Correction of Radioisotope Uptake for Organ Depth using Double Tracer System

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One of the problems encountered in measuring thyroid ^{131}I uptake and kidney ^{197}Hg and ^{203}Hg uptake is the uncertainty of the organ depth in tisue. This can lead to error of uptake ratio due to the unknown attenuation by overlying tissue.

The present investigation is a method employing a mixture of ^{125}I and ^{131}I for measuring the thickness of overlying tissue and obtaining correction factor of the uptake.

Because of the wide energy separation between ^{125}I and ^{131}I, the relative attenuation of their radiation may give a measure of organ depth. To establish this relationship, lucite neck and body phantoms with mock-thyroid and mock-kidney containing equal counts of ^{125}I and ^{131}I were used. Layers of Luicite plate simulated overlying tissue were added.

The detector housed in a lead collimator was 2×2 in. NaI (Tl) crystal and the pulses were analysed by a 100 channel pulse height analyzer. The tissue surface—crystal surface distance chosen was 10 in. for thyroid and 10 cm. for kidney.

The results obtained showed the ratio of the 27 keV $\times$ radiation to the 364 keV gamma radiation could be used as a function of the organ depth. Also from the ratio could be determined the factor needed to correct the observed ^{125}I and ^{131}I count rate to 1 cm. tissue overlying the thyroid and the observed ^{125}I, ^{131}I, ^{197}Hg and ^{203}Hg count rate to 7 cm. overlying the kidney.

Preliminary results on two adults subjects who ingested a mixture of ^{125}I and ^{131}I showed the depth of "apparent" center of the thyroid was 3.7 and 3.8 cm. The thyroid uptake corrected for these two subjects was 47.2% and 17.3%.

The 5.4 cm. depth of "apparent" center of the kidney was found in one subject who was injected intravenously a mixture of ^{125}I and ^{131}I labeled ortho-iodohippurate.

To measure kidney depth, similar studies have been done using ^{197}Hg and ^{203}Hg double tracer system. Less well data, however, could be derived because of the poor energy separation and the influence of compton scattering.

II. Scanning

A Method for the Test of Honey Cone Collimators

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Radioisotope γ-ray source was placed at the site of crystal on the collimator to be tested. The source was shielded with Pb and set on a dark box containing shets of X-ray films between metacrylate plates. After an appropriate exposure time, films were developed. The results, with 5.5 mc ^{131}I for 3 days, showed the depth and width

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of focus, effects of separation wall, relation between a hole to a hole, and the leakage of gamma rays outside the collimation.

A hexagonal honey cone having 5 cm showed 6 beams of radiation corresponding to the largest gamma ray bundle in the direction of the 6 corners of the hexagonal space consisting of holes.

Angular dependence of the honey cone collimator as pointed out by Honda was found to be a phenomenon induced by the leakage of gamma rays through the separation walls of honey cone collimator.

Such leakage was not marked with hexagonal 10 cm focusing collimator, and the 5 cm collimator filled out it's holes with casted Pb bars.

This method is free from the mechanical condition of a scanner and can be applied for the examination of various types of collimators.

The hexagonal 5 cm honey cone collimator tested was not good for scanning. The round type collimator would have no such unhomogeneous angular leakage of gamma rays.

Stereoscanning for the Measurement of the Depth of Image

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It was not always easy to measure the depth of Scan-image so far. The speaker found a method of measuring the depth of image by stereoscanning.

A lead disc with a pinhole at the center was placed between the pinhole collimator and a subject. The pinhole collimator was made to suite the scanning of image through the pinhole disc.

After scanning from the first angle, the pinholed disc was shifted and then scanned again from the second angle. These two scintigrams showed the shift of image in proportion to the shift of the pinholed disc.

The following formula was used to calculate the depth (d) of an image (A) below the surface of the subject's body.

$$d = \frac{ph}{s - p} - g$$

where h = scan level of pinhole
g = pinhole to body surface
p = shift of pinhole
s = shift of image A.

Phantom experiments proved the accuracy of the above method. Therefore, the method was applied for the measurement of the depth of a metastatic spot of thyroid cancer. The spot was 6 cm below the body surface, probably at the anterior margin of vertebra.

If the scintillation camera is used, the stereoscanning will be more effective and much widely applicable.

Multi-Nuclide Scanning with MUHC

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Multi-nuclide scintiscanning is one of the important applications of MUHC.

With Alderson's organ scanning phantom which holds a liver, a pair of kidneys, a pancreas and a spleen, simultaneous four nuclides scintiscanning was performed successfully.

Since the depth of positions of the organs

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