Size and Positional Relationships Between Thyroid Lobes in the Adult As Determined by Scintillation Scanning[1]

Richard P. Spencer, M.D., Ph.D. and
Robert Waldman, M.D.[2]

New Haven, Conn.

Following administration of radioactive iodine, scintillation scanning has been employed to estimate the weight of the normal (1) and hyperactive (2) thyroid gland. There have been no reports, however, as to the normal range of dimensions and positional relationships of the adult thyroid as estimated by this technique. Such an investigation appeared necessary in order to describe the range within which the normal gland occurs, and, hence, to point out those variants which are unusual. As an interesting side result of this study, a possible approach to estimating the weight of the normal thyroid is suggested.

METHODS

Scintillation scans of the thyroid were performed in the anteroposterior direction using a standardized technique (2). It can be recognized that the same procedure must be rigidly enforced each time in order to have internally consistent data; care was taken that the same methodology was employed from patient to patient. Scans were performed 24 hours after the oral administration of 50 μc of sodium iodide [131]I. The neck was hyperextended by means of a pillow under the shoulders. The small collimator for a Picker Magnascanner was used, and placed three inches above the skin surface. Scanning speed was 18 cm per minute with 0.25 cm between lines. The count range differential was set at 50, and the background erase at 10. Carefully marked on the scans were the notch in the thyroid cartilage and the sternal notch. A line was drawn between these two points, and other lines constructed perpendicularly. Using these latter lines, the broadest dimension of each thyroid lobe was measured. From the uppermost

point of each thyroid pole, measurement was made of the longest dimension. All measurements were made with a transparent ruler, by the same individual, to the nearest 0.1 cm.

The average age of the twelve adult males used in the study was 45.1 years, while for the 38 females it was 46.2 years. These individuals were 50 consecutive patients seen at this laboratory who met the following criteria. The thyroid was not palpably enlarged, and there were no nodules. No history of thyroid disease was present, as well as no history of ingestion of exogenous thyroid or its analogues, iodides or antithyroid medication. Thyroidal uptake of radioiodine was 20 to 40 percent at 24 hours. Any other pertinent data available were within normal limits (BMR, red cell uptake of triiodothyronine, and so on). Finally, the individuals had no heterotopic functional thyroidal tissue.

RESULTS

Dimensions of the thyroid gland in this selected population are given in Table 1. Listed with the mean value are the standard deviation and mode of each measurement. Actual distribution of values is shown in Figs. 1 through 4. The mean value of the length of the right lobe was 11 percent greater than the left. The mean broadest width of the right lobe was 5 percent greater than that of the left. Eight of the 50 individuals had the left lobe longer than the right. Utilizing the method of least squares, the equation describing the relationship between the longest dimension of the right (R) and left (L) lobes (in cm) was:

$$R = 0.94 \, L + 0.8 \tag{1}$$

The correlation coefficient was 0.74.

There was no greater percentage deviation of the length of the right lobe, as determined by using the formula and the known length of the left lobe, for the seven youngest individuals in the study (average age 18) than the seven oldest individuals (average age 69). In only three out of the 50 cases was the left lobe both broader and longer than the right. A thyroid lobe less than 3 cm, or greater than 7 cm, in length was unusual (3 cases in 50).

Presented in Table II are values illustrating the positional relationship of the right and left thyroid lobes. Out of the 50 individuals, only three showed the left lobe to begin higher in the neck than the right lobe.

TABLE I

DIMENSIONS OF THE ADULT THYROID GLAND (50 INDIVIDUALS) AS DETERMINED BY SCINTILLATION SCANNING

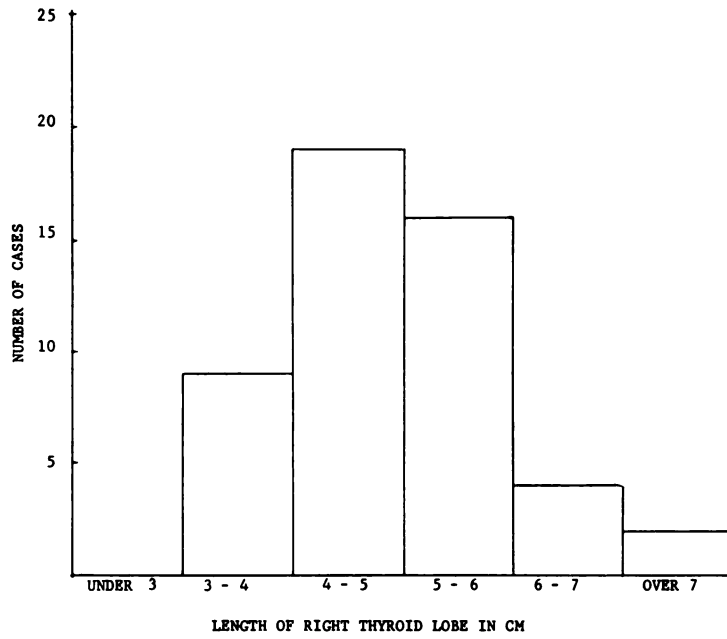| Dimension	Mean (cm) ± Std Dev	Least	Greatest	Mode
Length of right lobe	5.1 ± 0.8	3.6	7.9	4–5
Length of left lobe	4 6 ± 0 8	2.6	7.0	4–5
Width of right lobe	2.1 ± 0.3	1.6	2.8	2.0
Width of left lobe	2.0 ± 0.3	1.4	2.5	1.8

