

RADIOACTIVE IODINE AS AN INDICATOR IN THYROID PHYSIOLOGY

OBSERVATIONS ON RABBITS AND ON GOITER PATIENTS*

(21)

By SAUL HERTZ, M.D.
BOSTON, MASSACHUSETTS

THIS report summarizes a series of cooperative experiments started in the fall of 1937, on the metabolism of iodine in relation to thyroid function. The only radioactive isotope of iodine then available was I^{131} , with a half period of twenty-six minutes. The earliest experiments¹ demonstrated that the collection of iodine by the thyroid was extremely rapid, the amount present in the gland within ten minutes after intravenous injection not being exceeded within ninety minutes. Hyperplastic glands collected more iodine than did normal glands, the injections being equal.

A systematic study was then undertaken of the relations among the dosage of administered labelled iodine, the time of collection, previous iodine administration, and the functional state of the thyroid as indicated by its size. The results² indicated that the thyroid took up a larger portion of a small dose of iodine than it did of a large dose. Curves showing these relations were established for normal animals, animals treated with anterior pituitary thyrotropic hormone, animals on an exclusive cabbage diet, and animals injected with methyl cyanide. Previous iodine administration caused a marked decrease in the collection of subsequent doses.

When strong samples of the newly discovered long-lived isotopes of iodine became available, further lines of investigation were undertaken. These were the extension of experiments on thyroid iodine collection to patients with Graves' disease, the chemical investigation of the partition of iodine among various iodine fractions in the thyroid, and the introduction of a new technique, multiple labelling,² for the study of different doses of iodine at the same time.

The multiple labelling technique showed that the collection from a second dose of iodine is almost invariably less than that from the first dose. This led to the suspicion that the routine preoperative massive iodination in Graves' disease might be unnecessary. It has now been shown that the response to a single dose is clinically indistinguishable from the response to protracted iodination.

At the same time a more complete correlation of iodine collection with the known measures of thyroid function, viz., basal metabolic rate, thyroid size, histologic appearance, and with the time and method of preparation of the subject was carried out using rabbits. The experiments upon patients with Graves' disease were at first concerned with measuring the amount of iodine in the thyroid (as obtained at operation) which remained from a single initial labelled dose of varying size, administered at various times during the course of iodination and at varying intervals before operation. In addition, the chemical fate of the iodine was investigated, and the urinary excretion followed. As in rabbits, maximum collection was found within a short time after administration, and collection was relatively largest from small doses of iodine. Chemical analysis in the main confirmed previous findings.

In a recent series of experiments, an externally placed counter was used to measure the relative activity of labelled iodine in the thyroid as a function of time. By means of a single absolute determination after surgery, it was possible to calculate the absolute content at any previous time. *The initial thyroid collection in previously untreated Graves' disease patients approxi-*

*From Massachusetts General Hospital, Massachusetts Institute of Technology and Harvard Medical School. Read at the Forty-first Annual Meeting, American Roentgen Ray Society, Boston, Mass., Oct. 1-4, 1940.

mates 100 per cent for small doses (0.2-5.0 mg.), while the initial collection of previously iodinated patients, normal controls, and the collection of all patients from larger doses is considerably smaller. These results are not inconsistent with the smaller collections obtained by Hamilton and Soley³ from larger doses. This initially collected iodine rapidly leaves the thyroid in the untreated patients given small doses, less than a third remaining after a week, with a slower decline thereafter.

A series of experiments on the behavior of thyroids isolated and surviving in a perfusion apparatus has been instituted; and it has been shown that the behavior of the thyroid in collecting iodine from the

perfusion fluid is directly comparable to the results in vivo.^{4,*}

REFERENCES

1. HERTZ, S., ROBERTS, A., and EVANS, R. D. Radioactive iodine as indicator in study of thyroid physiology. *Proc. Soc. Exper. Biol. & Med.*, 1938, 38, 510-513.
2. HERTZ, S., ROBERTS, A., MEANS, J. H., and EVANS, R. D. Radioactive iodine as indicator in thyroid physiology; iodine collection by normal and hyperplastic thyroids in rabbits. *Am. J. Physiol.*, 1940, 128, 568-576.
3. HAMILTON, J. G., and SOLEY, M. H. Studies in iodine metabolism by use of new radioactive isotope of iodine. *Am. J. Physiol.*, 1939, 127, 557-572.
4. MAININI, C. G. Personal communication.

* For discussion see page 473.

