

Stability of Values for Thyroid Radioiodine Uptake

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Chronological changes in values for thyroid radioiodine uptake measurements (RIU) have been reported in the last four decades. These changes are attributed to geographical and chronological variations in dietary iodine intake in the population. Fluctuations in normal values for RIU can affect the interpretation of these diagnostic tests in patients. **Methods:** During the last 16 yr, thyroid RIU measurements using ^{123}I were obtained in 671 euthyroid patients and 274 hyperthyroid patients, of which 233 patients had a diffuse goiter and 41 patients had a nodular goiter. RIU was measured 24 hr after the oral administration of ^{123}I , 3.7–7.4 MBq (0.1–0.2 mCi) with no changes in technique during this period. Values (mean \pm s.d.) for RIU were calculated for various groups of patients for each year. Combined data for 1979–83 and 1988–94 were compared. Differences between mean values for each year were determined by a one-way ANOVA and a pairwise comparison. **Results:** For euthyroid patients, there were no significant differences in the mean and range of values from year to year. Additionally, there were no significant differences between the combined values for the earlier years (1979–83) and the later years (1988–94) for hyperthyroid patients. Minor statistical variations in the yearly values for the hyperthyroid patients were evident but not clinically important. **Conclusion:** Values for thyroid uptake of ^{123}I in euthyroid and hyperthyroid patients in Boston have remained stable for the last 16 yr.

Key Words: thyroid; iodine-123 uptake; euthyroid; hyperthyroid

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Substantial changes in the values for thyroid radioiodine uptake (RIU) occurred in the last four decades (1–5). Values (mean \pm s.d.) for RIU in euthyroid subjects in Alabama changed from 28.6 ± 6.5 in 1959 to 15.4 ± 6.8 in 1967–68 (1). Values for RIU in euthyroid subjects in the Minneapolis area declined to 11.5 ± 4.4 in 1971 and rose to 20.5 ± 6.1 in 1975 (3). No substantial change in values for RIU occurred in patients studied at a United States Air Force hospital from 1967 to 1976 (4). A review of the literature Sostre (4) concluded that there was a nationwide decline in values for RIU between 1955 and the late 1960's but after that time there was a trend toward stabilization. Normal RIU values in New Mexico, however, declined significantly between 1971 and 1979 (5). A similar decrease in values for RIU in patients with toxic nodular goiter occurred between 1970 and 1976 while values for RIU in patients with Graves' disease did not change significantly (6). Between 1965 and 1977 values for RIU in hyperthyroid patients remained relatively stable (7).

Chronological changes in RIU values have been attributed to variations in the dietary intake of iodine (1,3), particularly in increased amounts of iodine in commercial bread (8). It is well-established that thyroid RIU is inversely related to the dietary intake of iodine in persons with normal thyroid function (9,10). In the United States there are substantial geographic variations in iodine intake (11).

As part of a quality assurance program we reviewed our records of thyroid RIU determinations performed since 1979 when we began to use ^{123}I for most thyroid RIU measurements

as well as for thyroid scintigraphy. We discuss the implications for quality assurance for thyroid RIU determinations.

MATERIALS AND METHODS

Patients

Patients were referred by their physicians for thyroid RIU determinations and scintigraphy. Patients were classified as euthyroid or hyperthyroid on the basis of the clinical impressions of the referring physician or nuclear medicine physician who examined the patient and one or more tests of thyroid function that included serum total T4, free T4 index, total T3 and TSH determinations. Classification was independent of the RIU value. Classification of diffuse or nodular goiter was based on palpation, the appearance of the thyroid scan or both. Most of the euthyroid patients had a goiter but were not further classified as having a diffuse, uninodular or multinodular goiter.

Patients with known Hashimoto thyroiditis were excluded from the analysis, but thyroid antibody tests were not routinely obtained. Urinary iodide excretion determinations were not done. When the diagnosis of hyperthyroidism or euthyroidism was ambiguous, those patients were also excluded from the analysis. Any medication that interfered with RIU at the time of the test eliminated a patient. Also, patients who recently received radiographic contrast media were excluded from the analysis. The most frequent indications for obtaining the thyroid RIU and scan were: characterization of a palpable goiter or nodules; confirmation of a suspected diagnosis of hyperthyroidism; or ^{131}I therapy. There were 671 euthyroid patients and 274 hyperthyroid patients. In the hyperthyroid groups, 233 patients had a diffuse goiter and 41 patients had a nodular goiter.

Sodium iodide ^{123}I in capsules in dosage of 3.7–7.4 MBq (0.1–0.2 mCi) was given orally about 24 hr prior to measurement of the thyroid RIU. For patients studied from 1988 through 1994, all measurements were made in the same location with the same instruments. Thyroid uptake was measured with a thyroid uptake system with a NaI(Tl) crystal, 2 in. thick and 2 in. in diameter, attached to a series 35 multichannel analyzer. Patients were seated facing the collimated detector, which was positioned 25 cm from the anterior surface of the patient's neck at the level of the cricoid. Two consecutive 1-min

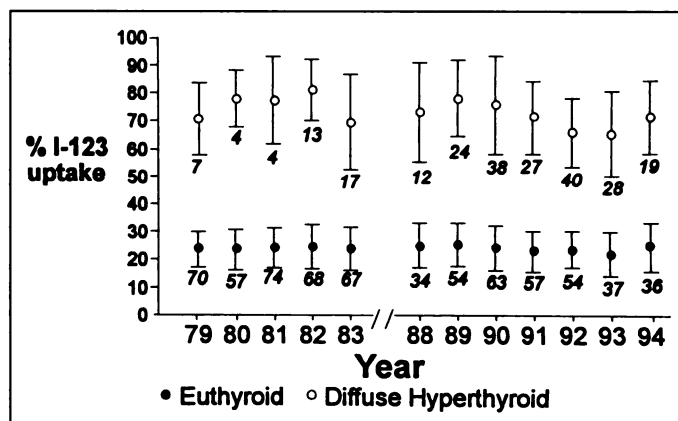


FIGURE 1. Thyroid ^{123}I uptake (%) at 24 hr in euthyroid patients and hyperthyroid patients with diffuse goiter. Mean \pm s.d. are shown for each year. Number of patients in each group is indicated below the bars.

