DOSIMETRY OF ^{197}Hg- AND ^{203}Hg-CHLORMERODRIN

Dr. Pavel's Letter to the Editor (*J. Nucl. Med.*, **8**:697, 1967) was quite interesting. Dosimetry calculations are rather subjective because of differences of opinion on methods of calculation, biological half-life, geometric factors and the amount of the administered dose retained in the kidneys. Without knowledge of the figures Dr. Pavel used for the latter items, it is impossible to reproduce his figures.

Speaking in relative terms one can make a valid comparison of the absorbed dose and eliminate or minimize some problems resulting from these differences of opinions.

Method:

$$\frac{D_{\beta+\gamma}(^{203}Hg)}{D_{\beta+\gamma}(^{197}Hg)} = \frac{T_{eff}(73.8\,E_\beta + 0.0346\,\Gamma\bar{g})}{T_{eff}(73.8\,E_\beta + 0.0346\,\Gamma\bar{g})}$$

Assuming a biological half-life in the kidney of 23 days

$T_{eff}(^{203}Hg) = 15.4$ days
$T_{eff}(^{197}Hg) = 2.4$ days
$\bar{g} = 24.5$ (one kidney: activity concentrated in cortex)

Then using the values of Smith *et al* (*1*)

$$\frac{D_{\beta+\gamma}(^{203}Hg)}{D_{\beta+\gamma}(^{197}Hg)} = \frac{15.4\,[(73.8)(0.099)+(0.0346)(1.20)(24.5)]}{2.4\,[(73.8)(0.0794)+(0.0346)(0.31)(24.5)]}$$

$$= \frac{127.5}{14.1}$$

$$= 9.05$$

Thus, Dr. Pavel's calculations would imply that the dose from ^{203}Hg Neohydrin is:

$$9.05 \times 34.2 = 310 \text{ rads to kidney}$$

Although this is considerably higher than any previous estimation, the fact remains that an approximate nine-fold reduction in renal absorbed radiation dose can be achieved with ^{197}Hg Neohydrin.

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REFERENCE

1. SMITH, E. M., HARRIS, C. C. AND ROHRER, R. H.: Calculation of local energy deposition due to electron capture and internal conversion. *J. Nucl. Med.* 7:23, 1966.

^{197}Hg-CHLORMERODRIN DOSIMETRY

The dosimetry of ^{197}Hg-chlormerodrin has been the subject of debate for some time and the contribution made in the Letter to the Editor, *J. Nucl. Med.* **8**:697, 1967, which gives a value of 34.2 rads to the kidneys/1 mc administered does not appear to improve matters.

Rather than showing a single value, I believe that the entire formulae with all substitutions and assumptions should be shown. Tissue concentrations and effective half-time values are as vital as physical radiation characteristics.

Using the classical formulae (*1*) and the following assumptions:

1. $D_{\beta+\gamma} = CT_{eff}\,(73.8\,E_\beta + 0.0346\,\Gamma\bar{g})$.
2. Administered dose = 700 μc (10 μc/kg) (*2–4*).
3. 50% excretion in the first 8 hr and a biological half-time of 3 days for the remainder (*2*). One might reasonably assume that 50% of an administered dose would be as much as would be found in the kidneys at any period in time and could be used as the tissue concentration for the purpose of dosimetry calculations.
4. Mass of the kidneys (taken together) = 300 gm (*5*).
5. T_{eff} equal to T_{phy} = 65 hr or 2.7 days (*5*).

6. $E_\beta = 0.0794$ Mev (*6*).

7. $\Gamma = 0.31$ (*6*).

