Fundamental and Clinical Studies for the Measurement of Bone Mineral Content

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The bone mineral content (BMC) in subjects with various demineralizing diseases was measured by a photon absorption method. We used ^{241}Am as a radiation source and measured the BMC of the radius in water.

Fundamental Studies

1: The accuracy utilizing bone scanner was experimentally 4% level.
2: A highly significant correlation ($\gamma=0.99$) was found between the ash weight of standard hydroxyappatite and the BMC.
3: The measurement of the BMC was shown to have a significant correlation between two successive examination in 15 normal controls ($\lambda=0.93$).

Clinical Studies

1: The BMC of normal males was higher than that of females after the age of twenty. There is a marked decrease in the bone mass in females after the age of fourty-five.
2: In various conditions such as hyperthyroidism, hyperparathyroidism, chronic renal failure, rheumatoid arthritis, muscular dystrophy and epilepsy with a treatment of anticonvulsants, the BMC showed the following interesting results.

1: In hyperthyroid patients there was increased bone metabolism with the lower BMC than normal controls, and the BMC returned to normal faster than ordinally (T_4 value) after treatment. In hyperparathyroidism, the BMC was found to be increased after operation compared with the pre-operative value.
II: There was the lower BMC in patients with chronic renal failure under a long-term dialysis than in patients without dialysis.
III: In patients with rheumatoid arthritis of muscular dystrophy, the lower BMC was also found than that in normal controls. In the muscular dystrophy, calcitonin or 1α OH D_3 was used for the protection of disuse osteoporosis, and the BMC tended to increase in the cource of treatment.

The measurement of BMC with photon absorption is a useful method for the investigation of various metabolic diseases and for the following of the treatment in various demineralizing diseases. Also this technique is simple and easy to perform with the use of a bone mineral analyzer.

The Quantitative Aanlysis of Bone Scintigrame (Around the Spine)

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Quantitative analysis of bone scintigram is used for the evalation of the grade and differential diagnosis of bone diseases.

In bone congreses of the Japan Orthopaedic Surgery Association (1975) and of the Neuclear Medicine in Kinki Destrick (1975, 1976), our preliminary reports for quantitative analysis were informed about sacroiliac joint and small parts of spine, and it has been proved that the quantitative analysis may be useful for these purposes.

Now, we report the result of quantitative analysis about the spine.

The method is as follows.

1) Radioactive technetium-pyrophosphate is injected intraveneously in the way of 50 μCi/kg of RI or 86 μg/kg of pyrophosphate.
2) Dynamic scintigram is done on the sacroiliac joint for one hour using computer.

3) Stastic scintigram follows after this on every examination area for five minutes.
4) For the evaluation of scintilation counts, one count-unit which takes maximum counts around the examined area is adopted as the count-unit of this region.
5) The count ratio, counts of every region of spine to that of sacrum, is used as another factor.

The result is as follows.

a) It is possible to set the normal range in the scintilation counts and the ratios.
b) Tumors or metastatic lesion take extremely high counts and ratios.
c) Metabolic bone diseases show high scintilation count, but ratios of this group are lower than that of normal.
d) Moderately high counts are shown in the inflammatory group of spine, but ratios are extremely high like in tumors.
e) In the cases of tumor in spine, the spine without lesion take lower counts and ratios than that of normal.

These result is shown in the beginning of disease though X-rayphotograph does not indicate abnormality.

Now, we can differentiate the diagnosis of bone diseases in spinal region, and it will be possible to evaluate the grade of diseases in the future.

Delayed Bone Scan of the Pelvis

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Work-up of patients of neoplastic disease with possible metastasis has been changed from a radiographic skeletal survey to radionuclide scanning of the bone, liver and brain, with remarkably better results. Although many reports indicate that radionuclide bone scanning is a more sensitive method than the radiographic skeletal survey for the detection of skeletal metastases. Mall et al. summarized several disadvantages of radionuclide bone scanning, including false negatives in the pelvic lesions obscured by a high level of radioactivity in the bladder. As far as the pelvis is concerned, Galasko and Doyle concluded that a radiograph of the pelvis is more informative than a radionuclide bone scanning.

Three to five hours after intravenous injection of 15–20 mCi of ^{99m}Tc-pyrophosphate or ^{99m}Tc-EHDP, bone scan is taken first with a whole body scanner. On viewing this scan, pictures of the areas of interest or questionable metastasis are taken from multiple angles with Scinticamera. In addition to such routine scanning, scan of the pelvis 24 hours later is obtained. In this delayed scan it takes 5–10 minutes to get an image because radioactivity of the pelvic bone has decreased. But a satisfactory picture can be obtained by increasing the brightness on C R T.

With this method we were able to detect suspected or unsuspected metastatic lesions which were masked by high radioactivity of the bladder in previous routine scan. Furthermore in many cases our delayed scan showed no abnormal uptake of the pelvic bone and it proved that abnormal radioactivities observed in previous routine scan were due to radioactivity in a dislocated or unusually shaped bladder or contamination on patients' skin or underwear.