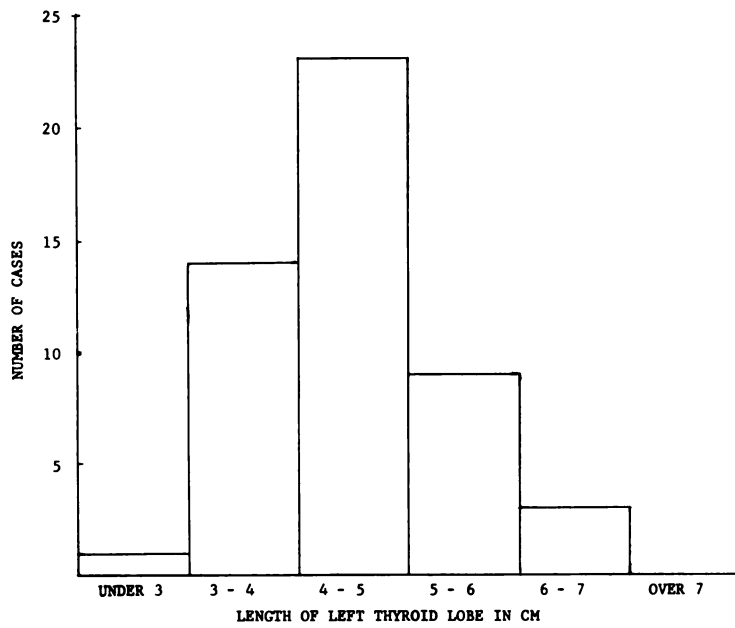Fig. 1. Length of right thyroid lobe in 50 euthyroid individuals.

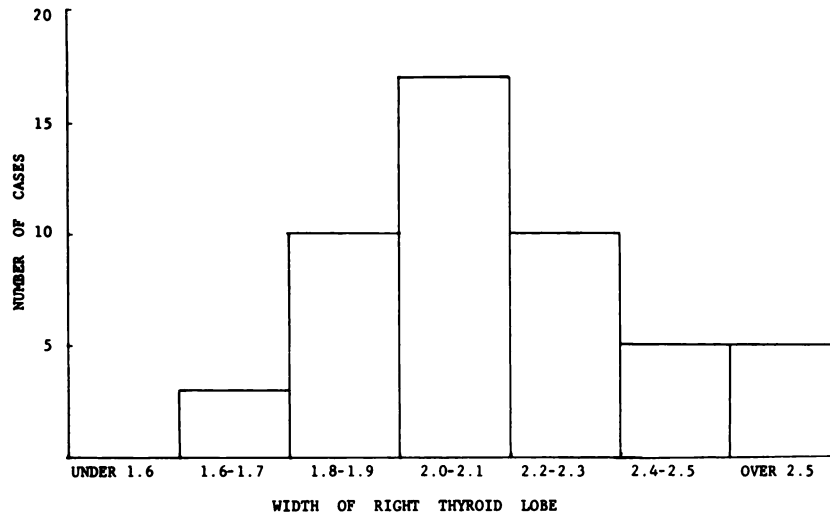Fig. 2. Length of left thyroid lobe in 50 euthyroid individuals.

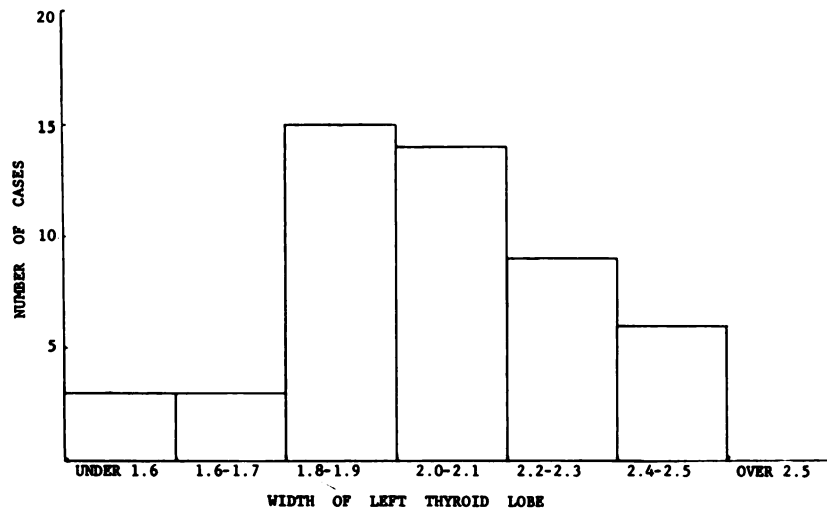Fig. 3. Width of right thyroid lobe (cm) in 50 euthyroid individuals.

