15978

Urinary Excretion of Radioactive Iodine, I^{131}, in a Case of Severe Hyperthyroidism.*

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Earlier studies of Hamilton,[1] Hertz and Roberts,[2] Chapman and Evans[3] and others have provided helpful data with respect to the absorption of I^{130}, its deposition in the thyroid, elimination, and effectiveness in controlling the symptoms in patients suffering with hyperthyroidism. This isotope, obtained from the cyclotron, has a half-life of 12 hours. The isotope, I^{131}, which can be obtained carrier-free from the uranium pile has a half-life of 8 days. The irradiation is, therefore, distributed over a much longer time when I^{131} is used for therapeutic purposes. The amount of I^{131} required for treatment needs to be determined and little data is as yet available in the literature with respect to its use in the treatment of hyperthyroidism. The purpose of the present report is to provide data concerning the excretion and retention of I^{131}.

Radioactive iodine,† I^{131}, was administered orally to a female patient, age 29, suffering from a severe hyperthyroidism of diffuse type with marked exophthalmos. Lugol's solution had been given for a period of several months but had produced only brief improvement and was discontinued 3 weeks before the first dose of radioactive iodine was administered. The patient proved to be sensitive to thiouracil and she was not in good enough condition to tolerate surgery. Her weight had gone down to 87 pounds and the BMR was +70. The weight of the thyroid was estimated to be 50 g.

A dose of 9.1 millicuries of I^{131} was given on October 11, 1946. No toxic reaction was observed. Urinary excretion was determined by means of a beta-ray Geiger-Muller Counter.[4] In the first four 12-hour intervals it was respectively 10.4%, 15.5%, 10.4%, and 8.5% (in per cent of I^{131} given), thus indicating a total retention after 2 days of 54%. A dose of 3 millicuries was given on November 24, 1946. Urinary excretion in the first two 12-hour intervals was respectively (in per cent of I^{131} given) 12.7% and 1.8% giving a total retention after 1 day of 85.5%.

Calculated values of retention of iodine in the body are given in Table I, and measurements on excretion of I^{131} in the urine are given in Fig. 1. Iodine retention is given in per cent of the original dose. (Both radioactive decay and excretion factors being considered.) Excretion is plotted in per cent of the iodine retained at a time half-way between the collection of specimens.

The question has been raised of the advisability of giving stable iodine following the administration of the radioactive isotope. For this reason, stable iodine was administered as Lugol's solution for a period of 2 days after the urinary excretion of I^{131} had reached a low level. (The continued low level of excretion of I^{131} has been explained on the basis of decay of thyroxin in the blood.) Administration of Lugol's solution was followed, each time, by excretion of I^{131} in relatively large amounts. The excretion of radioactive iodine seemed to begin some 24 hours after the stable iodine was given. This delay is quite different from the immediate excretion (in the first 12-hour

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1 Hamilton, J. G., *Radiology*, 1942, **39**, 641.

2 Hertz, S., and Roberts, A., *J. Am. Med. Assn.*, 1946, **131**, 81.

3 Chapman, E. M., and Evans, R. D., *J. Am. Med. Assn.*, 1946, **131**, 86.

† The radioactive iodine was obtained through the cooperation of the Isotope Branch, Research Division, United States Engineering Office, Manhattan District, Oak Ridge, Tenn.

4 Wang, J. C., Marvin, J. F., and Stenstrom, K. W., *Rev. Scient. Inst.*, 1942, **13**, 81.

TABLE I.

Interval, days	% of administered I^{131} retained (at midpoint of interval) I—9.15 mc (100%) (.18 mc/g thyroid)	II—3.0 mc (100%) (.06 mc/g thyroid)	Equivalent roentgens per interval I	II
0 -0.5	93.5	91.5	1040	330
0.5-1.0	78	82	870	300
1.0-1.5	61	76	680	275
1.5-2.5	51	70	1140	510
2.5-3.5	43	64	960	470
3.5-4.5	38	58	850	425
4.5-5.5	34	51	760	370
5.5-6.5	30	43	670	315
6.5-7.5	24	37	535	270
7.5-8.5	17.5	33	390	240
8.5-9.5	13	30	290	220
Estimated additional dosage (extended over a period of several weeks)			1765	1775
Total dose in equivalent roentgens			9950	5500

interval) following administration of radioactive iodine. The same experiment was carried out in one case of carcinoma of the thyroid with metastasis (unpublished).)In this case, however, administration of Lugol's solution did not result in increased excretion of I^{131}.

The estimated dose in roentgens for each 12-hr or 24-hr period is given in Table I. This data was calculated in accordance with

