# SAUL HERTZ, MD (1905-1950): A PIONEER IN THE USE OF RADIOACTIVE IODINE

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## DR. SAUL HERTZ POSES A QUESTION

Long before the first atomic bomb of World War II, Dr. Saul Hertz (1905-1950) (Fig. 1) took a profound step forward in the field of nuclear medicine. On November 12, 1936, Dr. Hertz attended a luncheon meeting at Harvard Medical School with the president of the Massachusetts Institute of Technology (MIT) (Cambridge, Massachusetts), Dr. Karl Compton (1887-1954). Dr. Compton was discussing "What Physics Can Do for Biology and Medicine." Dr. Hertz, who was director of the Thyroid Clinic (1931-1943) at the Massachusetts General Hospital (MGH) (Boston, Massachusetts), asked Dr. Compton, "Could iodine be made radioactive artificially?" (1). The question was posed spontaneously, inasmuch as Dr. Hertz had been conducting studies on the effect of iodine on thyroid function. Dr. Compton responded affirmatively by letter on December 15, 1936, describing the properties of radioactive iodine (1). A week later, Dr. Hertz wrote back that he hoped to perform experiments in animals and devise a useful therapy for patients with hyperthyroidism (1).

**Fig. 1.** Dr. Saul Hertz (circa 1945).

During the early months of 1937, the engineering skills of MIT and the medical expertise of MGH were brought together. Dr. Hertz, who was in charge of the biologic and medical work, collaborated with Dr. Arthur Roberts, a young physicist from MIT. Drs. Hertz and Roberts did their first series of experiments with iodine 128 ($^{128}$I) on rabbits in late 1937. These early experiments involving 48 rabbits demonstrated that the normal thyroid gland concentrated $^{128}$I, and the hyperplastic thyroid gland took up even more iodine (2-4). In May 1938, the John and Mary Markle Foundation of New York City, New York, funded the building of a cyclotron at MIT with a $30,000 donation. The construction project was completed 2 years later in 1940. Experiments continued on rabbits during 1939 and 1940. Without a cyclotron, Hertz and Roberts were dependent on others for longer-lived radioactive isotopes such as sodium iodide 131 ($^{131}$I).

## THE FIRST PATIENTS

In late 1940, Dr. Hertz began using the cyclotron to produce sodium iodide 130 ($^{130}$I) and $^{131}$I, which he used in studies involving patients with Graves hyperthyroidism (5). In early 1941, he administered $^{130}$I to the first patients at MGH (Fig. 2). Gradually, a series of about 30 patients were treated and underwent follow-up (Fig. 3 and 4) until Dr. Hertz joined the US Navy during the war years.

After the war, there was considerable interest in using atomic energy for peaceful purposes. In May 1946, the *Journal of the American Medical Association* published an article on use of radioactive iodine therapy in hyperthyroidism by Drs. Hertz and Roberts (6), reflecting the success of this treatment in the first series of patients during a 5-year follow-up (Fig. 4). This firmly launched the use of radioactive iodine therapy, which has become a standard treatment for Graves disease.

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**Fig. 2.** Dr. Saul Hertz, using a multicounter to analyze the distribution of radioactive iodine in a patient in early 1941.

## USE OF NUCLEAR FISSION IN CANCER TREATMENT

In 1946, Dr. Hertz established the Radioactive Isotope Research Institute (Boston, Massachusetts), with a major focus on use of fission products for treatment of thyroid cancer, goiter, and other malignant tumors. He extensively studied the use of radioactive iodine in the treatment of thyroid cancer (7) and the application of radioactive phosphorus and isotopic studies in the assessment of the influence of hormones on cancer (8,9).

## REMEMBERING SAUL HERTZ, MD

Saul Hertz was a brilliant scholar and researcher who devoted his life to scientific work. He authored more than 30 scientific publications on thyroid physiology and on thyroid disease and its treatment. Dr. Hertz pioneered the use of radioiodine as a tracer in studying thyroid physiology and was the first to administer therapeutic doses of radioactive iodine to treat thyroid disease. Former First Lady Mrs. Barbara Bush, who was successfully treated for thyroid disease, wrote to Dr. Hertz's wife, Vitta Hertz: "It is comforting to know that so many people are well because of the scientific expertise of people like Dr. Hertz."

