

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  $^{99m}\text{Tc}$ -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  $\mu\text{Ci}$  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 $^{197}\text{HgCl}_2$ Uptake into Thyroid Tumor

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Previously, we reported clinical application of thyroid tumor scanning with  $^{197}\text{HgCl}_2$ , which was a valuable diagnostic method for the detection of

thyroid carcinoma. Then, we investigated uptake of  $^{197}\text{HgCl}_2$  into thyroid tumor and found that the uptake of  $^{197}\text{HgCl}_2$  in thyroid carcinoma

showed significantly higher than in normal thyroid tissue around carcinoma, cervical muscle and thyroid adenoma.

Recently, in order to localize the incorporation sites of  $^{197}\text{HgCl}_2$  in human thyroid carcinoma, both normal and carcinoma tissues biopsied from surgery were incubated in vitro in  $^{203}\text{HgCl}_2$ , fixed either by glutaraldehyde-osmium or freeze-drying and embedded in Epon, sectioned and either wet-or dry-mounted for both LM and EM radioautography for both soluble and insoluble forms.

Light microscopically, soluble Hg was observed to localize diffusely in nucleolus and cytoplasm of

normal follicular and carcinoma cells intensely than insoluble Hg. Electron microscopically, soluble and insoluble Hg was observed diffusely in ER, mitochondria and cytoplasmic matrix. In general, soluble Hg concentration was more than insoluble Hg and incorporation of carcinoma was more than normal thyroid tissue.

From these results, it was concluded that most Hg concentrated in carcinoma or normal thyroid tissues was soluble form and that insoluble form might be combined with some protein in ER, mitochondria and cytoplasmic matrix.

### **Evaluation of $^{67}\text{Ga}$ -citrate Scan for Nonfunctional Thyroid Nodule**

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Thirty patients with nonfunctional thyroid nodules were investigated by  $^{67}\text{Ga}$ -citrate, to evaluate the diagnostic efficacy of thyroid cancer. The scintigrams were taken with gamma-camera at forty-eight hours after injection of 2 mCi of  $^{67}\text{Ga}$ -citrate. Positive scans were found in 8 out of 23 patients with thyroid cancer, all of 5 patients with undifferentiated carcinoma (100%), 2 out of 14 with papillary adenocarcinoma (14%) and one out of 4 with follicular adenocarcinoma (25%). In 7 patients with benign lesion, one with chronic

thyroiditis and one with subacute thyroiditis showed positive scans. In the one patient with undifferentiated carcinoma, which showed to positive accumulation, no uptake of  $^{67}\text{Ga}$ -citrate was found at repeated scan after radiation therapy.

Although  $^{67}\text{Ga}$ -citrate thyroid scan was less valuable for diagnosis of thyroid cancer, its clinical application was considered to be the diagnosis of undifferentiated carcinoma, and the evaluation of radiotherapy effect.

### **Studies on the Radioreceptor Assay of TSH**

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Thyroid Stimulating Immunoglobulins; TSI have been detected in patients with Graves' disease and Hashimoto's thyroiditis by using radioreceptor assay of TSH. In untreated Graves' patients TSI levels correlated well with thyroid  $^{99\text{m}}\text{Tc}$  uptake at 30 min and grades of epithelial hyperplasia of thyroid follicles. These correlations were much better than with LATS activity. There were many patients who had high TSI levels without detectable LATS activity and in these patients close correlation was observed between

TSI levels and LATS-Protector activity.

In these Graves' patients treated with MMI,  $\text{T}_3$  suppression test was performed and there were some Graves' patients whose thyroid  $^{99\text{m}}\text{Tc}$  uptake were suppressible by  $\text{T}_3$  administration, together with detectable levels of TSI and LATS-Protector. Moreover there was a discrepancy between TSI levels and circulating  $\text{T}_3, \text{T}_4$  concentrations.

In conclusion, about the pathogenetic mechanisms present in Graves' disease TSI would be a candidate but not determined at present.