nm/CONCISE COMMUNICATION

FURTHER OBSERVATIONS ON THE NORMAL RADIOACTIVE IODINE UPTAKE

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Two recent publications (1,2) have annotated a lowering of the normal radioactive iodine uptake (RAIU). Whereas older textbooks quote a normal value of 15–45%, Pittman, Dailey, and Beschi (2) in 1969 described a mean value of 15.4% with a standard deviation of 6.8% from patients residing in Alabama. One year later, from patients residing in southern California, McDonald, and Nesmith (1) reported their mean normal value to be 15.6% with a standard deviation of 4.5%. Both reports emphasized dietary variations in iodine intake in various geographical areas. These observations have prompted an evaluation of the normal RAIU in our laboratory which mainly serves patients from central and south Texas.

METHODS AND MATERIALS

Radioiodine uptakes are performed at Wilford Hall Medical Center 2 and 24 hr after oral administration of 5–20 μCi of Na^{131}I. If a scan is performed, approximately 50 μCi are administered.

Uptakes are counted on a Picker scintillation detector equipped with a Picker flatfield collimator. A thigh count at 35 cm is measured as extrathyroid background, and a standard capsule is counted in a Lucite neck phantom at the same distance.

During 1970 432 patients considered euthyroid received RAIU as a part of their evaluation. The euthyroid state was based on combined evaluation of history, physical examination, T$_3$ uptake, T$_4$ by Murphy-Pattee, and in certain cases by a PBI. The RAIU was not included in these patients' evaluations. Each patient was quizzed extensively, and those with obvious organic or inorganic iodine saturation were excluded. The designation of euthyroid was agreed upon by two physicians independently evaluating all the data. Similar screening of the 1970 records identified 60 patients as hyperthyroid and 32 patients as
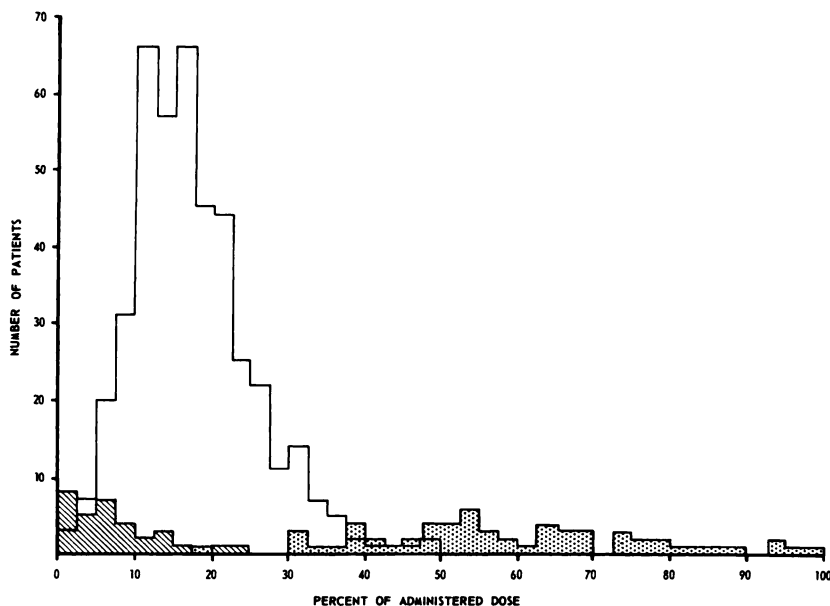
FIG. 1. Distribution of 24-hr RAIU in euthyroid, hypothyroid, (cross-hatched), and hyperthyroid (stippled).

