Clinical Evalution of ^{67}Ga-Citrate as a Tumor Scanning Agent

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The clinical usefullness of ^{67}Ga-citrate as a tumor scanning agent was evaluated from the experiences of more than 50 cases, and the problems on what sorts of tumors and in what ways the agent should be applied were descussed. The twin-headed 5-inch Hitachi whole body scanner was used for the scanning. The whole bodies of the patients scanned 3 to 4 days after the i.v. administration of 2 mCi of ^{67}Ga-citrates. The scans were recorded in 1/5 of the real size. When the localized high concentrations of the radioactivities wer found, the real-sized scans were performed over such areas. The ^{67}Ga-citrate tumor scans were then compared with the plysical examinations and x-rays. The cases scanned include the corcinomas of the lung, carcinomas of the thyroid, beign adenomas of the thyroid, carcinomas of the cervix uteri, malignant lymphomas, malignant chorionepithelioma, rabdomyosarcoma etc. The mechanism of concentration remains unknown. From the clinical point of views, however, it is likely that the malignant neoplasms well concentrate while the benign neoplasms or infections do not or less.

While the high concentrations were obtained in almost of all cases of the malignant lymphomas, no concentration in the malignant tumors (such as the carcinomas of the thyroid) or good concentrations in benign pathology (such as the lymphadenitis colli tuberculosa) were also observed.

As the conclusion, ^{67}Ga-citrate was clinically useful in cases of which scans told us the extent of invasions or the exsistence of distant metastases of malignant neoplasms.

Diagnostic Aspect of Malignant Tumor with ^{67}Ga-Citrate

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Clinical survey using ^{67}Ga-citrate was performed in 170 patients with a variety of malignant and benign neoplasmas, and inflammatory lesions of lung, breast, maxillary sinus, stomach, colon, pancreas and liver. Especially, ^{67}Ga-citrate was valuable to establish the diagnosis of cancer of lung, breast and maxilla. However, it was rather difficult, at present, to obtain positive scintigram in the case of cancer of stomach, pancreas and

liver. As far as the benign tumors were concerned, fibroadenoma and cystic disease of the breast and mixed tumor of the salivary gland showed negative scintigram. As far inflammation, the focus of active tuberculosis showed positive scintigram, but old tuberculous lesion and tuberculoma showed negative scintigram. It can be considered that there is a difference of uptake of ^{67}Ga-citrate into the inflammatory lesion depending upon whether or not chemotherapy is applied. Gallium localization is greatest in viable tumor, less in fibrotic or necrotic tumor, and diminished by irradiation and effective chemotherapy. Studies were made on the accumulation of ^{67}Ga-citrate in the tumor-bearing mice. The accumulation of ^{67}Ga in the tumor cell was elucidated both by chemical analysis and by autoradiogram. Localization of ^{67}Ga in various mouse tumors was variable. This pattern of distribution was confirmed with a whole-body autoradiogram. Accumulation of ^{67}Ga seems to be some correlation to the cell function. The fact that similar tumor-to-normal tissue concentration ratios were obtained with gallium-lactate, pyruvate, acetate and galuctate as citrate, suggests that the initial active form of gallium in the tumor localization process is an ionic one. The simultaneous administration of stable gallium with ^{67}Ga causes a greatly reduced concentration of ^{67}Ga in tumor tissue. However, the previous administration of Fesin (saccharated ferric oxide) causes a reduced concentration of ^{67}Ga in liver tissue. In vitro experiments, accumulation of ^{67}Ga in Ehrlich's tumor cell was rapidly increased, but with addition of 5 mM. EDTA in this medium, the accumulation of ^{67}Ga in Ehrlich's tumor cell completely stoped.

The mechanism of uptake is still unknown. At present, we would like to consider that instead of active uptake, ^{67}Ga-citrate was taken into intracellularly because of the abnormal permeability of cell membrane of the tumor cell and combined with cytoplasmic protein and accumulated in the cells.

A Study of ^{67}Ga-Citrate in the Gastric Diseases

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Patients with gastric cancer and gastric ulcer were examined with ^{67}Ga-citrate. From 2 to 2.5 mCi of ^{67}Ga-citrate was given by intravenose injection. After 1 to 4 days later patients were biopsied from the normal and pathologic regions under the direct gastrofiberscope. In some of the cases we took tissues from surgical method. After counting with a welltype scintillation counter, each data was compared as c.p.m. per 1 mg of the tissue.

The results are as follows:

We could find 3 cases of early stage gastric cancer and advanced carcinoma, and there is no difference of c.p.m. between normal and pathologic region. In cases of gastric ulcer we could find that pathologic region revealed same c.p.m. or much less than c.p.m. as normal tissue. One of the tissue from 2 surgical specimens of advanced gastric carcinoma does not show large amount of c.p.m. but other does show 2.5 times as normal tissue uptake.