I. Thyroid and Acces. Thyroid

Dynamic Analysis of Thyroid Function Using 99mTc

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Dynamic analysis of thyroid function using 99mTc was studied for the purpose of detection of thyroid carcinoma in an early stage. The scintillation camera with pinhole collimeter was connected with a small general purpose computer. Thyroid scintillation photo was recorded on magnetic tape every 10 to 20 seconds interval immediately after intra-venous administration of 2 to 3 mc. of 99mTc through cubital vein. By flagging regions of interest, two areas of an equal size in the thyroid were chosen, one including center of nodule, the other maximal point of uptake within the thyroid. The counts of both areas were continuously printed and their fluctuation was also analysed.

1. Dissociation time: Dissociation of uptake curves of both areas was found after 100 seconds following 99mTc injection in benign solid nodule cases, whereas it was within 40 seconds in benign cystic nodule. However, dissociation of two uptake curves of malignant nodules cases was recorded between 40 and 100 seconds.

The observation of Dissociation time is adequate in 10 seconds interval record.

2. Consuming time to reach the maximal uptake level of the curve of maximal point area in histologically known 145 cases was measured and analysed.

In observation record for 18 minutes, out of 18 malignant nodule cases, in which 3 occult carcinomas were included, consuming time of 14 cases were recorded beyond 14 minutes. In 127 cases of non-malignant cases, consuming time of 80 cases were recorded within 13 minutes. Particularly, it was shorter in chronic thyroiditis case. We expect above-mentioned analyses are of an effective screening method for T1 type of thyroid carcinoma and chronic thyroiditis.

Functional Imaging of the Thyroid with 99mTc-Pertechnetate

Appraisal for a Parameter of Initial Slope

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Functional imaging of the thyroid using a new parameter "Initial Slope" was investigated. Following intravenous injection of 5 mCi of 99mTc-pertechnetate, sequential data were collected in a mode with 64 × 64 matrix using a gamma camera and an on-line computer (DAP-5000 N). For all the time-activity curves on the 64 × 64 elements initial slope was calculated according to following formula and displayed such that brightness is proportional to calculated values for T 1/2.

\[ T 1/2 = 3.51 \sum_{t=0.5}^{2} [C_{10}/(C_{10} - C_t)] \]

where, \( C_t \) represents count rates at \( t \) minutes after injection.

Constructed functional images showed special regional thyroid function in terms of T 1/2 of initial slope. Averaged values for T 1/2 in thyroid area, which was automatically printed out, ranged 0.4 to 1.1 minutes in euthyroidism, increasing in hyperthyroidism, decreasing in hypothyroidism. In addition, it showed good responses to T3 suppression and TSH stimulation. There was a good correlation between averaged T 1/2 and 131I uptake (\( r=0.857, P<0.005 \)).
Calculated values for $T_{1/2}$ in downward time-activity curves were displayed in another images with appropriate background cut off. Malignant thyroid tumors with vascularity were displayed as hot areas, while benign tumors were not displayed on the images either by cut off or in the absence of downward slope.

This functional image is of special value for daily clinical studies on thyroid function as well as thyroid nodule because this method does not need standard measurement, requires data processing time of only 10 minutes including calculation time of 2 minutes, can be performed along with usual $^{99m}$Tc-pertechnetate scintigraphy.

Comparison of Thyroid Images with I-123 and Tc-99m

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Though thyroid imaging has been performed with various nuclides, I-123 and Tc-99m are more suitable, because of their smaller radiation dose to the thyroid and more suitable photon energies than the others. Since I-123 has become available in this country, we studied the clinical usefulness of I-123 and compared thyroid images obtained with I-123 and Tc-99m.

Forty three cases of various thyroid diseases (solitary nodule 23, diffuse goiter 16, postoperative remnant 4) were examined with I-123. At 8 hours after the oral administration of 100–200 μCi of I-123, images of thyroid gland were obtained on the gamma camera equipped with a pinhole collimator. In 38 out of 43 patients, Tc-99m images were taken at 30–60 minutes after the intravenous injection of 1–2 mCi of Tc-99m on the previous day.

In 42 of 43 cases examined with I-123, excellent images were obtained. In 38 cases in which I-123 and Tc-99m images were compared, both images were poor in 1, equally excellent in 26, and I-123 image was better than that of Tc-99m in 11 patients, respectively. The detail of the last group was as follows. In 3 cases, Tc-99m uptake was insufficient for a clear image. In 6 cases, the high background detracted from the sharpness of detail. In 2 cases small nonfunctioning nodules were more clearly seen on the I-123 image than with Tc-99m.

Two patients with chronic lymphocytic thyroiditis showed discordant image between 2 scintigrams, that was a focal area which accumulated the same Tc-99m as, and less I-123 than, the other area. The histology of the lobe which was resected in one of them, was consistent with chronic lymphocytic thyroiditis and the section showing the discrepancy of Tc-99m and I-123 images did not show any characteristic feature different from the rest of gland. Such a discrepancy between 2 images has been reported in the cases of adenomatous goiter, thyroid adenoma and carcinoma. No case of chronic lymphocytic thyroiditis has been known to our knowledge that showed the discrepancy.

RI Diagnosis of Thyroid Tumor (Report III) Study of $^{197}$HgCl₂ Uptake into Thyroid Tumor

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Previously, we reported clinical application of thyroid tumor scanning with $^{197}$HgCl₂, which was a valuable diagnostic method for the detection of thyroid carcinoma. Then, we investigated uptake of $^{197}$HgCl₂ into thyroid tumor and found that the uptake of $^{197}$HgCl₂ in thyroid carcinoma...