## DISCLOSURE

The authors have no multiplicity of interest to disclose.

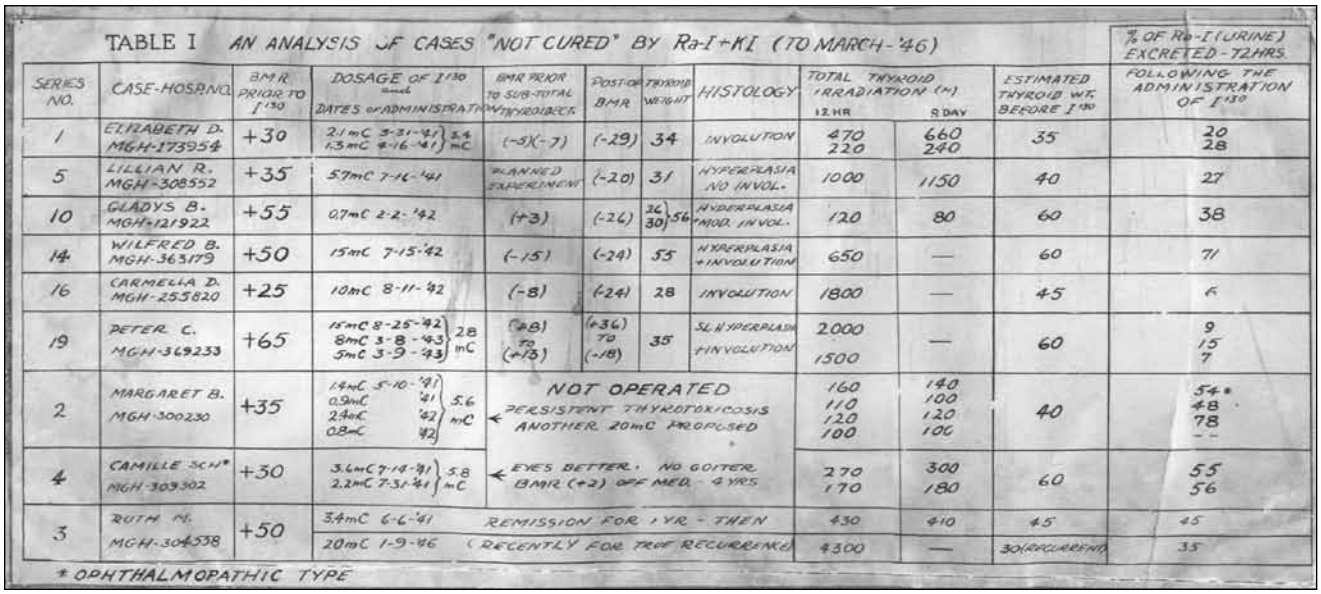

TABLE I AN ANALYSIS OF CASES "NOT CURED" BY Ra-I+KI (TO MARCH-'46)

