STUDIES OF THYROXINE IODINE SERUM AS A MEASUREMENT OF THYROID FUNCTION IN 87 PATIENTS*

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Abstract. Pleehachinda, Rudee, et al.: Studies of Thyroxine Iodine Serum as a Measurement of Thyroid Function in 87 Patients. Siriraj Hosp. Gaz. 1970, 22: 507–512.

Serum thyroxine iodine determinations after the Murphy and Pattee method were studied in 87 patients. The procedure has been described. The resulting values show excellent discrimination between the thyroid conditions. The method appears to be one of the reliable indices of thyroid conditions.

Until recent years, the objective confirmation of the clinical diagnosis of thyroid disorders has relied on one or more of the following tests :–

1. Uptake of radioiodine by the thyroid gland and thyroid suppression test.

2. Measurement of protein bound radioactive iodine at a fixed time following administration of the radionuclide.

3. Chemical measurement of serum PBI.

All of these techniques are limited by such factors as the size of the iodide pool, the patients' renal function, the radiation hazards associated with in vivo administration of the radionuclide and also exogenous iodine.

On account of these limitations, an increasing amount of attention has been focussed on the measurement of thyroxine iodine in the serum based on the principle of "Ekins's competitive protein binding saturation analysis"(1) (Fig. 1). This is measured by extracting serum and labelling with ethyl alcohol and letting them compete with each other in saturating the thyroxine binding globulins (TBG) of the pooled serum of the unbinding sites. The unbound thyroxine (T_4) is then separated from the bound T_4 by resin. The concentration of T_4 in the serum specimens is read from the values of total T_4/bound T_4 activities (y/x), as plotted in the standard curve of varying standards of added non-radioactive T_4.

In the present paper, the results of assays of T_4 in serum by the method which has been adapted from Murphy

* Read at the Siriraj Medical Meeting on the 80th Anniversary of the Medical School, 30th April 1970.

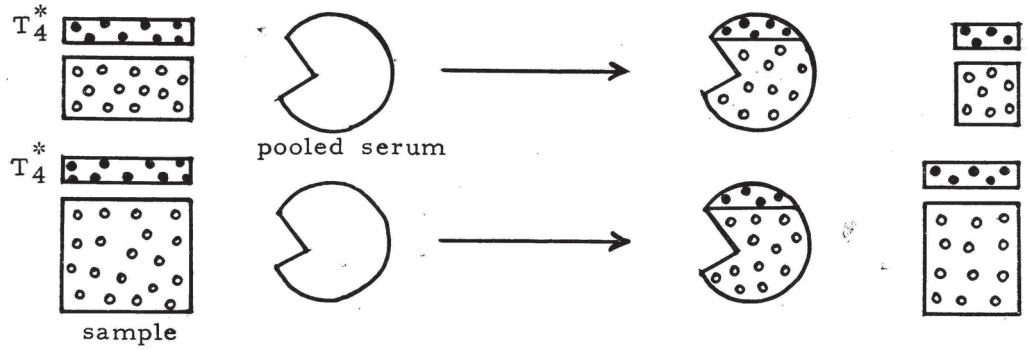


Figure 1. Principle of "competitive protein binding saturation radioassay" based on the assumption that the radioactive label will faithfully follow the same fate as that of the non–radioactive stable mother material. The stable compound will compete with the label and displace it from the binding sites of TBG of the pooled serum to the proportion that varies with its quantity in the serum.

and Pattee, 1966,(2) Nakajima, et al., 1966,(3) Ekins, 1960,(1) are presented. The entities of which thyroid function is assessed include various thyroid disorders and endemic goitre.

Materials and Methods

Serum was obtained for the studies from a series of patients who attended the Nuclear Medicine Section for thyroid function measurement. Of 77 patients, there were 55 euthyroids, 16 hyperthyroids and 6 hypothyroids, as verified by clinical examination, ^{131}I uptake and thyroid suppression test, Fraser's T index, T_3 charcoal and T_3 Sephadex tests. Serum specimens were also collected from 10 villagers in the endemic goitre area of Prae, Thailand; most of these patients had been on iodated salt for the control of the goitre.

