Construction and Performance of the Whole Body Counter at Nagasaki University

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In April 1968, a low-level whole body counter was built at Nagasaki University. A major effort has been made toward reducing the background to a very low level and producing a reasonably uniform response.

Data are as follows:

Monitoring room
- Inside dimension: L-260, W-140, H-210 (cm)
- Shielding: Fe-200, Pb-3, Plastics-3 (mm)

Detectors
- Detector number 2
- NaI(Tl) $8''\phi\times4''$ A light pipe of inactive NaI ($8'\phi\times3''$) seperates the active crystal from the phototube.

Basic ancillary equipment
- Analyzer: 400 channel pulse height analyzer
- Read out units: typewriter, tape, X-Y plotter, 2 pen recorder

Methods
- Stretcher, standard chair, 1 m arc, linear scanning

Background index

$$=\frac{\text{Integral background (0.1}\sim\text{2.0 MeV)}}{\text{Total crystal volume}}=0.27$$

Calibration data

Technique	stretcher method	
Radionuclide	^{40}K	^{137}Cs
Energy band (MeV)	1.35~1.57	0.57~0.75
Net background (cpm)	62.7	194.3
Net pulse rate	0.94 cpm/gk	1.38×10^4 cpm/μCi
Spectrometric resolution (in vivo)	6.2%	9.5%

Other some features
1. Double scanning
2. Scanning speed control
   - program method
   - live time scanning
3. Geometrical mean value recording

A New Design of 5″ Whole Body Scanner

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Comparing with the scintillation camera, the scintiscanner needs a long time to produce a scintigram of certain definite area, but, it has the advantage that is the capability to enlarge its scanning area to necesitive size, if, it is given a suitable mechanical construction.

A new disigned 5″ twin-head whole body scanner is able to perform whole body scanning efficiently with a high delecting sensitibity and extremely high scanning speed.

It has peculiar mechanical construction to conform to high speed wide scanning, that is the two detectors are supported oppositely by upper and lower arms of the carridge. The carridge make possible vary its arm height for adjusting upper detector height. A treatment

table lies between these two detectors. The transverse motion of detectors along each arms of carridge is driven by variable speed motor controled by SCR circuit, and the longitudinal motion of carridge itself for spacing, is driven by another motor controled by pulse indexing circuit (Scanning area 50cm × 180mm). Combining these two motions, the area scan and the linear scan are available by one device.

The other hand, the recording device driven by servomechanism synchronized with motion of scanning device produces the scintigrams from full scale to 1/5 scale reduction.

Union type detectors consist of 5″ dia. NaI and 5″ dia. photo-multiplier, and complete shielding of above 5.6cm lead equivalent thickness including heavy-alloy, brings to higher sensitivity and energy resolution and low background than 5″ dia. scinti-scanner.

As a result of comparison with the sensitivity of the collimator (19cm focus-37 holes) for 3″ diameter NaI, the sensitivity become 6.6 times on our 3″ focused 31 holes collimator, 1.2 times on 163 holes collimator, 3.8 times on 5″ focuse 85 holes collimator and 0.9 times on 265 holes collimator.

High sensitivity and high scanning speed (up to max. 5m/min) became consequently possible to shorten the scanning time.

For example, a whole body scintigram of the patient accepted ^{131}I, 20 mCi, was produced about 25 minutes. Whole body scannings are expected to give many effective and useful informations for diagnosis about bone and marrow.

For producing confront two plane scannings by one time driving, twin-head scanner is exremely convenient and useful for saving scanning times, because the distribution of RI in organs varies by a lapse of time.

Besides, the scintigrams treated addition or substraction of two informations got by upper and lower detectors, are possible to be produced, and positron scanning using coincidence circuit, including this device, is available too.

Use of Whole-Body Counter to Study Body Retension of Radiocopper in Wilson's Disease

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It has become evident that Wilson's disease involves an abnormality in copper metabolism, as a result of a genetic defect. It is important to study siblings of patients who have Wilson's disease to determine whether they are normal, are carriers of the disease, or actually have a disease. In the present study, the retention of radiocopper was measured with the whole-body counter and the reliability of this method as a screening test for Wilson's disease was investigated.

Six patients with Wilson's disease, seven relatives, and nine normal subjects received 5μCi of ^{64}Cu intravenously. Immediately after injection, ^{64}Cu was measured with the whole-body counter at 5-minute intervals for 1 hour. This average value was taken as 100% of the dose. Subsequent counting of the ^{64}Cu retained by the body was done in the whole-body counter at 3, 6, 24, 36, 48, and 72 hours after injection. One patient with Wilson's disease and seven relatives were studied by combined overlapping of excreta analyses and whole-body counting, when the radioactivity present in the subjects had decayed to around 10μCi, each subject was counted in the whole-body counter daily for another 3 or 4 days.

This permitted a 3-day overlapping of the disappearance curves after a single 750μCi injection, providing long curves.

The Mayo Clinic whole-body counter was used in this study. It consists of eight plastic