate that the doses to the cortex, medulla and ovaries might be roughly in the ratio 15:1:0.1. Frequently 10  $\mu\text{Ci/kg}$  is administered, and at this level the dose to the ovaries in typical cases might be of the order of 0.5 rad. Data obtained by analysis of blood and urine specimens can be used to adjust the above estimates in individual cases.

## DISCUSSION

J. B. HURSH (U.S.A.):

I should like to ask Dr. Lindell if the radon found in the cow's milk derives, in his opinion, entirely from the ingested water or if respired radon is an appreciable supplemental source.

B. LINDELL:

We first found  $\text{Rn}^{222}$  in cow's milk from two farms which were investigated for  $\text{Cs}^{137}$  in milk. We visited the farms and were able to prove that the radon originated in the water that was used by the cows and which was taken from deep bored wells which held about 40 nCi/l.

W. S. SNYDER (U.S.A.):

Did your calculations take into account the retention of  $\text{Pb}^{210}$  in the body?

B. LINDELL:

We have not made any measurements of lead-210, as yet.

R. B. HOLTZMAN (U.S.A.):

Are you familiar with the Rn emanation bones which show emanation values *in vitro* bone about equal to the measured wholebody emanation?

H. G. PETROW:

Yes, I am familiar with the data of Rowland *et al.* and Mays *et al.* pertaining to the loss of radon from dead bone, both human and beagle. I submit first, that human bone that is living, is not the same as dead bone, whether human or dog. Secondly, Mays *et al.* have shown that in young beagle bone, radon retention is less in the ends of long bone, than in the shaft.

W. E. STARKEY:

The concentration of  $\text{Sr}^{90}$  in the roots relates to recent dietary levels while the mean concentration in the crowns seems to relate to dietary levels prevailing about 4 years previously. By extrapolation, curves can be constructed to express the uptake of  $\text{Sr}^{90}$  throughout the period of development of the tooth.

When this is done they correspond closely with the bone values obtained from similar age-groups.

Since the tooth burdens are permanent and the bone levels are labile this suggests that the teeth could be used to estimate levels that had previously prevailed in bone, many years after they had been modified by changing dietary conditions.

R. J. DELLA ROSA (U.S.A.):

$\text{Sr}^{90}$  in teeth of beagle dogs, relative to bone, represents the maximum concentration in teeth relative to  $\text{Sr}^{90}$  concentration of diet at time teeth are formed. Unlike bone which has a discrete turnover of mineral, that of teeth is very small, and thus can be considered representative of diet and the deposition of dietary  $\text{Sr}^{90}$  in hard tissue at any time after the formation of permanent teeth. These observations are in essential agreement with those made by Dr. Starkey.

R. E. JOHNSTON (U.S.A.):

In the paper on  $\text{Se}^{75}$  dosimetry, I should like to point out a correction. With more recent experimental data for the decay scheme of  $\text{Se}^{75}$ , and in more proper units, the gamma factor is equal to 1.93 roentgens per mCi-hr at 1 cm, and the average  $\beta$ -energy is 12.8 keV/dis.

In our biological studies we found an increased concentration of selenomethionine in pre-pubertal rat organs, as compared to the post-pubertal organs. In addition we also note a peak concentration in the gonads between 10 to 15 days, as compared to 6 to 24 hr for other organs. We thus feel that it is important to consider the stage of development of the animal when investigating the biological distribution of radionuclides for dosimetric purposes.

G. TORI (Italy):

Pongo due domande:

1. Se gli autori hanno calcolato il rapporto di accumulo della  $\text{Se}^{75}$ -metionina nei ratti tra fegato e gonadi.

2. Se gli autori possono precisare l'entità dell'accumulo del radionuclide nelle gonadi nei ratti giovani ed in quelli di età adulta ed avanzata.

R. E. JOHNSTON:

1. We attempted to relate the integral concentrations in the organ to the organ retention, the total body mass, and organ mass. We found the ratio of organ retention for pre-pubertal to organ retention for post-pubertal for the gonads to be 0.88 or approximately 1, which implies an independence of age for organ retention for the gonads. The same ratio for the kidneys was found to be 0.5.

2. We found a difference of  $2\frac{1}{2}$  times greater concentrations in all pre-pubertal organs in general, i.e. livers, kidneys, and gonads.

G. TORI:

Il problema della dosimetria beta, gamma del

Hg<sup>203</sup> a livello renale è tuttora aperto. I dati della letteratura sono piuttosto discordanti. Noi saremmo lieti di avere al riguardo qualche suggerimento da parte di esperti qui presenti. Presentemente stiamo controllando, mediante biopsie renali nell'uomo, se l'entità delle dosi assorbite dai reni è stata in grado di determinare lesioni apprezzabili. Finora però, il periodo trascorso dalle osservazioni effettuate non è sufficientemente lungo per trarre conclusioni definitive.

M. R. FORD (U.S.A.):

I should like to add that the dose value we have estimated for a typical treatment is within the range of values reported by Dr. Tori in his paper.