Brain Scanning

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Brain scanning with new agents, ^{99m}Technetium pertechnetate and ^{113m}Indium-Fe-EDTA, has recently been employed in Chiba University Hospital. Their short half lives and no beta emission allow to increase the administration dose to millicurie order without additional radiation hazard, resulting higher counting efficiency which is favorable for the detection of brain tumors.

Seventy two cases histologically verified were analyzed in this report. By the addition of the new agents, the rate of diagnostic accuracy increased to 64% from 52.2% of the time ^{203}Hg Chlormerodrin was a agent for the brain scanning. The diagnostic accuracy of the brain tumor by ^{99m}Tc and ^{113m}In is 84.7% which is much higher than by ^{203}Hg Chlormerodrin. This rate is fairly comparable with that of the angiographic study (82.3%).

When one would evaluate the role of the scanning in brain tumor detection, the pathology, the size, and the location of the tumor should be taken into consideration. The percent diagnostic accuracy of the scanning was high in meningioma (14/14), glioblastoma (12/15), and metastatic tumors (5/8), and was low in hypophyseal tumors (3/8) and acustic neurinoma (1/3). Judging from the phantom experiment, even the tumor-brain ratio of the agent was as low as 3 to 1, the tumor larger than 3 cm in diameter would be detectable. While the tumor locates in the parietooccipital or in the midline region is more easily detected by the scanning rather than by the angiography, the tumor of the brain-stem or of the occipital region is hard to be identified by the scanning.

The brain scanning for the detection of tumors is as effective as the angiography, and is more easily and safely performed than the angiography. The time required for the scanning (1 to 1.5 hours for a patient) will be lessend by the use of the scintillation camera. Besides, the scintillation camera will make the dynamic study useful for the diagnosis of brain pathology.

2) Thyroid Gland

Thyroid Scintigram

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Thyroid scannig is one of the most popularized and the most valuable examinations in the field of nuclear medicine at present. Many literatures on this problem are already reported and it seems no refreshing problems in this examination.[1])

In this report, such reports are generalized on the basis of our experiment of about 7,000 cases of thyroid diseases in the University of Tokyo Hospital, Okudo Manucipal Hospital of Tokyo and Toranomon Hospital.

1) ADMINISTRATION DOSAGE OF IODINE-131

The clinical evaluations of scintigrams are depending on the doses of radioisotopes in the organs. In the case of thyroid scintigram, the dose of radioisotope in thyroid gland does not depend on the administered dose but mainly on the uptake ratio of ^{131}I to the thyroid. And the dose required in the thyroid scintigram diagnosis depends on the request of the analysis of the scintigram, that is what is the main purpose of examination just as to find the area, the position or the figure anomalies.

For these reasons, careful palpation and examination of the patient histories which suggest these formerly stated purposes are recommended before the determination of administration dose of radioisotopes for the patient.

It is not a good way to administer a lower dose of radioiodine to care about the radiation dose to the patients. It needs sometimes another administration to get a valuable scintigrams which leads to give the unvaluable radiation to the patient and otherwise to give the misdiagnosis of the disease.

Some opinions are exist to determine the uptake ratio with smaller dose of iodine before the scintigram study. It seems to be a rational procedure for this purpose, but it is not widely accepted because of its troubleness procedures both for the patients and hospitals.

The required administration dose also depends on the scanner to examine, mainly on the size of NaI(Tl) crystal of the scanner. Generally speaking, the dose required to have a complete diagnosis is about $20/L^2(\mu Ci)$ in the gland where L means the diameter of the crystal in inches. From this formula the radiation dose to the thyroid is calculated about 10 rads in the case of 3″ diameter crystal scanner.

2) SCINTIGRAM READINGS

Thyroid scintigrams are examined for the diagnosis concerning on area, position, figure and uniformity of ^{131}I deposit as formerly stated. The normal range of the area is between 10 and 20 cm^2 as both lobes, and the greater area of iodine deposit, that is greater volume of thyroid gland, suggest the diagnosis of hyperthyroidism or some kinds of simple goiter, on the contrally, smaller area suggests the diseases concerning the disturbances of pituitary hormones just as dwarfism. Of course it depends on the patient's age. The iodine deposits in abnormal position mean the ectopic goiter or the deviation of the thyroid by extra-or intra-thyroidsl masses, and they are usually associated with the abnormal figure of thyroid glands. The deposit of ^{131}I in metastatic lymph nodes will comfirm the thyroid cancer easily.

