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BROOKHAVEN NATIONAL LABORATORY

MEMORANDUM

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COLLECTION Protocols - Clinical
BOX No. 4
FOLDER Human Protocols 1950-1963

DATE: 3 March 1960

TO: Radioisotope Committee

FROM: Dr. J. S. Robertson
Dr. R. L. Cranny

SUBJECT: H-58, Amendment of

In project H-58 it is proposed that in studies involving I^{131}, the uptake of this isotope by the thyroid be prevented by use of appropriate blocking agents. It has been pointed out to us that such a procedure could introduce an error into the interpretation of the importance of competition between the gastric secretion of iodide and thyroid uptake. Also it is conceivable that the blocking agents interfere with gastric secretion of iodide. However, the proposed doses of I^{131} are too large to use in unprotected euthyroids, and doses sufficiently small to be acceptable from the thyroid viewpoint are too small for the other studies.

It is therefore proposed that project H-58 be amended to specify that I^{132} be used instead of I^{131}. I^{132} has a half-life of only 2.33 hours, so most of the I^{132} radiation is expended in the rest of the body before this isotope is taken up by the thyroid.

For calculation of the whole-body dose from I^{132}, assuming uniform distribution, the formulas: $D_\beta = 73.8\ \bar{E}_\beta T\ C_o$ and $D_\gamma = 0.0346 \Gamma\ C_o\ g\ T$ rad (from Hine and Brownell Eq 17, p. 828 and Eq 93c, p. 862) may be used, with $\bar{E}_\beta = 0.49$ Mev, $\Gamma = 11.8\ cm^2 \cdot r/mc \cdot hr$ (Hine and Brownell, page 903), and T = 2.33/24 days. This leads to an answer of $D_\beta = 3.53\ C_o$ and $D_\gamma = 5.00\ C_o$ rad for g = 126. Thus for D = 0.100 rad, the administered dose may be about 10 μc/Kg in adults.

Calculation of the dose to the thyroid requires a slightly different approach. The usual dose rate formulas $R_\beta = 2.13\ \bar{E}_\beta\ C(t)$ rad/hr and $R_\gamma = 10^{-3}\ C(t)\ \Gamma\ g$ rad/hr (Hine and Brownell, p. 824 and p. 859), with g = 10, are valid, but instead of $C(t) = C_o\ e^{-0.693\ t/T}$ (compare Eq 13, p. 859, Hine and Brownell) we have to consider

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C(t) to be a more complex function to allow for its relatively slow uptake. Lacking knowledge of the precise shape of the iodine uptake curve for a given individual in advance of measuring it, it is not unreasonable to assume an uptake rate of 0.02 per hour (in terms of cold iodine). If this is accepted, then $C(t) = 0.02\, t\, e^{-0.693\, t/T}$ and $D = \int_0^\infty 0.02\,(2.13\,\bar{E}_\beta + 10^{-3}\,\bar{E}_\gamma)\, t\, e^{-0.693\, t/T}$ rad.

For infinite t, $\int_0^t t\, e^{-\alpha t}$ is simply $\frac{1}{\alpha^2}$

and for intermediate times, it is $\frac{1}{\alpha^2}\left[1 - (\alpha t - 1)\, e^{-\alpha t}\right]$.

Filling in the appropriate constants, we find that 1 μc I^{132} administered delivers 0.257 gram-rad to the thyroid. Eighty per cent of the infinite time dose is delivered in the first 10 hours. Here another assumption, that of thyroid weight enters. For a 30-gram thyroid, the integrated dose is about 0.0086 rad per μc administered. Thus a 500-μc administered dose of I^{132} would deliver 4.3 rad to the thyroid in a patient in whom the assumptions made above are valid. This dose is comparable to that obtained when what is accepted as a safe tracer dose of I^{131} is given, namely if it is assumed that 5 μc of I^{131} is administered, 25% is taken up by the thyroid, and the effective half-life is 6 days.

Other facts about I^{132} are presented in detail in project H-42. It does not seem necessary to repeat this presentation. In summary, I^{132} is available from the BNL hot laboratory on alternate Mondays. It is "milked" from a parent isotope, Te^{132}, which at present is delivered on an ion exchange column, by elution with a weak ammonia solution. Dilution in sterile saline and sterilization by autoclaving produces a solution suitable for intravenous injection. In the old method there was some hazard of getting Te^{132} in the eluent, but this is negligible with the column exchange method now used. (The problem is discussed at length in H-42.)

It is therefore proposed that I^{132} be administered in doses of up to 5 μc/Kg (this is half of the concentrations considered above) in patients with neoplastic diseases, gastric and thyroid disorders as described in the original proposal. A memorandum giving the pertinent facts about each patient actually to be used will be sent to the Medical Director for approval prior to each study. These facts

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will include the patient's age, pertinent gonadal information, the clinical diagnosis and prognosis, marital status, and other previous and contemplated exposures to radiation as well as the dose to be used.

Approved:

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_____ B.E. Stickley, Ph.D.	_____ J.S. Robertson, M.D., Ph.D. Ex-officio
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