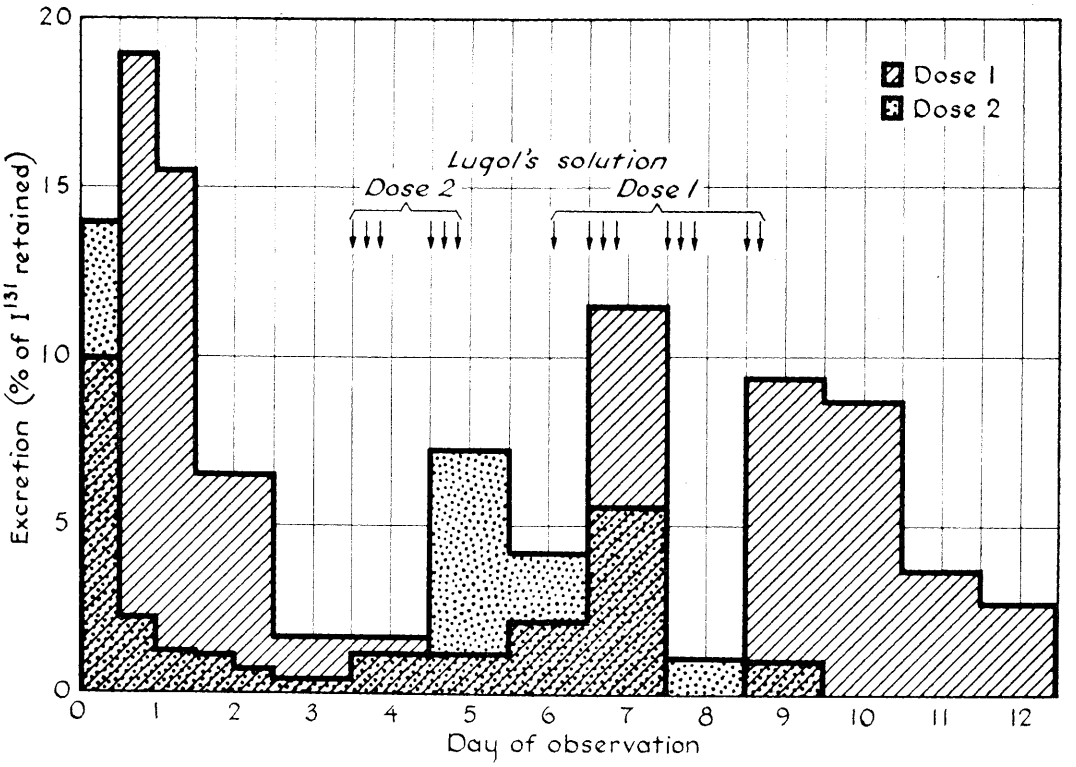

FIG. 1.

Urinary excretion of I^{131} per 12 hours calculated in per cent of iodine retained at a time half-way between the collection of specimens. Dose 1 was 9 mc. Dose 2 was 3 mc, one month later. No data were available for the 8th day following dose 1 as the specimen was lost. Arrows indicate the time of administration of Lugol's solution.

Evans[3] formula, on the basis of a thyroid weight of 50 g. (The table gives estimates of the dose per 12 or 24-hour interval and of the total dose). The total dose is estimated to be 9950 roentgens for the first administration of 9.1 millicuries, and 5500 roentgens for the second administration of 3 millicuries. It should be noted that the total dose in roentgens following the second administration (3 millicuries) agrees with the simplified formula of Hertz and Roberts,[2] roentgens eqivalent

$$= 117{,}000 \times \frac{\text{millicuries } I^{131}}{\text{grams thyroid}}$$

It is too early to evaluate the result of the treatment. Though the patient has improved somewhat and has gained weight, no decided reduction of the BMR occurred in the first 2 months following the first dose, and it seems probable that further treatment will be required.

Summary. Information is given of the urinary excretion of radioactive iodine following administration of relatively large doses in a patient with severe hyperthyroidism. Administration of stable iodine (in Lugol's solution) after the urinary excretion of I^{131} had reached a low level resulted in a pronounced increase in this excretion, which lasted some 48 hours after discontinuing Lugol's solution. This increase in excretion of I^{131} was not observed following administration of Lugol's solution in one case of carcinoma of the thyroid with metastasis. Retention of 85% of the I^{131} by the thyroid agrees with other figures on the retention of I^{130} by the hyperplastic thyroid, when iodine has been withheld for a period of over 4 weeks prior to radioactive iodine.‡

‡ A third dose of 9 millicuries of I^{131} was given the same patient in January, 1947. Loss of iodine in the first 2 days was high (50%). Use of Lugol's solution again resulted in increased excretion of radioactive iodine. The metabolic rate had returned to normal when the patient was next seen in March, 1947.

Two additional cases have since been treated with doses of 9 millicuries of I^{131} (estimated 50 grams thyroid tissue). Excretion was much the same as that following the second dose of iodine for patient No. 1. Use of Lugol's solution resulted in increased excretion of radioactive iodine in both of these cases.

Dr. C. J. Watson, Director of the Department of Internal Medicine, University of Minnesota Hospitals, made the arrangements for the treatment of the patient, and we are obliged to him for the opportunity to carry out these measurements and for valuable advice.

15979 P

The Development of *Fundulus heteroclitus* Embryos in Solutions of Metrazol.

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Speidel[1] has attempted to ascertain the specific effect of metrazol on the nervous system by immersing frog tadpoles in aqueous solutions of it and by studying, by direct microscopic and ciné-photomicrographic methods, the outgrowth of living nerve fibers in the tadpoles' tails. Using a 2% solution for approximately 20 minutes, Speidel found that the growing nerve endings degenerated during the period of immersion, but recovered and subsequently regenerated when the tadpoles were returned to pond-water.

The present communication reports the results of studying the development of cer-

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1 Speidel, C. C., *Proc. Am. Philos. Soc.*, 1940, **83**, 349.