A REGION-OF-INTEREST SYSTEM TO REDUCE TISSUE BACKGROUND IN RENOGRAMS

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Use of a scintillation camera for performing radioisotopic renal function studies is growing. The additional information of radioisotope distribution provided by the scintigrams compared with probe systems aids interpretation (*1*). However, the hemi-crystal of the scintillation camera used to obtain the counting-rate curve of the kidney "sees" a good deal of surrounding tissue. The distorting effect of tissue background on the curves has previously been demonstrated (*2*). No information concerning the fraction of the counting rate arising from the kidney versus that from the surrounding tissues is available for a camera.

To assess the magnitude of the problem and provide significant reduction of tissue background, a "region-of-interest" system* was obtained that directly interfaces with the Pho/Gamma III (Nuclear-Chicago) camera. This system allows selection of any two separate variable-sized areas of the field of view of the crystal for counting. It also incorporates a dual digital ratemeter with digital and analog outputs for graphic plotting. A system for obtaining the ratio of the counting rate in one area over the sum of the two areas is built in also to yield data comparable to that previously described as diagnostic in renal vascular disease with a probe system (*3,4*). The entire system is composed of a variable persistance oscilloscope, the region-of-interest system described above and a graphic recorder. The system is compact and sits atop the scintillation camera.

Fifty microcuries of ^{197}Hg-chlormerodrin were given 45–60 min before the study, and the patients were orally hydrated during the interval. The regions of interest were selected to provide the smallest rectangles that enclosed the kidneys. The spectrometer was then set for the ^{131}I peak and an ^{131}I-Hippuran study done as described previously (*1,3,4*).

Two types of studies were performed. During routine radioisotopic renal function studies, patients had counts recorded at intervals from the two scalers of the scintillation camera collecting counts from each hemi-crystal. The counts from the selected kidney areas representing a portion of each hemi-crystal were manually integrated from the graph to the times selected for recording the hemi-crystal integrated counts. The ratio of the two numbers were obtained at these times ranging from 200 to 1,150 sec. This was done in six patients with bilaterally normal studies. The ratio of the counting rate in the kidney area to that of the hemi-crystal fell slightly as the procedure progressed in each patient, indicating a rising relative tissue background contribution. Inasmuch as few patients are being evaluated and no difference between right and left kidneys was evident, all the data were pooled despite the slight systematic variation with time to provide an index of the magnitude of the problem rather than exact percentages. The mean of the ratios was 0.53 ($\pm$0.15 s.d.). The rather high variance of the data reflects differences among patients rather than variation of the percentage background over time.

Studies in four uninephrectomized patients were performed in which the counting rate from the kidney area was compared with an identical region viewing the contralateral flank without a kidney. In the first seconds after appearance the tissue background accounts for 70–80% of the total activity, falling to 20–30% at peak and rising to 25–45% by 15 min after peak.

Although only a small number of patients have had critical evaluation, it seems clear that use of the hemi-crystal of a scintillation camera to record data from the kidney results in at least 60% of the total counts arising from extra-renal tissue, assuming that at least 20% of the counts within our region of interest system are extra-renal in origin. Use of the region of interest system greatly reduced the fraction of tissue background in the renal area curves.

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Parenthetically, the system has also proved valuable for obtaining counts from each cerebral hemisphere alone while obtaining scintigrams from the entire head and neck in cerebral flow examinations and for obtaining counting-rate curves from each lung during ^{133}Xe washout.

REFERENCES

1. FARMELANT, M. H., GENNA, S. AND BURROWS, B. A.: Renal function studies with a scintillation camera. In *Medical Radioisotope Scintigraphy*, vol. 2, IAEA, Vienna, 1968, p. 229.

2. FARMELANT, M. H., SACHS, C. E. AND BURROWS, B. A.: The influence tissue background radioactivity on the apparent renal accumulation of radioactive compounds. *J. Nucl. Med.* **11**:112, 1970.

3. BLOCK, J. B., HINE, G. J. AND BURROWS, B. A.: I^{131}-Diodrast studies in unilateral renal disease. *Circulation* **23**: 913, 1960.

4. FARMELANT, M. H. *et al:* Radioisotopic renal function studies and surgical findings in 102 hypertensive patients. *Am. J. Surg.* **107**:50, 1964.

SECTION ON SPECIAL TOPICS: SESSION ON NUCLEAR MEDICINE CLINICAL APPLICATIONS OF NUCLEAR MEDICINE FOR THE PRACTICING PHYSICIAN

AMA ANNUAL CONVENTION
Chicago, June 1970
Monday, June 22, 2–5 P.M.
International Amphitheatre
Room J

1. William S. Maxfield, M.D., New Orleans, La.
   "The Camera Renogram Compared with Intravenous Pyelography."
2. Salvador Treves, M.D., New Haven, Conn.
   "Use of High Photon Yield Radionuclides in Kidney and Bladder Studies."
3. Milo M. Webber, M.D., Los Angeles, Calif.
   "Thrombophlebitis—Demonstration by Radionuclide Scanning."
4. James J. Conway, M.D., Chicago, Ill.
   "Radionuclide Studies of Pediatric Chest Diseases."
5. E. James Potchen, M.D., St. Louis, Mo.
   "The Radioisotopic Assessment of Regional Pulmonary Function."
6. Malcolm R. Powell, M.D., San Francisco, Calif.
   "Clinical Correlation of Liver Gamma Photography Findings."
7. Ernest Greenberg, M.D., New York, N.Y.
   "Kinetics of Bone Seeking Radionuclides Used for Bone Scanning."
8. Richard E. Peterson, M.D., Iowa City, Ia.
   "Screening for Metastatic Bone Lesions with Whole Body Scanning."
9. James J. Smith, M.D., New York, N.Y.
   "Treatment of Hyperthyroidism with Low Dose ^{131}I."