

## Scintigram and Scintiphoto of the Active Bone Marrow in Various Hematological Diseases

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The bone marrow can be visualized with radioactive colloid which is phagocytosed by the reticuloendothelial cells.  $^{99m}\text{Tc}$  sulfur colloid was prepared according to the method of Nelp et al. The yield of the colloid was about 90%.  $^{99m}\text{Tc}$  sulfur colloid was given intravenously, and bone marrow scintigram was obtained with  $\gamma$ -ray scintillation camera. When the colloid was injected intravenously into rats, 70% or more was recovered from the liver and 15~20% from the bone marrow.

Plasma clearance of  $^{99m}\text{Tc}$  sulfur colloid in man was composed of three exponential factors. In the first phase, it was rapidly cleared from the circulation ( $T_{1/2}=1-3$  minutes). Only 10% of the injected radioactivity had remained in the blood 10 minutes after administration. Urinary excretion within the first 24 hours after injection was less than 4% of the injected radioactivity.

Resolution of scintillation camera tested with line and spot phantom was satisfactory. The details of scintiphoto in pelvic bone marrow by camera were sometimes more valuable than scintiscanner's.

After the intravenous injection of about 5 mCi of  $^{99m}\text{Tc}$  colloid, the scanning procedure was commenced after a half hour, in the order of the pelvis, limbs, midtrunk region and

skull. The active bone marrow was normally found in the pelvis, proximal ends of femurs and humeri, sternum and skull. A high uptake of colloid in the liver and spleen prevented visualizing marrow in the upper lumbar and lower thoracic spine. In the skull, there was visualization of the salivary gland which made difficult to distinguish the active marrow.

When radioactivity of the normal pelvic bone marrow was distributed with 1600 channel analyzer on  $40\times 40$  matrix, higher activity was found in lower lumbar spine, sacrum and femoral heads.

The scintigrams of patient with chronic myeloid leukemia had shown some expanded marrow extending into distal femur, proximal and distal tibia and bones of foot. In aplastic anemia, marrow uptake decreased in general. Particularly, lack of activity in the sacrum was found corresponding to low activity of surface counting on sacrum by the ferrokinetics.

It is concluded that bone marrow scanning is a useful technique to visualize the active bone marrow which offers the valuable information for understanding the patient's hematopoietic status.

## Studies of Whole Body Counting after Administration of Radioisotope on Various Hematological Disorders. Report. II.

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In our previous study, the basic problems for the application of our whole body counter on hematological investigation was already re-

ported. In this paper, some of the significant results on the measurement of iron absorption ratio, the quantitation of iron loss from body

iron and also the calculation of the amount of bleeding in various diseases using our whole body counter, were reported.

Plastic scintillation counter and two detector method of NaI scintillation counter were used for the measurement of iron absorption. NaI arc method was used for long term follow-up of iron loss after intravenous administration of  $^{59}\text{Fe}$ .

Absorption of hemoglobin iron was determined on eight cases of hematologically normal patients.  $^{59}\text{Fe}$  labelled hemoglobin iron was obtained from the blood of the patients who were examined for ferrokinetic studies. The  $^{59}\text{Fe}$  labelled red cell was washed several times by physiological saline solution, then, the red cell was hemolysed by distilled water. One gram of hemoglobin was administered orally to each subject.

Follow-up study of whole body counting for the absorption of hemoglobin iron revealed rapid fecal excretion of  $^{59}\text{Fe}$  within a few days and the counting value reached to the plateau level after 7–10 days. Mean absorption ratio of hemoglobin iron in normal subject was  $12.1 \pm 6.9\%$ .

Whole body counting method was compared to other several methods for measurement of iron absorption, which were 1) Saylor-Finch's method using  $^{59}\text{Fe}$  and  $^{55}\text{Fe}$ , 2) fecal collection method using  $^{51}\text{Cr}$  as non-absorbable marker, 3) rough calculation method by red cell volume from body weight and the  $^{59}\text{Fe}$  count in peripheral blood.

In general, measured values did not show great difference in each other. But, in most cases, fecal collection method using  $^{51}\text{Cr}$  as

non-absorbable marker proved the highest value, second, whole body counting method, third, Saylor-Finch's method and the lowest value by the rough calculation method. There were significant correlations in all methods.

Follow-up study over 100 days after administration of  $10\mu\text{C}$   $^{59}\text{Fe}$  was performed on a hematologically normal patient with no evidence of significant gastrointestinal bleeding, two patients of iron deficiency anemia and a patient of Rendu-Osler disease associated with remarkable continuous bleeding from gastrointestinal tract.

Whole body counting of  $^{59}\text{Fe}$  activity which was corrected for physical decay in a hematologically normal patient was decreasing exponentially and by the rate of decrease, biological half life of iron was calculated as 1226 days and iron loss from the body per day was 0.06%. On two patients of iron deficiency anemia, the time was remarkably reduced and the amount of iron excretion increased. On the patient of Rendu-Osler disease with marked gastrointestinal bleeding, follow-up study of the activity of  $^{59}\text{Fe}$  in whole body and peripheral blood showed marked continuous bleeding from digestive tract with large amount of iron loss and good correspondence was recognized in  $^{59}\text{Fe}$  activity between whole body and peripheral blood.

In conclusion, we appreciate the whole body counter as one of the useful apparatus for dynamic study of clinical hematology, i.e. study of iron absorption, body iron turnover, the amount of bleeding as well as iron loss and so on.

## The Determination of Manganese, Copper and Zinc in the Blood Cells by Neutron Activation Analysis

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The biological importance of trace elements has been well recognized, but their exact roles

are obscure.

The determination of Mn, Cu and Zinc in