Fig. 4. Width of left thyroid lobe (cm) in 50 euthyroid individuals.

DISCUSSION

The values presented are those for a euthyroid population scanned under carefully controlled conditions. An interesting thyroid positional relationship emerged from the data (a left lobe higher in the neck than the right in only 6% of the individuals), and such measurements should be extended to the hypothyroid and hyperthyroid populations.

Recognizing the difficulties presented in such an attempt, thyroid dimensions may be used to calculate the weight of the gland in this euthyroid population. Utilizing the broadest dimension of the thyroid lobe as the diameter of a solid cylinder, and the longest dimension as its length, weights can be calculated for the two lobes. For such a cylinder, assuming the density to be about 1:

$$W = \pi r^2 L \tag{2}$$

For the right lobe, using the mean width and length:

$$W = \pi \left(\frac{2.1}{2}\right)^2 (5.1) = 17.7 \ gm \tag{3}$$

For the left lobe:

$$W = \pi \left(\frac{2.0}{2}\right)^2 (4.6) = 14.4 \ gm \tag{4}$$

The right lobe thus calculates to be about 23 percent heavier than the left. Initially, using the cylindrical approximation appears to be of some value since the mean thyroid weight predicted (32.1 gm) is about that determined on adult thyroid glands at time of autopsy. (3) If one applies to the above values the ap-

TABLE II

VERTICAL RELATIONSHIPS BETWEEN THE THYROID POLES

	Mean (cm)
VERTICAL DISTANCE, between right upper pole and left upper pole:	
Right higher than the left, 41 cases	+0.8
Right at same height as the left, 6 cases	0
Right lower than the left, 3 cases	−0.5
Algebraic average of 50 cases (R > L)	+0.6
VERTICAL DISTANCE, between right lower pole and left lower pole:	
Right lower than the left, 23 cases	−0.4
Right at same height as the left, 5 cases	0
Right higher than the left, 22 cases	+0.5
Algebraic average of 50 cases (R = L)	0

proximation for determining thyroid weights put forth by Goodwin and cowork-ers, (1) the weight of the right lobe calculates to be 17.5 gm, while that for the left lobe is 13.5 gm. It should be recognized that the volume of a cylinder ex-ceeds that of an inscribed irregular figure such as the thyroid. Hence, the use of a cylindrical model would tend to overestimate thyroidal weights. To counter-balance this, however, the density of the thyroid is in reality greater than 1, and the final estimate may be close to the actual weight *in situ*. While the use of a cylindrical model of the adult human thyroid gland may thus be both conceptu-ally and technically simple, an evaluation of such an approach must be delayed until the estimates are correlated with the weight of the thyroid gland determined at surgery or autopsy.

SUMMARY

Following oral administration of sodium iodide ^{131}I, scintillation scans of the normal adult thyroid were performed, at 24 hours, in the anteroposterior direction. Dimensions and locations of the right and left thyroid lobes were determined.

1. A left lobe beginning higher in the neck than the right was unusual (6%). The right lobe extended lower in the neck than the left in 23 cases, while in five individuals the two lobes ended at the same level.

2. The mean longest dimension of the right lobe was 11 percent greater than the left, and its mean greatest width was 5 percent greater. In only three cases (6%) was the left lobe both longer and broader than the right.

3. By the method of least squares, for this selected population of 50 indi-viduals, the linear equation relating the length of the right thyroid lobe (R) to that of the left (L) in cm was found to be: $R = 0.94L + 0.8$.

4. The use of a simple cylindrical model in estimating the weight of the normal thyroid was proposed.

REFERENCES

1. GOODWIN, W. E.; CASSEN, B. AND BAUER, F. K.: Thyroid gland weight determination from thyroid scintigrams (with postmortem verification). *Radiology* 61:88, 1953.
2. GALLAHER, W. H. AND SPENCER, R. P.: Preliminary estimation of functional thyroid weights in a selected hyperthyroid population. *J. Nuclear Med.* 5:649, 1964.
3. MORTENSEN, J. D.: WOOLNER, L. B. AND BENNETT, W. A.: Gross and microscopic findings in clinically normal thyroid glands. *J. Clin. Endocrinol. & Metab.* 15:1270, 1955.