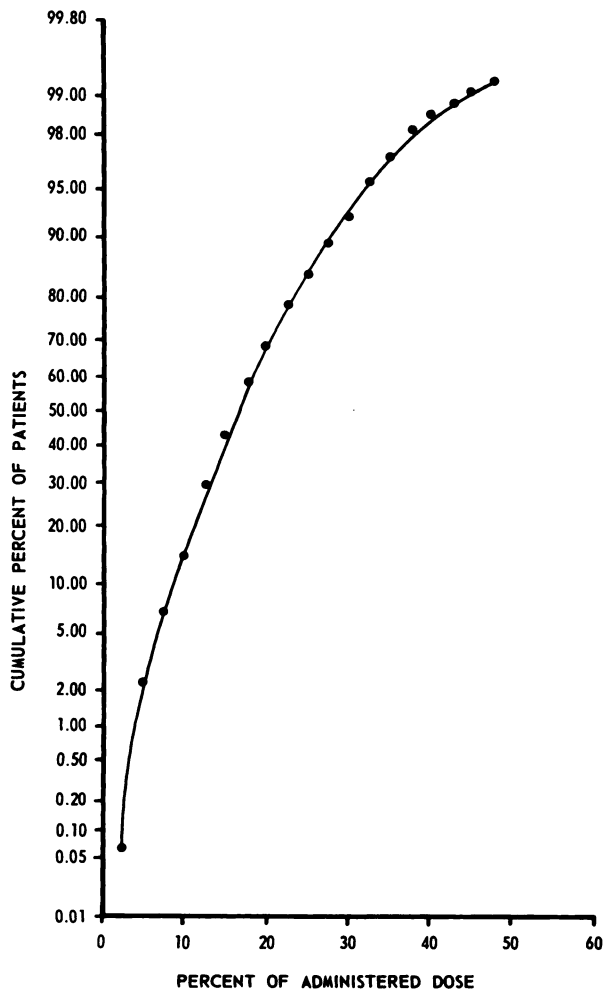FIG. 2. Cumulative-percentage polygon of euthyroid RAIU demonstrating skewed population.

ranged from 0.5 to 20% and the hyperthyroid uptake from 9.0 to 99.4%.

DISCUSSION

Our data confirm a lower normal radioiodine uptake than reported in the past. In fact, there is remarkable similarity in the mean values of uptake in Alabama (2), southern California (1), and south-central Texas (15.4, 15.6, and 17.4%, respectively).

The distribution of individual values in the group studied is not statistically normal, and therefore the standard deviation cannot properly be applied to determine the statistical limits of normalcy. This skewedness is demonstrated in Fig. 2. This represents a cumulative-percentage polygon plotted on normal probability paper. For a normally distributed population the data will plot as a straight line. A deviation from a straight line is an indication that the population is not normally distributed. The skewed distribution demonstrated here appeared in some of the older reported series (3) as well as in the series of Pittman, Dailey, and Beschi and Bernard, McDonald, and Nesmith cited earlier.
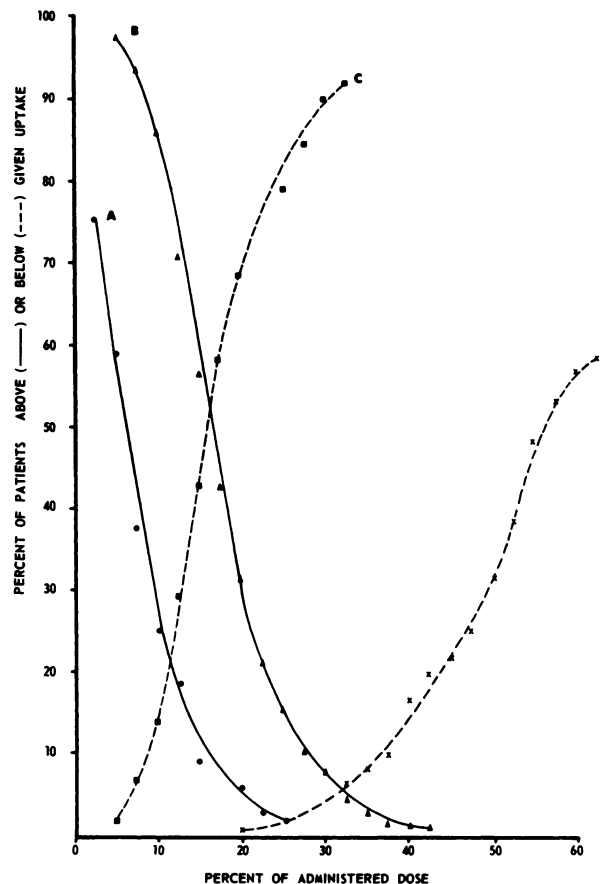
Clinical laboratories frequently report normal val-