| SERIES NO. | CASE-HOSP.NO. | BMR PRIOR TO I¹³⁰ | DOSAGE OF I¹³⁰ and DATES OF ADMINISTRATION | BMR PRIOR TO SUB-TOTAL THYROIDECT. | POST-OP BMR | THYROID WEIGHT | HISTOLOGY | TOTAL THYROID IRRADIATION (M) 12 HR | 8 DAY | ESTIMATED THYROID WT. BEFORE I¹³⁰ | % OF Ra-I (URINE) EXCRETED-72 HRS. FOLLOWING THE ADMINISTRATION OF I¹³⁰ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ELIZABETH D. MGH-173954 | +30 | 2.1 mC 5-31-41 / 1.3 mC 9-16-41 } 3.4 mC | (-5)(-7) | (-29) | 34 | INVOLUTION | 470<br>220 | 660<br>240 | 35 | 20<br>28 |
| 5 | LILLIAN R. MGH-308552 | +35 | 5.7 mC 7-16-'41 | PLANNED EXPERIMENT | (-20) | 31 | HYPERPLASIA NO INVOL. | 1000 | 1150 | 40 | 27 |
| 10 | GLADYS B. MGH-121922 | +55 | 0.7 mC 2-2-'42 | (+3) | (-24) | 26/30 56 | HYPERPLASIA +MOD. INVOL. | 120 | 80 | 60 | 38 |
| 14 | WILFRED B. MGH-363179 | +50 | 15 mC 7-15-'42 | (-15) | (-24) | 55 | HYPERPLASIA +INVOLUTION | 650 | — | 60 | 71 |
| 16 | CARMELLA D. MGH-253820 | +25 | 10 mC 8-11-'42 | (-8) | (-24) | 28 | INVOLUTION | 1800 | — | 45 | 6 |
| 19 | PETER C. MGH-369233 | +65 | 15 mC 8-25-'42 / 8 mC 3-8-'43 / 5 mC 3-9-'43 } 28 mC | (+8) TO (+13) | (+36) TO (-18) | 35 | SL. HYPERPLASIA +INVOLUTION | 2000<br>1500 | — | 60 | 9<br>15<br>7 |
| 2 | MARGARET B. MGH-300230 | +35 | 1.4 mC 5-10-'41 / 0.9 mC '41 / 2.4 mC '42 / 0.8 mC '42 } 5.6 mC | NOT OPERATED ← PERSISTENT THYROTOXICOSIS ANOTHER 20 mC PROPOSED | | | | 160<br>110<br>120<br>100 | 140<br>100<br>120<br>100 | 40 | 54*<br>48<br>78<br>— — |
| 4 | CAMILLE SCH* MGH-309302 | +30 | 3.4 mC 7-14-'41 / 2.2 mC 7-31-'41 } 5.8 mC | ← EYES BETTER. NO GOITER. BMR (+2) OFF MED. 4 YRS | | | | 270<br>170 | 300<br>180 | 60 | 55<br>56 |
| 3 | RUTH M. MGH-304538 | +50 | 3.4 mC 6-6-'41 | REMISSION FOR 1 YR - THEN | | | | 430 | 410 | 45 | 45 |
| | | | 20 mC 1-9-'46 | (RECENTLY FOR TRUE RECURRENCE) | | | | 4300 | — | 30 (RECURRENT) | 35 |

* OPHTHALMOPATHIC TYPE

**Fig. 3.** Copy of Dr. Saul Hertz's original, handwritten table, detailing the first series of Massachusetts General Hospital (*MGH*) patients whose hyperthyroidism was not cured by administration of radioactive iodine (*RaI*) and potassium iodide (*KI*). *BMR* = basal metabolic rate; *HOSP* = hospital; *MED* = medication; *MOD* = moderate; *SL* = slight; *WT* = weight.

