President Lecture

The Role of Nuclear Medicine in Radiological Diagnoses

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Radiological diagnosis is divided into two categories, those are roentgenological and nuclear medicine diagnoses. Images obtained by roentgenological procedure have good resolution and can detect the morphological abnormalities more precisely than those by nuclear medicine procedure. Scintigraphy is inferior to roentgenography in its resolution, but it has the advantage in examining noninvasively and in demonstrating the physiological and functional abnormalities of the organs. Both techniques, therefore, should be performed covering each other.

In this special lecture, our experiences on nuclear medicine technique with comparison of roentgenological one in diagnoses of respiratory diseases, bone diseases and liver cancers were mentioned.

Lung scientigraphy:

In regard to the respiratory disease, radioisotopic method was proved to be an excellent alternative for a blind spot of the chest radiograph. Since the roentgenographic manifestation of the chest can merely discriminate watery density from surrounding air density, abnormalities due to airways are rather difficult to detect in contrast to those due to blood vessels. In this respect, radioisotopic methods compensate for this defect. For example, the radioaerosol inhalation scintigraphy is especially useful in detecting the early changes of the central airway and radioxenon scientigraphy for the changes of the small airway. Typical cases were presented in this respect.

Case 1: The case with early lung cancer with a size of $0.5 \times 0.5 \times 1.0$ cm at the region of S_3 of the left lung, which was difficult to diagnose on the chest radiograph, revealed a slight accumulation of ^{67}Ga as well as inhalation defect at this region.

Case 2: The case with bronchial asthma in remission, representing a slight sign of air trapping on the chest radiograph, revealed washout delay of radioxenon from the peripheral region of the middle to lower lobe. A bolus inhalation of this tracer at the reserve volume accentuated this finding, suggesting the existence of small airway closure of this region.

Another aspect of physiological abnormalities in the lung which was hardly predictable by the chest radiograph alone could also be visualized, if adequate tagging agents were chosen. Two typical cases were presented in this respect.

Case 3: The case with chronic renal failure with a heart enlargement and a sign of pulmonary edema on the chest radiograph revealed remarkable accumulation of ^{99m}Tc-diphosphonate, suggesting the abnormal calcium deposition in the lung which was proved to be reversible after the dialysis on this scintigram.

Case 4: The case with Good Pasture's syndrome with nonspecific diffusely scattered nodular shadow

on the chest radiogram revealed abnormal accumulation of ^{51}Cr-RBC in the entire lung field, suggesting the existence of the pulmonary hemorrahage.

Bone scintigraphy with ^{99m}Tc-EHDP:

In general, osseous lesions of primary malignat bone tumors accumulate increased amount or radioactivity except multiple myeloma and chordoma, while those of benign tumors take up relatively less amount of the radionuclide. Radiograms usually reveal the lesions at the first visit of the patients with primary bone tumors and the usefulness of bone scintigraphy is limited to some extent as a method of early detection of primary bone tumors. Scintigram, however, may well lend increased objectivity to evaluation of the activity of secondary bone reaction to the destruction caused by the tumors and may offer useful information supplementally to radiography.

It is well known that scintigraphy is more sensitive than radiographs in the early detection of bony metastases. Bone scintigraphy revealed bony metastases in 27% of the 412 cases with malignant tumors and especially high occurrence was seen in the cases with breast cancer, prostate cancer and pulmonary cancer. It is essntial to perform bone scintigraphy as a routine examination in those malignancies and then the false positive lesions such as fracture, inflammation, degenerative diseases or Paget's disease should be excluded by radiography.

Scintigraphy is also useful in detecting fracture site especially in the complex bone. Our experience with serial scanning of mandibular fractures suggests the following timetable of events. Little or no change from control sites was seen until approximately the 5th day, when a gradual increase of uptake became progressively more intense at the fracture sites. Maximum intensity was usually seen from 10th through 180th days, followed by a gradual decrease in intensity, however, increased uptake continued about a year. The timetable can be influenced by a number of factors, among which clinically of importance is the complication of osteomyelitis or formation of pseudoarthrosis.

Studies on liver cancers:

Liver scintigraphies with ^{99m}Tc-colloid and ^{67}Ga-citrate, measurements of the levels of alpha-fetoprotein (AFP) and carcino-embryonic antigen (CEA) as nuclear medicine diagnosis and selective angiography of the liver as roentgenologic diagnosis were performed.

Detectability of the hepatoma by scintigraphy was 97% of 36 confirmed cases, while that by angiography was 94% of 31 cases. However, angiography was superior to scintigraphy in its quality. The smallest lesion was 4cm in diameter by ^{67}Ga scintigraphy and was 5cm in right lobe and 2.5cm in left lobe of the liver by ^{99m}Tc-colloid scintigraphy.

The distribution of ^{67}Ga in the hepatoma was various. The uptake of ^{67}Ga in the tumor was graded into 5 degrees from exceeding increased to decreased uptake in comparison with that in the noncancerous area of the liver. Increased uptake of ^{67}Ga into the lesions was observed in 83%, while decreased uptake was seen in the rest of patients with hepatoma.

The serum AFP was positive (normal range: 160 ng/ml) in 76% of the 36 hepatomas. All cases of eight AFP-negative hepatomas in our series showed increased uptake of ^{67}Ga except one case. The combination of these two diagnostic procedures made it possible to diagnose 97.5% of the 36 cases with hepatoma. Intrahepatic metastatic lesion with a size of 2cm was not demonstrated by scintigraphies which was showed clearly by angiography. In our series, the smallest lesion of hepatoma demonstrated by angiography after detecting positive AFP was 4cm in diameter. It will be concluded so far that hepatoma which is greater than 4cm in diameter can be diagnosed by AFP measurement and scintigraphy. It is necessary, of course, to perform angiography before determining the indication of the surgery.

The serum CEA level was positive in 66% of hepatoma, while it was positive in 94% of the 34 cases with metastatic liver cancer. There observed overlapped cases with hepatoma, which showed negative AFP with positive CEA. All these cases, however, could be identified by increased uptake of ^{67}Ga in the lesion.

It is possible to differentiate the hepatoma from the metastatic liver cancer by measuring both serum AFP and CEA levels and ^{67}Ga-citrate scintigraphy.

Summary:

The role of nuclear medicine in radiological diagnoses of respiratory diseases, bone diseases and liver cancers was mentioned.