METHOD FOR REDUCING EXTRATHYROIDAL NECK RADIOACTIVITY: USE OF A SPECIAL COLLIMATED SCINTILLATION DETECTOR

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Precise measurement of the early thyroid uptake (20 min) of ^{131}I and ^{99m}Tc by directional counting necessitates correction for the extrathyroidal neck radioactivity (ETA); this is usually 5–7% of the administered isotope dose when the IAEA collimator is used (*1,2*). Since the normal early thyroidal uptake of these isotopes is only 1–4% of the administered dose, the uncertainty in estimating the correction for other neck radioactivity leads to unacceptably large errors in the derived thyroid uptake.

Using closer collimation we have reduced the volume of neck seen by the counter while still including the whole of the thyroid. This communication describes studies to evaluate the physical characteristics of our collimator and to assess the accuracy of measurement of ^{131}I and ^{99m}Tc ETA with it.

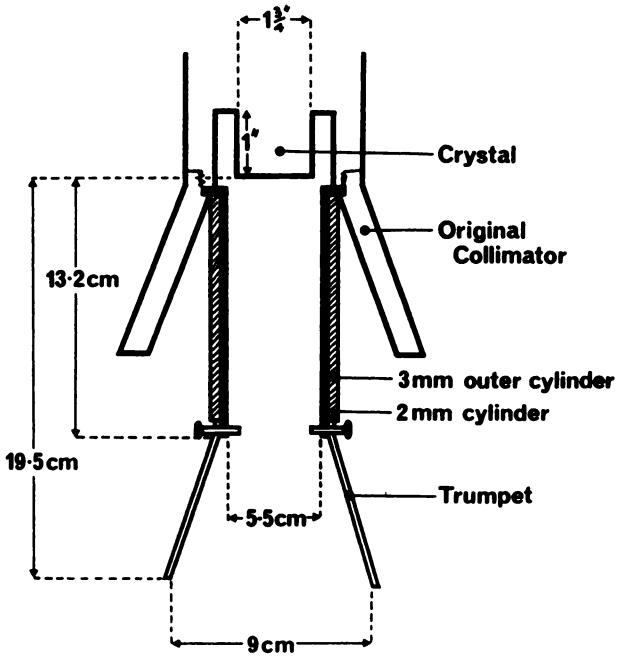

FIG. 1. Diagram of special collimation showing original collimator and addition in long axis.

METHODS

Collimation. The special collimator (Fig. 1) was used with a directional scintillation counter. It consisted of an axial cylinder of lead 5 mm thick with a trumpet of 2 mm lead added which was of rectangular cross section (9 × 6 cm) at its outer edge but tapered to fit the cylinder.

Collimator characteristics. The collimator response and field of view were measured using small sources of ^{131}I and ^{99m}Tc both for the long and short axis of the trumpet.

Extrathyroidal background study. The ETA of ^{131}I and ^{99m}Tc was measured following their separate and simultaneous intravenous administration (25 and 400 μCi, respectively) in normal subjects whose thyroid uptake had been blocked with oral perchlorate. A ratemeter and potentiometric recorder were used for each isotope giving a continuous recording of ETA. Isotope standards in a thyroid phantom were used for system calibration.

RANDOM ERRORS

Statistical variation in output voltage of ratemeter. The error for ^{131}I was approximately 1%, and for ^{99m}Tc, it was less than 1%.

Repositioning of patients. With a reproducibility of collimator-neck distance of ±0.5 cm, both ^{131}I and ^{99m}Tc had an error of approximately 5%.

Injection calibration. The standards were in error by approximately 3%.

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TABLE 1. MEAN ETA OF ^{99m}Tc AND ^{131}I AT 5, 10, 15, AND 20 MIN AFTER SINGLE AND SIMULTANEOUS INJECTION AS PERCENT DOSE ±2 S.D.

No. of patients	Isotope given	5 min		10 min		15 min		20 min	
		^{99m}Tc	^{131}I	^{99m}Tc	^{131}I	^{99m}Tc	^{131}I	^{99m}Tc	^{131}I
5	^{99m}Tc	1.79 ± 0.58	—	1.71 ± 0.59	—	1.66 ± 0.51	—	1.63 ± 0.50	—
5	^{131}I	—	1.96 ± 0.64	—	1.93 ± 0.63	—	1.89 ± 0.61	—	1.89 ± 0.61
5	^{99m}Tc + ^{131}I	1.99 ± 0.50	1.87 + 0.61	1.90 ± 0.53	1.82 ± 0.55	1.80 ± 0.48	1.78 ± 0.55	1.74 ± 0.45	1.75 ± 0.50

The s.d. shown is for the distribution of ETA in the subject population.

RESULTS

Collimator characteristics. The collimator response curves for ^{131}I and ^{99m}Tc were virtually identical and gave a 90% response within a maximum area of 8 × 7.5 cm at a working distance of 25 cm from the crystal.

Extrathyroidal background study. Results are shown in Table 1. Each ETA value given is the mean of three measurements at intervals of 24 hr on each of five patients—a total of 15 measurements. It can be seen that (A) the ETA is approximately 1–2% of the dose for both ^{131}I and ^{99m}Tc, (B) there is a close correlation between the ETA of ^{131}I and ^{99m}Tc when measured simultaneously, and (C) the difference between the ETA at 5 and 20 min is small. The error (±2 s.d.) for ETA measurement in a single subject was approximately 10% for ^{99m}Tc and 20% for ^{131}I.

DISCUSSION

The high ETA from ^{131}I or ^{99m}Tc has precluded the use of directional counting with the IAEA collimator for accurate early thyroidal uptake measurements. As we felt that a simpler approach was needed for routine ^{131}I discharge tests (*3*) and for the routine measurement of the ^{99m}Tc thyroid uptake, we have minimized ETA by closer collimation. The 8 × 7.5-cm rectangle (90% response) is in our experience adequate to cover all but very large thyroids. In only 6% of 300 routine thyroid scintiscans was the thyroid greater in size than this and the majority of these were large nontoxic goiters over 100 gm in size.

The ETA measurement data (Table 1) show a reduction to approximately 30% of the value of ETA obtained using the IAEA collimator. As the individual measurements of ETA were acceptably reproducible, this improvement greatly reduces the error in early thyroid uptake measurements in normal subjects from approximately 40 to 10%. In addition, simultaneous studies using both ^{131}I and ^{99m}Tc are possible as the collimator fields for both isotopes are identical.

SUMMARY

A simple method for reducing ETA is described. It allows more precise measurements of the early thyroidal uptake of ^{131}I or ^{99m}Tc in glands of up to 100 gm in mass.

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