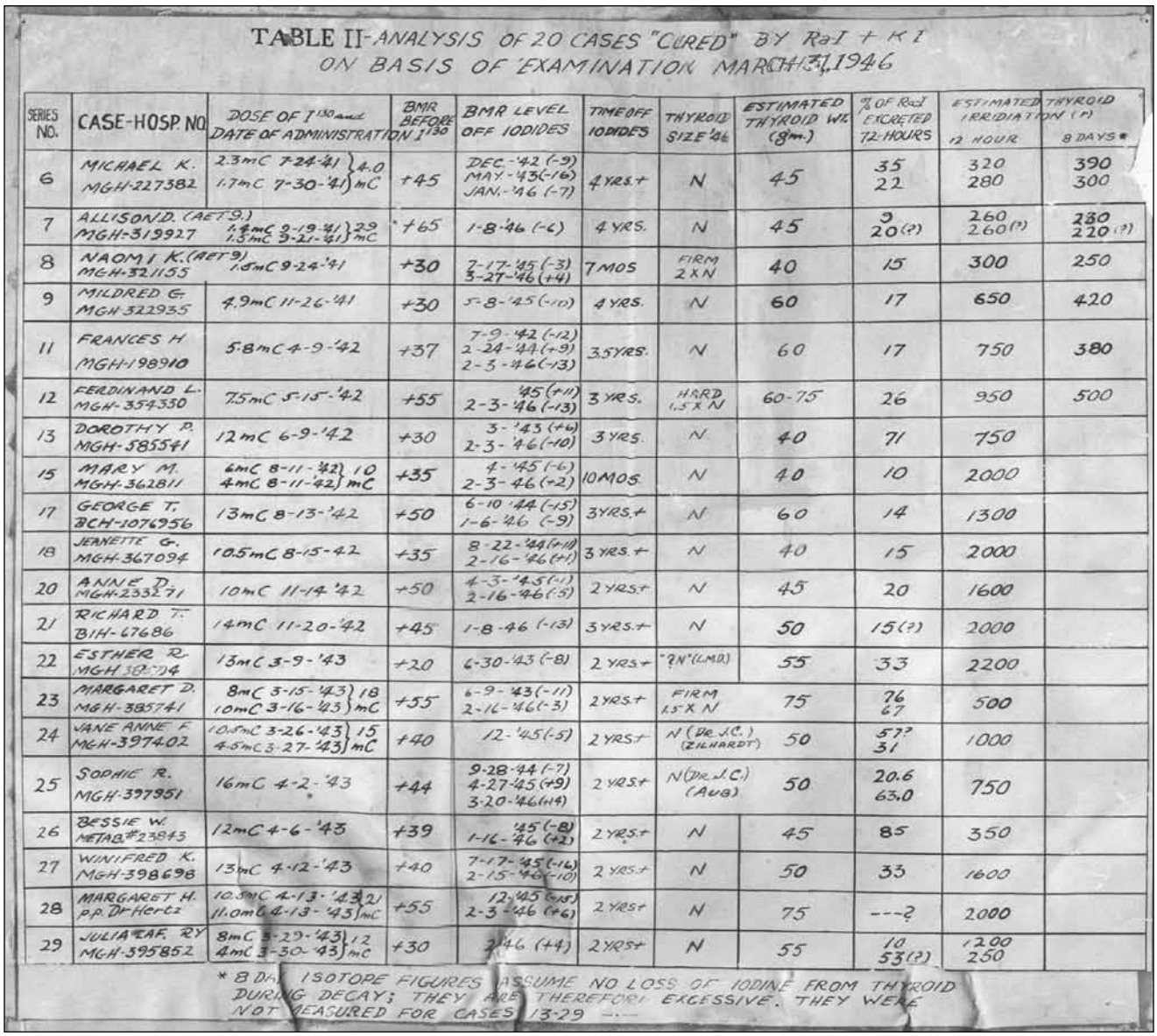

TABLE II-ANALYSIS OF 20 CASES "CURED" BY RaI + KI
ON BASIS OF EXAMINATION MARCH 31, 1946

| SERIES NO. | CASE-HOSP. NO. | DOSE OF $I^{130}$ and DATE OF ADMINISTRATION | BMR BEFORE ON $I^{130}$ | BMR LEVEL OFF IODIDES | TIME OFF IODIDES | THYROID SIZE '46 | ESTIMATED THYROID WT. (Gm.) | % OF RaI EXCRETED 72-HOURS | ESTIMATED IRRIDIATION (r) 12 HOUR | ESTIMATED IRRIDIATION (r) 8 DAYS* |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 | MICHAEL K. MGH-227382 | 2.3mC 7-24-41 } 4.0 1.7mC 7-30-41 } mC | +45 | DEC.-'42 (-9) MAY-'43 (-16) JAN.-'46 (-7) | 4 YRS.+ | N | 45 | 35 22 | 320 280 | 390 300 |
| 7 | ALLISON D. (AET 9.) MGH-319927 | 1.4mC 3-19-41 } 2.9 1.5mC 3-21-41 } mC | +65 | 1-8-'46 (-4) | 4 YRS. | N | 45 | 3 20(?) | 260 260(?) | 280 220(?) |
| 8 | NAOMI K. (AET 9) MGH-321155 | 1.8mC 9-24-'41 | +30 | 7-17-'45 (-3) 3-27-'46 (+4) | 7 MOS | FIRM 2 X N | 40 | 15 | 300 | 250 |
| 9 | MILDRED G. MGH-322935 | 4.9mC 11-26-'41 | +30 | 5-8-'45 (-10) | 4 YRS. | N | 60 | 17 | 650 | 420 |
| 11 | FRANCES H. MGH-198910 | 5.8mC 4-9-'42 | +37 | 7-9-'42 (-12) 2-24-'44 (+9) 2-3-'46 (-13) | 3.5 YRS. | N | 60 | 17 | 750 | 380 |
| 12 | FERDINAND L. MGH-354330 | 7.5mC 5-15-'42 | +55 | '45 (+11) 2-3-'46 (-13) | 3 YRS. | HARD 1.5 X N | 60-75 | 26 | 950 | 500 |
| 13 | DOROTHY P. MGH-385541 | 12mC 6-9-'42 | +30 | 3-'43 (+6) 2-3-'46 (-10) | 3 YRS. | N | 40 | 71 | 750 | |
| 15 | MARY M. MGH-362811 | 6mC 8-11-'42 } 10 4mC 8-11-'42 } mC | +35 | 4-'45 (-6) 2-3-'46 (+2) | 10 MOS. | N | 40 | 10 | 2000 | |
| 17 | GEORGE T. BCH-1076956 | 13mC 8-13-'42 | +50 | 6-10-'44 (-15) 1-6-'46 (-9) | 3 YRS.+ | N | 60 | 14 | 1300 | |
| 18 | JEANETTE G. MGH-367094 | 10.5mC 8-15-42 | +35 | 8-22-'44 (+11) 2-16-'46 (+1) | 3 YRS.+ | N | 40 | 15 | 2000 | |