hypothyroid. We recognize the theoretical bias that these patients might not represent the "normal" population since they were referred to this laboratory because of some clinical suspicion of thyroid disease. In most cases the diagnosis of hypothyroidism was not pursued beyond establishment of the patient's metabolic state since we rarely performed thyroid biopsy and do not have ready access to confirmatory tests of Hashimoto's thyroiditis or to the elucidation of the enzymatic abnormalities of congenital dyshormonogenesis.

RESULTS

Results of the radioactive iodine uptake on 432 euthyroid patients are shown in the histogram of Fig. 1. The mean value is 17.4% with a range of 0.8–63.5%. This figure also shows the histograms for hypothyroid and euthyroid patients superimposed on the normal histogram. The mean values for hypothyroid and hyperthyroid patients are 7.0 and 58.8%, respectively. The hypothyroid uptake values

FIG. 3. Distribution curve showing percent of patients having uptake greater than (—) or less than (- - -) given percent uptake. A, hypothyroid; B, euthyroid; C, euthyroid; D, hyperthyroid.

ues in terms of two or three standard deviations of the mean. Since our euthyroid population is clearly not distributed normally, the standard deviation cannot be applied. If one were to retreat to purely arbitrary statistical measures and select a degree of probability that could be judged adequate for clinical means, the probability curve in Fig. 3 could be constructed.

From this figure four basic questions can be answered:

1. What percent of the hypothyroid sample group had an uptake of greater than a specified amount (Curve A)?
2. What percent of the euthyroid sample group had an uptake of greater than a specified amount (Curve B)?
3. What percent of the euthyroid sample group had an uptake of less than a specified amount (Curve C)?
4. What percent of the hyperthyroid sample group had an uptake of less than a specified amount (Curve D)?

If one were willing to accept a 5% chance of diagnosing a hypothyroid patient as euthyroid, the boundary between hypothyroidism and euthyroidism would be set at 20% uptake. However, with the establishment of this boundary, 70% of our euthyroid sample group would have been called hypothyroid. Likewise, if 5% uptake were established as the boundary between hypothyroidism and euthyroidism there would be only 2.5% chance of calling a euthyroid patient hypothyroid, but a 57% chance of calling a hypothyroid patient euthyroid. At the point of intersection of Curves A and C (11% uptake) the chances for calling a euthyroid patient hypothyroid and vice versa are both 20%. The intersection

of these two curves is a compromise point for establishing a boundary between two populations. At any other point we could lessen our chances of misdiagnosing an individual; however, our chances of misdiagnosing an individual in the adjoining group are greatly increased. In the case of distinguishing hyperthyroidism and euthyroidism, the compromise point falls at an uptake of 31%. A boundary set at this point will lead to a 6% chance of misdiagnosing individuals from either group.

If one employed the standard deviation in our data, the normal RAIU (± 2 s.d.) would be 0–30%, and the uptake would be of no value whatever in the diagnosis of hypothyroidism. However, if one sets the lower limit of normal arbitrarily at 5%, he can place some confidence in the diagnostic value of an uptake less than this provided ordinary means are taken to exclude iodine saturation.

SUMMARY

The radioiodine uptake of 432 euthyroid, 60 hyperthyroid, and 32 hypothyroid patients was studied. Results showed a statistically abnormal population. By purely arbitrary setting of limits, normal values for the radioactive iodine uptake were established. The new normal range for RAIU is 5–31%.

REFERENCES

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