Methods of assay of thyroxine iodine in serum

The experimental procedure is as follows:–

Add one drop (0.03 ml.) of labelled T_4 (^{125}I–T_4 or T_4 *, obtained from Radiochemical Centre, Amersham, England, and this may be called solution A) into 0.5 ml. serum. Shake gently and count z. Add one ml. of 95 % ethanol and mix with fine wire. After centrifuging for 5 minutes, remove one ml. of supernatant into a siliconised tube. Dry gently with an air stream in a 45–50°C water bath for one hour. Add 2.5 ml. of 1/50 serum dilution (solution B).

For the standard curve (Fig. 2), add standard (solution C) 0.2, 0.5, 1.0, 1.5, 2.0 and 2.5 ml. into 2.3, 2.0, 1.5, 1.0, 0.5, and 0 ml. of solution B. Shake vigorously at 47°C for 10 minutes. Cool to room temperature and transfer 2 ml. aliquots into disposable tubes. Stopper all tubes and count y. Cool in ice and bath in the refrigerator for 30 minutes or longer. Add a spoonful of resin (Amberite IRA–400, chloride form) or about 0.5 g. of resin to each tube. Shake and add 3 ml. of ice–cold buffer (Veronal buffer, pH 8.6) to each tube. Shake and take two ml. to

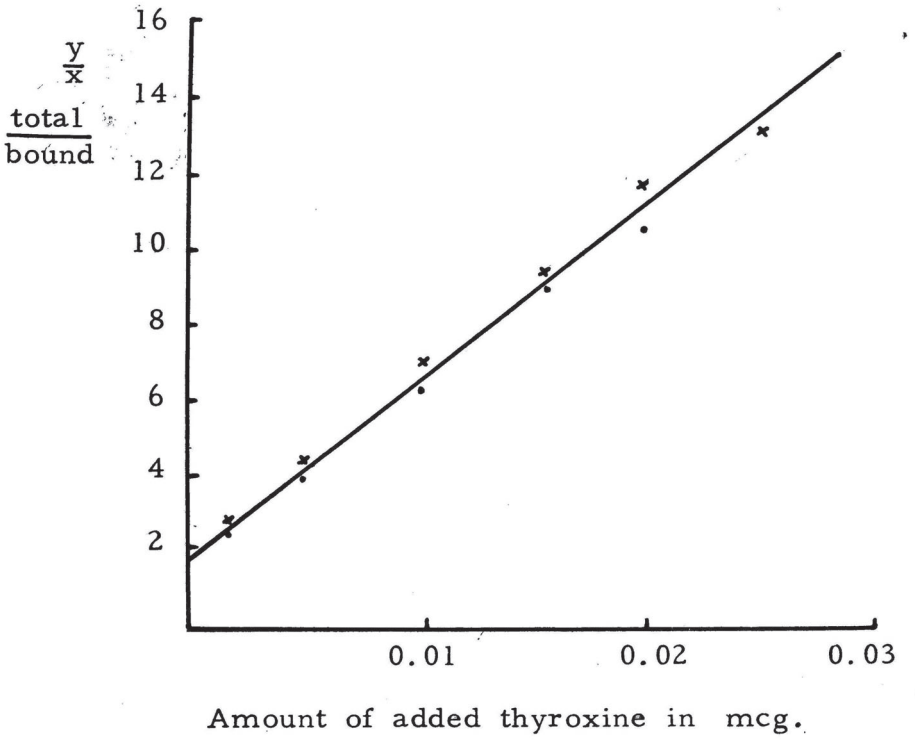


Figure 2. Typical thyroxine iodine in serum standard curve.

count x. Plot a standard curve of y/x against micrograms of T_4 added for the standards. Calculate y/x for the sera and read off μg T_4 from the standard curve x 100 = μg T_4 in 100 ml., and x 0.653 to express the result as μg thyroxine iodine per 100 ml. of serum after subtracting the amount of T_4 added to each serum sample when labelling with solution A.