| 20 | ANNE D. MGH-233271 | 10mC 11-14-'42 | +50 | 4-3-'45 (-1) 2-16-'46 (-5) | 2 YRS.+ | N | 45 | 20 | 1600 | |
| 21 | RICHARD T. BIH-67686 | 14mC 11-20-'42 | +45 | 1-8-46 (-13) | 3 YRS.+ | N | 50 | 15(?) | 2000 | |
| 22 | ESTHER R. MGH 30[illegible]4 | 13mC 3-9-'43 | +20 | 6-30-'43 (-8) | 2 YRS.+ | "?N" (LMD) | 55 | 33 | 2200 | |
| 23 | MARGARET D. MGH-385741 | 8mC 3-15-'43 } 18 10mC 3-16-'43 } mC | +55 | 6-9-'43 (-11) 2-16-'46 (-3) | 2 YRS.+ | FIRM 1.5 X N | 75 | 76 67 | 500 | |
| 24 | JANE ANNE F. MGH-397402 | 10.5mC 3-26-'43 } 15 4.5mC 3-27-'43 } mC | +40 | 12-'45 (-5) | 2 YRS.+ | N (DR. J.C.) (ZILHARDT) | 50 | 57? 31 | 1000 | |
| 25 | SOPHIE R. MGH-397951 | 16mC 4-2-'43 | +44 | 9-28-'44 (-7) 4-27-'45 (+9) 3-20-'46 (+4) | 2 YRS.+ | N (DR. J.C.) (AUB) | 50 | 20.6 63.0 | 750 | |
| 26 | BESSIE W. METAB #23843 | 12mC 4-6-'43 | +39 | '45 (-8) 1-16-'46 (+2) | 2 YRS.+ | N | 45 | 85 | 350 | |
| 27 | WINIFRED K. MGH-398698 | 13mC 4-12-'43 | +40 | 7-17-'45 (-16) 2-15-'46 (-10) | 2 YRS.+ | N | 50 | 33 | 1600 | |
| 28 | MARGARET H. p.p. DR. HERTZ | 10.5mC 4-13-'43 } 21 11.0mC 4-13-'43 } mC | +55 | 12-'45 (-15) 2-3-'46 (+6) | 2 YRS.+ | N | 75 | ---? | 2000 | |
| 29 | JULIA CAF. RY MGH-395852 | 8mC 3-29-'43 } 12 4mC 3-30-'43 } mC | +30 | 2-'46 (+4) | 2 YRS.+ | N | 55 | 10 53(?) | 1200 250 | |

* 8 DAY ISOTOPE FIGURES ASSUME NO LOSS OF IODINE FROM THYROID DURING DECAY; THEY ARE THEREFORE EXCESSIVE. THEY WERE NOT MEASURED FOR CASES 13-29 ---

**Fig. 4.** Copy of Dr. Saul Hertz's original, handwritten table, detailing the first series of Massachusetts General Hospital (*MGH*) patients whose hyperthyroidism was successfully treated with radioactive iodine (*RaI*) and potassium iodide (*KI*). *BMR* = basal metabolic rate; *HOSP* = hospital; *N* = normal; *WT* = weight.

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