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PRELIMINARY NOTE:

Effect of Radioiodide Therapy on Thyroid Length and Estimated Weight[1]

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Scanning, which has been utilized to determine the length of normal thyroid lobes (1), has been extended to include measurements in hyperthyroidism before and after radioiodide therapy. Preliminary data on 16 consecutive cases of hyperthyroidism, presented here, suggest possible simple quantitative approaches to estimating the expected change in thyroid size following radioiodide therapy.

The 14 females and two males, at an average age of 51 years, had both clinical and laboratory evidence of hyperthyroidism and diffusely enlarged (nonnodular) glands. Scans of the thyroid were performed as previously described (1) and the length of the right and left lobes measured from the dot scans. These two measurements were averaged to give the mean thyroid length prior to therapy. Assuming an effective half-life of radioiodide in the thyroid gland of six days, each patient was treated with a dose of radioiodide determined by means of the following relationship.

$$\text{Dose} = (80\mu\text{Ci/g thyroid})\ (\text{thyroid weight})\ (100/\text{highest uptake}) \quad (1)$$

Although there are difficulties in estimating thyroid weights from anteroposterior scans (2), we utilized the following relationship (all lengths in cm):

$$\text{Weight (gm)} = (\text{average length})\ (\text{surface area on scan})\ (0.3) \quad (2)$$

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An average of nine months later, the patients returned and the thyroid scan was repeated. The mean thyroid lengths and estimated weights were again determined. A plot of the lengths after treatment (L_A) are given in Figure 1 as a function of the lengths before treatment (L_B). The mean pretreatment length was 6.0 cm, the mean posttreatment length 5.1 cm. The least squares relationship of all the points (solid line in Figure 1) was:

$$L_A = 1.03\ L_B - 1.06 \tag{3}$$

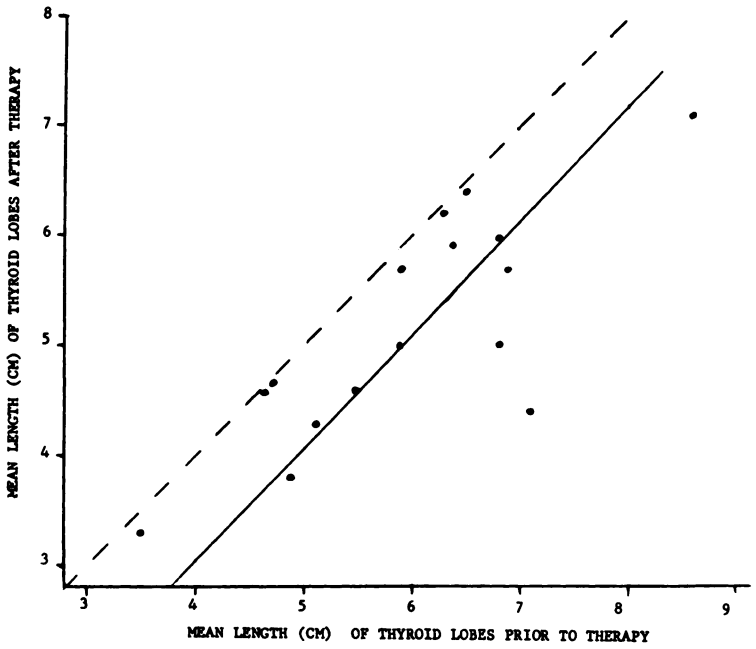

Fig. 1. A plot of posttreatment thyroid length as a function of the pretreatment length. The dotted line is that expected for no change. The solid line was determined by the method of least squares.

The correlation coefficient was over 0.7. The 45° line (no change in thyroid length) is shown in Figure 1 as a dotted line. All of the points fall on or below this line. That is, an average of nine months after therapy, the thyroid lengths had either not changed or had decreased.

If the weight of the thyroid gland is approximately in proportion to the cube of a linear dimension, then:

$$\frac{(\text{weight after therapy})}{(\text{weight before therapy})} = f\left[\frac{L_A}{L_B}\right]^3 \tag{4}$$

where f is some unknown function. For the average dimensions in this series of cases, assuming f to be simply a proportionality constant, we have:

$$\frac{(\text{weight after therapy})}{(\text{weight before therapy})} = \left[\frac{5.1}{6.0}\right]^3 = 61\% \tag{5}$$

The estimated gland weights, calculated by means of equation (2), before (W_B) and after (W_A) therapy were related by:

$$W_A = 18.5 + 0.28\ W_B \tag{6}$$

The correlation coefficient was 0.7. In a series of hyperthyroid patients seen at this laboratory, the average estimated pretreatment thyroid weight was 55 g (3). Using this value in equation (6) gives an estimated posttreatment thyroid weight of 33.9 g. In this instance, then:

$$\frac{(\text{weight after therapy})}{(\text{weight before therapy})} = \frac{33.9}{55.0} = 62\% \tag{7}$$

The predictions by equations (5) and (7) are fairly similar. We can combine equations (4) and (3) to yield:

$$\frac{(\text{weight after therapy})}{(\text{weight before therapy})} = \left[\frac{L_A}{L_B}\right]^3 = \left[\frac{1.03\ L_B - 1.06}{L_B}\right]^3 \tag{8}$$

Equations such as (3), (4), and (8) allow a first approach to estimating the change in thyroid length and weight following radioiodide therapy of hyperthyroidism by a standard regimen in a selected population. Certainly more sophisticated models can be evolved, and this must be viewed as but a first approach. The predictive value in a single case at present will of course be low. However, it can be appreciated that more meaningful results will likely be obtained from a larger series of patients in which appropriate consideration is given to such factors as ethnic origin, age, duration of disease and so on. It will also be of interest to follow the thyroid dimensions as a function of time, and to determine if any early prediction can be made as to which patients will become hypothyroid.

SUMMARY

Based on measurements obtained from thyroid scans, initial approaches to estimating the decrease in thyroid length and weight after radioiodide treatment of hyperthyroidism were discussed.

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