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TABLE 1
Comparison of Iodine-123 Uptake (%) in Various Groups of Patients (mean \pm s.d.)

Groups	1979-1983	1988-1994
Euthyroid	24.1 + 7.3 (n = 336)	24.1 + 7.5 (n = 335)
Hyperthyroid Diffuse goiter	74.5 + 14.8 (n = 45)	71.9 + 14.6 (n = 188)
Hyperthyroid Nodular goiter	44.6 + 15.7 (n = 8)	45.8 + 12.1 (n = 33)
Hyperthyroid Diffuse and nodular combined	70.0 + 18.3 (n = 53)	67.5 + 16.9 (n = 221)

counts were obtained. A capsule of ^{123}I from the same lot was used as a standard. It was counted in a lucite phantom within a few minutes of measuring the patient's counts using the same equipment and technique used for the patient's counts.

The thyroid uptake was calculated as the quotient of the thyroid counts per minute divided by the standard counts per minute expressed as a percentage [(thyroid cpm/standard cpm) \times 100]. Background counts were not routinely measured but were periodically monitored. The background counts were negligible or below the threshold of detectability.

For the patients studied from 1979 through 1983 the uptake measurements were made in a different location from those in 1988 through 1994. The scintillation detector, sodium iodide crystal and collimator were similar but not identical to that used in 1988-1994. Specifications for the older equipment are no longer available; the counting technique was the same.

Statistical Analysis

RIU values were calculated for each year from 1979 through 1983 and from 1988 through 1994. Data for the years 1984 through 1987 were incomplete or unavailable, and were excluded in the analysis. RIU values for each year were compared with a one-way analysis of variance (ANOVA) and Tukey's method of pairwise comparison. Analyses were separately conducted for euthyroid and hyperthyroid (diffuse goiter) groups. In each category, 1979-83 and 1988-94 data were combined into two groups to compare the values for the earlier and later years. Significance differences were determined by the Student's t-test.

RESULTS

RIU values for euthyroid and hyperthyroid patients with diffuse goiter are shown in Figure 1. No significant differences between yearly mean RIU values for the euthyroid group ($F = 0.69$, $df = 11, 659$, $t = 0.75$) were present. Although the overall F value was significant for the hyperthyroid (diffuse goiter) group ($F = 2.40$, $df = 11, 221$, $p < 0.01$), there were no significant pairwise differences by Tukey's posthoc test (all $p \geq 0.057$).

RIU values for the various groups of patients are shown in Table 1. For each category of patients, the differences between the values for the early (1979-83) and late (1988-94) years were not significant.

Hyperthyroid patients with diffuse goiter and hyperthyroid patients with nodular goiter obviously represent different populations. Only 1.3% of the hyperthyroid patients with diffuse goiter but 26.8% of the hyperthyroid patients with nodular goiter had RIU values within the euthyroid reference range of 9-39% (mean \pm 2 s.d.).

DISCUSSION

The values for RIU at our institution have remained remarkably stable for the last 16 yr. This is true for euthyroid patients

as well as for hyperthyroid patients with diffuse or nodular goiter. This contrasts with reports 15-25 yr ago which showed substantial changes in RIU in euthyroid subjects (1-5) and patients with toxic nodular goiter (6) but not in patients with Graves' disease (6,7).

Annual variations in the numbers of patients in each category are probably accounted for by differences in referral patterns. More patients were referred for ^{131}I therapy in the later years than in the earlier years. The availability and increased use of other diagnostic modalities including ultrasonography, fine needle aspiration cytology and ultrasensitive TSH assays have influenced the referral of patients for thyroid RIU tests and scintigraphy.

Although it is reasonable to assume that RIU values obtained with ^{123}I would give the same results as those obtained with ^{131}I , comparative data are scarce. Variations in values for RIU are affected by differences in instrumentation and technique (12,13) as well as by variations in iodine intake in the population. Therefore we limited our study to RIU values obtained with ^{123}I without variations in technique.

Although increased dietary iodine intake is associated with decreased RIU in euthyroid persons (10), this effect is less evident in hyperthyroid patients (6,9). Pharmacologic doses of stable iodide markedly suppress thyroid RIU in euthyroid and hyperthyroid subjects, the effect is greater in hyperthyroid than in euthyroid subjects (14). The effect of small increments in iodine intake, however, as may occur in dietary changes, is variable in hyperthyroid patients (9).

CONCLUSION

No significant changes in values for the thyroid uptake of ^{123}I in euthyroid or hyperthyroid patients in Boston have occurred during the last 16 yr. The results of RIU tests should be monitored periodically to maintain quality assurance for this important diagnostic procedure because of chronological fluctuations in dietary iodine intake in the population.

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