Differencial diagnosis of abnormal figure of the thyroid is most important in the thyroid scintigram readings. They are usually nodular goiters. The great area of defect of iodine deposit with non expansive edges, the greater defect compared with palpable mass, the defect of iodine deposit in unilateral lobe suggest the malignant nodules, on the contrally, expansive defect, smaller defect compared with palpable nodule suggest benign nodules. And the location of defects in thyroid sometimes suggests the nature of nodules. For the experinced doctors, it is not so difficult to diagnose the nature of the nodules, but it is difficult to differenciate the malignant nodules from the chronic inflammation (Hashimoto's disease). Irregular pattern of the iodine deposit usually suggests the chronic inflammations, but sometimes such a pattern is observed in the scintigram of reticulum cell sarcoma in thyroid glands.

Hot deposit of nodules in thyroid gland is usually benign tumor but extra thyroidal deposit means the metastatic thyroid cancer in general.[2])

Some exceptional cases are found on our series and they are reported in this paper. One of them is metastatic ^{131}I deposit with benign histological findings. Another case has many lymph node metastases of thyroid cancer in neck region with the same histological sign, however, some of them deposit the iodine and others no iodine deposit.

The difinition of "hot nodule" is not obvious at present, some person confuse them with

"Plummer's disease" which is defined by only clinical sign originally. In this series we propose the term "hot nodule" is defined only on the scintigram findings. According to this definition many "hot nodules" are classified according to the ratio of iodine deposit in the tumor and in the surrounding thyroid tissue.[3])

Patient numbers in each type of thyroid scintigrams are not established in this report because of the limited time. Such numbers and more detailed classifications are reported in anothe rchance.[4])

3) PREPARATION FOR THE EXAMINATION

It is natural that the patient must be selected for this examination because of the radioisotope use in human. We have the opinion to palpate and ask the histories on the patients before the radioisotope examinations. Fortunately, emergency needs for radioisotope examination of thyroid diseases is very rare, and iodine limited diets are proposed for the patient at least one week before the examinations. Other physical and biochemical examinations concerning the diseases are recommended in these waiting days.

Some examinations utilizing the administration of radioactive iodine just as uptake, PB^{131}I, conversion ratio, are recommended to be done smiultaneously without another administration of radioisotopes. X-ray examinations with radioopaque materials containing iodine must be done after the thyroid radioisotope procedures. X-ray films of the neck region specially lateral view are helpful in the diagnosis of nodular goiters.

4) APPARATUSES AND RADIOISOTOPES

At present, the informaions on thyroid scintigrams depend on the characteristics of the scanner. It is more desiable to have scintigrams ont depending to the type of scanner. It will be generalized in near future because no technical interfares are existing. According to our experiences, the scintigrams by scintillation camera with pinhole collimeter show more valuable informations on thyroid scintigram.

As radioisotopes, ^{99m}Tc, ^{125}I and ^{132}I are reported with their superior merits compared with that of ^{131}I. ^{99m}Tc and ^{125}I have low γ energies which are superior on the point of collimation. ^{132}I has an advantages of very short half life which can be enable to detect serial examinations. But ^{99m}Tc has some disadvantages, they are too short half life, more radiation exposure to the hospital employees, more trouble procedures and high prices, ^{925}I also a too short half life and economical points. To compare these advantages and disadvantages, ^{131}I is now most adapted and useful radioisotope for thyroid scintigram.

5) ANALYSIS BY THE USE OF COMPUTERS

The informations from radioisotope examinations are more simple compared with other examinations just as x-ray examinations. But morphological analysis is not yet adapted in the case of computer analysis in our experiences. The weight differences among the informations are difficult to determine. We have not yet solve the problem that these analysis is not suitable at present of weight arrangement in informations and state is our opinion. Of course further trials must be done in these field and it is hoped to have a good result in defferencial diagnosis automatically.

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4) ISHIKAWA, D. et al.; Nippon Acta Radiol., in press.