8. $\bar{g} = 36.4$ (*7*). Length of cylinder 15 cm, radius 3 cm. Making the substitutions, we have

$$D_{\beta+\gamma} = \frac{700 \times 0.5}{300} \times 2.7\ (73.8 \times 0.0794 + 0.0346 \times 0.31 \times 36.4)$$

$$D = 1.15 \times 2.7 \times 6.24$$

$$D = 19.4 \text{ rads.}$$

One may, of course, interpret the biological data in a different manner. For example, 65% of an administered dose is eliminated in 24 hr (*2*). One might assign an elimination half-time of 3.4 hr which would account for more than 99% of this fraction. Substituting these values for C and T_{eff}, the formula becomes

$$D = \frac{700 \times 0.65}{300} \times \frac{3.4}{24} \times 6.24$$

$$D = 1.51 \times 0.143 \times 6.24$$

$$D = 1.34 \text{ rads.}$$

Ten percent of an administered dose is retained in the kidneys with a biological half-time of 28 days (*2,3*). Since the physical half-time cannot be exceeded, we can make the following substitution:

$$D = \frac{700 \times 0.10}{300} \times 2.7 \times 6.24$$

$$D = 0.23 \times 2.7 \times 6.24$$

$$D = 3.87 \text{ rads.}$$

Using whole-body counting, Sodee (*3*) found the effective half-life of ^{197}Hg-chlormerodrin to be 0.23 days. To account for the entire administered dose, one could make the following substitutions for the remaining fraction:

$$D = \frac{700 \times 0.25}{300} \times 0.23 \times 6.24$$

$$D = 0.575 \times 0.23 \times 6.24$$

$$D = 0.825 \text{ rad.}$$

Adding the three components we have

$$D = 1.34 + 3.87 + 0.825$$

$$D = 6.035 \text{ rads.}$$

There is yet one other important biological fact to be considered. It has been shown that the radiation dose to the kidneys may be reduced three fold by the administration of 1 ml nonradioactive mercurial diuretic 2–24 hr prior to the radioactive dose (*2*). Thus one might be giving only 2.012 rads to the kidneys of a standard (?) adult of 70 kg weight with normal kidneys when subjecting him to a brain scan with ^{197}Hg-chlormerodrin.

Hopefully, we can look to the reports of the work of the Medical Internal Radiation Dose Committee of the Society of Nuclear Medicine to lead us from this chaotic tangle of ignorance. But however sophisticated their methods and however refined their equipment, the results will only be as good as the biological data.

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REFERENCES

1. HINE, G. J. AND BROWNELL, G. L.: *Radiation Dosimetry*. Academic Press, Inc., New York, 1956.

2. BLAU, M. AND BENDER, M. A.: Radiomercury (Hg 203) labeled Neohydrin: a new agent for brain tumor localization. *J. Nucl Med.* **3**:83, 1962.

3. SODEE, D. B. AND CLIFTON, D.: Selective neoplasm localization with mercury-197 chlormerodrin. In *Scintillation Scanning in Clinical Medicine*, J. L. Quinn, III, ed., Saunders, Philadelphia, 1964, p. 114.

4. RHOTON, A. L., JR., EICHLING, J. AND TER-POGOSSIAN, M. M.: Comparaive study of mercury-197 chlormerodrin and mercury-203 chlormerodrin for brain scanning. *J. Nucl. Med.* **7**:50, 1966.

5. *Radiological Health Handbook*, rev. ed., Sept., 1960.

6. SMITH, E. M., HARRIS, C. C. AND ROHRER, R. H.: Calculation of local energy deposition due to electron capture and internal conversion. *J. Nucl. Med.* **7**:23, 1966.

7. FOCHT, E. F., *et al.*: *Radiology* **85**:151, 1965.

DEFINITION OF NUCLEAR MEDICINE

The editorial in the December, 1967, issue of the *Journal* requested comments on a proposed definition of nuclear medicine. I would like to offer the following operational definition of nuclear medicine:

Nuclear medicine is the scientific and clinical discipline in which free radionuclides or radionuclide compounds, redistributed *in vivo* or *in vitro* by physical or chemical mechanisms, are used for diagnostic, therapeutic or investigative purposes.

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