Results and Discussion

The mean values and ranges of thyroxine iodine in the serum of 87 patients are shown in Table 1. Figure 3 is a histogram of the individual values of thyroxine iodine in the serum. The value for thyroxine iodine was calculated to be 65.3 per cent of the serum thyroxine. It was suggested by Cassidy et al., 1968,[4] that the results be expressed in this term because the values obtained more closely approximate those for the butanol extractable iodine (BEI) to which physicians are accustomed.

Table 1. Results of thyroxine iodine determination in 87 patients.

Classification	*No. of cases*	*Thyroxine iodine μg/100 ml. serum*	
		Range	*Mean*
Euthyroid	55	3.2 – 8.0	5.3
Hyperthyroid	16	6.4 – 20.8	11.1
Hypothyroid	6	0.2 – 2.8	2.0
Endemic goitre	10	1.7 – 4.7	3.15
	87		

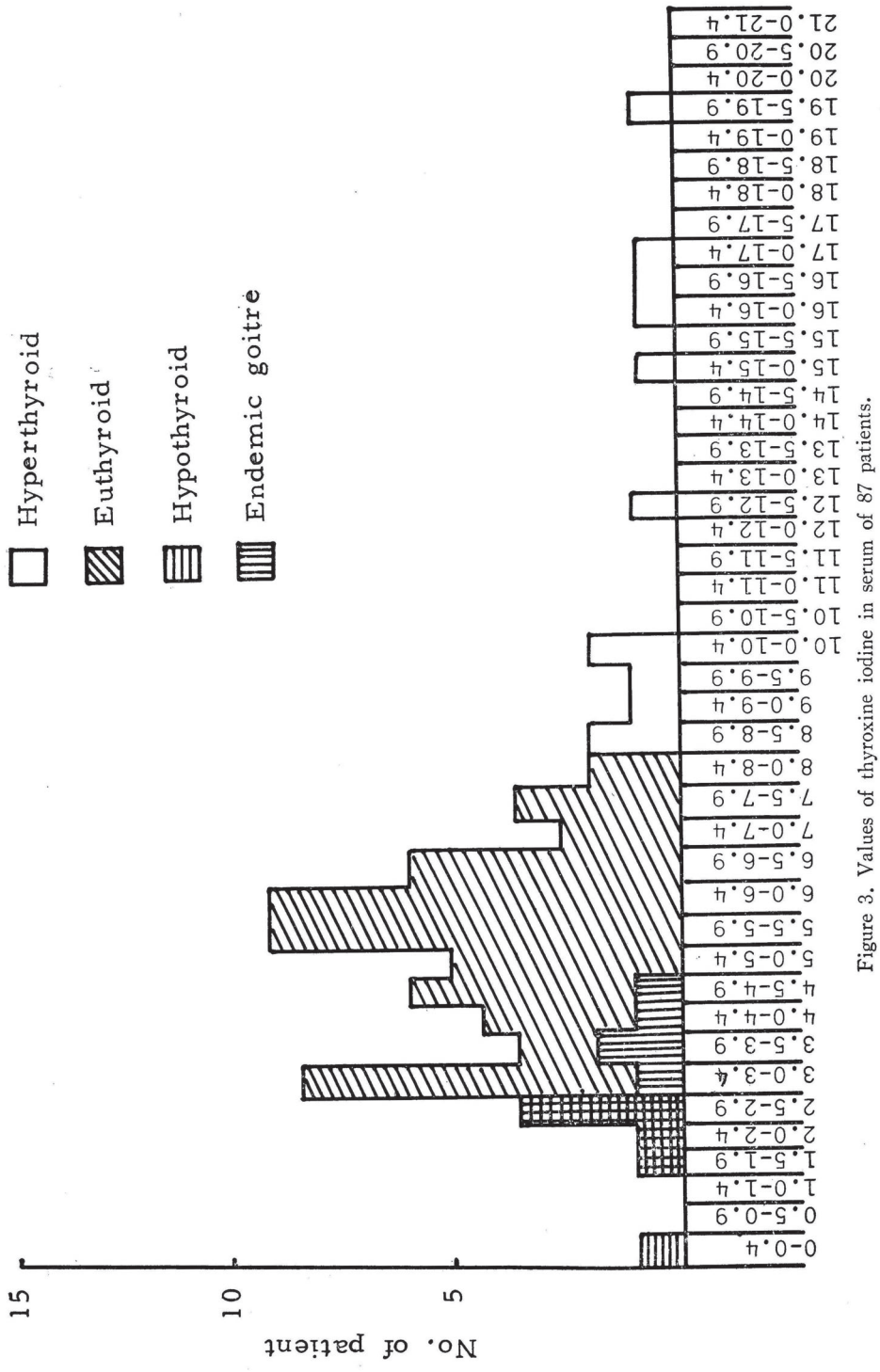


Figure 3. Values of thyroxine iodine in serum of 87 patients.

It appears that more than ninety per cent of the values obtained for normal patients are between 3 and 7 microgram per cent. The discrimination between hyperthyroidism and hypothyroidism is excellent; there is no overlapping of the results. The values for endemic goitre patients appear on the low side, being in both hypothyroid and low normal levels, which are in agreement with the previously determined serum PBI values. (5)

