C. Measurement II

Position Scintigraphy by Coincidence Counting Method Using Anger Camera

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Positron emitters produce high energy gamma rays (511 keV), so commercially available collimators attached to Anger camera cannot avoid septal penetration effect. To overcome this effect and define the direction of gamma ray incidence, coincidence detector was set opposite to Anger camera (TOSHIBA GCA-101) with the distance of 30 centimeters. One method was; coincidence 3 inches NaI detector equipped in Scanner (NUCLEAR-CHICAGO PHO/DOT II) was covered by 85 parallel holes collimator and was scanned over the Anger camera sensitive area. The other method was; 5 inches plane NaI detector shielded by 20 millimeters lead was settled under Anger camera, and thus sensitive area was defined by 5 inches NaI. Coincidence signals served as unblanking signal to Anger camera. Coincidence resolving time was set as 0.2 microseconds. To obtain real coincidence, signals from coincidence detector was delayed 3.0 microseconds against Anger camera signal.

These method reduced counting efficiency to 1/2,000 compared with that of Anger camera. From electrical restriction (pile up, saturation, random coincidence), activity in coincidence sensitive area was limited within a few hundred microcuries.

Resolution in phantom images was 10 millimaters. Rb-81 and F-18 solutions were injected into rats and clear distribution images of these nuclides were obtained.

This method can get clear image of positron emitter with simple electrical equipments and could be applied in clinical studies. When multicrystal (NaI) system is used for coincidence detector, electrical restriction will disappear and more activity and less measuring time will be promissing.

Basic Study of ^{14}C- and ^{13}C-Breath Test Using Glycine-Cholate

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We have reported that measurement of $^{14}CO_2$ in the breath after oral administration of glycine-1-^{14}C-cholate can detect bacterial deconjugation of bile salts by their early significant peak in contrast to normal flat curves. The use of stable isotope ^{13}C in place of ^{14}C-compounds can extend the applicability of the technique to children, young adults, pregnant women and mass survey of healthy subjects. With the pourpose to validate the use of ^{13}C-compounds for the clinical breath test, animal experiments were carried out. Carbon dioxide in the exhaled breath was collected by the nutralization of alkaline solution in the vial connected to the outlet of respirator being applied to anesthetized rats. Isotope ratio of $^{13}CO_2/^{12}CO_2$ was measured in a mass spectrometer, ^{14}C was measured in a liquid scintillation counter. Curves of $^{14}CO_2$ and $^{13}CO_2$ after simultaneous oral or i.v. administration of glycine-1-^{14}C and glycine-1-^{13}C in rats were identical showing early peak at 30–35 min. and 10–15 min. ^{14}C and ^{13}C-glycine-cholate were administrated by mouth in rats preoperated to form jejunocolostomy. $^{13}CO_2$ curves showed early peak simillar to those shown in patients with bacterial over growth or ileal resection. The curves showed striking contrast to the

flat curve obtained in control rats. $^{13}CO_2$ curves showed simillar pattern as $^{14}CO_2$ curves in rats with and without operation. When trace dose of ^{13}C-glycine alone was administrated, $^{14}CO_2$ curves showed earlier and lower peaks than those obtained after loading dose of glycine. Our results suggest that ^{13}C-glycine-cholate can be used as clinical breath test for the detection of bacterial deconjugation of bile salts. The animal model should prove useful for the preliminary comparative studies of various ^{14}C- and ^{13}C-breath tests prior to their clinical application.

Separate Counting of Gamma Rays of ^{51}Cr with well Scintillation Counter and Beta Rays of ^{32}P with Geiger Counter

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Mixed radionuclide as ^{59}Fe in blood sample in determining mean red cell life span with DF^{32}P can be eliminated by chemical extraction of heme as we reported previously. However, the separation of ^{51}Cr counts from ^{32}P is not so easy, since the channels ratio method or chemical extraction method are not available. Therefore, we prepared the standard and blood sample for well and Geiger counting respectively.

The separate counts can be obtained by calculation using the following formula.

(1) Standard of ^{32}P for Geiger counting ——Pg
" ^{51}Cr " ——Cg

(2) Standard of ^{32}P for well counting ——Pw
" ^{51}Cr " ——Cw

(3) The constant ratios of counting efficiency in Geiger and Well for ^{32}P and ^{51}Cr are P and C

$$P=Pg/Pw \qquad C=Cg/Cw$$

(4) Sample S containing ^{32}P and ^{51}Cr is counted in Geiger and well counter

$$Sg=Pg+Cg$$
$$Sw=Pw+Cw$$

(5) Then the formula gives respective counts needed.

$$Pg=(Sg-C.Sw)/(P-C)$$
$$Cw=(Sg-P.Sw)/(C-P)$$

This separate counting using two kinds of counters may be called "Cross Counting Method."

A Proposal for the Standardization of Iron Absorption Test by Whole Body Counting

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Iron absroption study is an important method for the diagnosis and therapy of iron deficiency anemia and hemochromatosis. The standardization of iron absorption procedure is needed for the international comparison of iron absorption data.

We propose the method to be standardized as follows.

I. Oral radioiron dose

Radioiron with 4 mg of carrier in the form of ferrous sulfate is administered to the patient kept fasting overnight. Eating and drinking are not allowed for 2 more hours after oral dose.

II. Counting

Whole body counting is performed 3 or more times in 14 days.

III. Geometry correction

The ratio of air to body count 10 to 14 days after intravenous radioiron injection and mean body radius showed correlation. This correlation is available when a ring-type whole body counter is used. For the patient to whom ferrokinetics study is scheduled in series, own geometry correction coefficient is available. For the patient to whom