These data then confirm the finding that the determination of thyroxine iodine in the serum is a reliable index of thyroid function. Murphy et al., 1968, (6) have shown that it correlated well with the protein bound iodine in serum (correlation coefficient = 0.823), and it has the decided advantage over the determination of serum PBI that the presence of iodide, organic iodine or mercury does not cause spurious results. The method is not a simple one, but meticulous attention to detail and technique yields excellent results.

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(ย่อความจากเรื่องภาษาอังกฤษข้างต้น)

การศึกษาหน้าที่ของต่อม ธัยรอยด์ โดยวิเคราะห์หา ธัยร็อกซีน ไอโอดีน*

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(ผู้อำนวยการโรงพยาบาลจังหวัดแพร่)

คณะผู้รายงานได้ทำการวิเคราะห์หา ธัยร็อกซีน ไอโอดีน ใน สิรั่ม ของผู้ป่วยโรคของต่อม ธัยรอยด์ ๘๗ คน, โดยใช้วิธีดัดแปลงจากวิธีของ เมอร์ฟี่ย์ และแพตตี้, ซึ่งอาศัยหลักการแข่งขันยึดจับกับ โปรเทอิน ที่เป็นพาหะของ ธอร์โมน. วิธีนี้เป็นวิธีที่ทำได้ง่าย, ไม่สิ้นเปลืองค่าใช้จ่ายจนเกินไป, และเป็นการตรวจในหลอดแก้วโดยไม่ต้องให้ ราดิโอนิวไคลด แก่ผู้ป่วย.

จากการศึกษาปรากฏว่าให้ผลในการวินิจฉัยแยกโรค หรือบอกถึงหน้าที่ของต่อม ธัยรอยด์ ได้เกินกว่า ๙๐ เปอร์เซ็นต. ค่า ธัยร็อกซีน ไอโอดีน ของคนปรกติอยู่ระหว่าง ๓—๗ ไมโครกรัม เปอร์เซ็นต. ค่าที่พบในผู้ป่วยคอพอกเป็นพิษ และผู้ป่วยธัยโปธัยรอยด์ แตกต่างไปจากค่าปรกติอย่างชัดเจน. ค่าที่พบในผู้ป่วยคอพอกประจำถิ่นก็ให้ผลสนับสนุนผลการตรวจสิรั่ม พีบีไอ, คือมีค่าโน้มเอียงไปในทางต่ำกว่าปรกติเช่นกัน.

* บรรยายในการประชุมใหญ่ทางวิชาการครั้งที่ ๓ ในโอกาสที่โรงเรียนแพทย์ (ศิริราช) ครบ ๘๐ ปี, ณ คณะแพทยศาสตร์ศิริราชพยาบาล, วันที่ ๓๐ เมษายน ๒๕๑๓.