Multiplane Tomographic Imaging of the Pancreas

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Using Se-75-selenomethionine, we obtained pancreatic scans on 20 patients with both a multiplane tomographic scanner and a scintillation camera. Comparison of the two methods revealed equivalent-to-improved resolution with the multiplane device. Other advantages of using the multiplane tomographic scanner— such as patient management, depth perception, superior resolution distal to the geometric focal plane, and visualization of regions obscured by the liver shadow or other structures—suggest that the multiplane tomographic scanner is the better instrument for pancreatic imaging.

Se-75-selenomethionine is an amino acid analogue that is rapidly accumulated by the pancreas, where it is incorporated into pancreatic digestive enzymes. Years of clinical experience with Se-75-selenomethionine imaging of the pancreas indicate that this method has limited but definite application as a noninvasive screening test for the presence of pancreatic abnormality *(1)*. However, the radionuclide pancreatic study is frequently of poor diagnostic quality because of such factors as overlapping of liver shadow, the varying degrees of Se-75 concentration in viscera surrounding the pancreas, and duodenal radioactivity *(2)*. These factors may be observed singularly or collectively.

The multiplane tomographic scanner combines the advantages of a single-crystal scintillation camera *and* the focused-collimator scanner. The multiplane tomographic scanner also provides the high spatial resolution at all depths that is not furnished by conventional cameras and scanners. Use of multiplane tomography may improve the clarity of pancreatic scans *(3)*.

Conventional scintigraphy of the pancreas with the Anger camera is time consuming and requires serial scintigraphy at selected time intervals. For example, considerable time is involved for techniques designed to insure proper positioning to visualize the organ. Additionally, scheduling of these procedures—in contention with more frequently requested and high diagnostic quality studies—can become quite difficult. Use of the multiplane scanner can relieve the scheduling problems of a busy nuclear medicine service quite effectively.

Instrumentation

Instrumentation consisted of the multiplane tomographic scanner, micro-dot imager, and analyzer control console (Searle Pho/Con multiplane imager system). The no. 820-822203, 380 keV, 10-mm collimator was utilized. Analyzers were calibrated and controls set according to detailed operating instructions in the instrument's operation manual. We emphasize that a thorough understanding of the multiplane tomographic scanner, its principles of operation and advantages, is necessary for proper utilization *(4)*.

Materials and Methods

Two-hundred fifty μCi of Se-75-selenomethionine is administered in an antecubital vein of the arm. For comparison with tomograms, conventional views of the pancreas were obtained with a scintillation camera.

Immediately after the 30-min scintigram, the patient is placed supine on the scanning table of the Pho-Con multiplane imager. Scanner assembly controls were set as follows:

Maximum scan area—35 × 35 cm;
Scan speed—90 cm/min; and
Index width—0.3 cm.

Determination of tomographic separation depends on organ thickness, format size (maximum scan area), and type of collimator used. Tomoplanes in our study were set as outlined in Table 1, which is derived from the method of Gors *(5)*.

Intensity of film exposure is selected relative to the image density value indicated on the image density range meter, which is proportional to three scanning parameters: selected scan speed; selected index width; and counting rate observed by the detector. These intensities were derived empirically. The average image density was 400 for the 250-μCi dose of Se-75-selenomethionine.

TABLE 1. Tomographic Technique Chart for Collimator No. 820 - 822203 - 380 keV - 10 mm in 35 × 35 Format

Organ Thickness (cm)	Tomographic Separation	Upper Detector Distance (cm)	Lower Detector Distance (cm)
14	2	19.2	5.2
16	3	19.8	3.8
18	3	21.8	3.8
20	4	22.4	2.4
22	4	24.4	2.4
24	4	26.4	2.4
26	5	27.1	1.1
28	5	29.1	1.1
30	6	31.1	1.1
32	6	32.0	0.5
34	6	34.0	0.5
36	8	37.4	1.4
38	9	38.6	0.6
40	9	40.6	0.6

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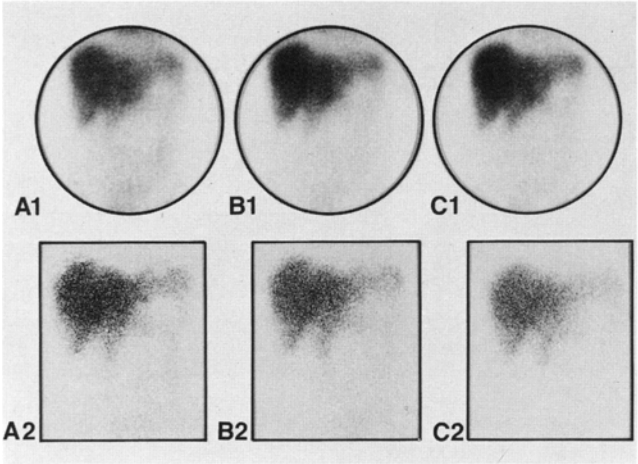

FIG. 1. Normal pancreatic scans: scintigrams (A1, B1, C1) demonstrate normal study at 10, 20, and 30 min respectively. Comparative tomograms (A2, B2, C2) are displayed at tomoplane 4, 5, 6 respectively.

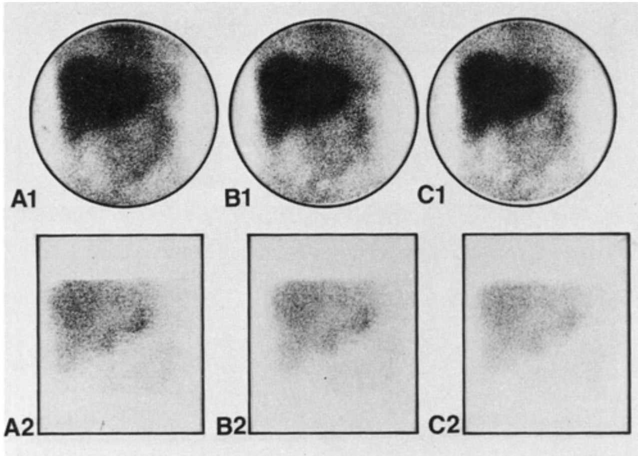

FIG. 2. Overlapping of pancreas by liver shadow is observed in scintigrams (A1, B1, C1), as well as in tomographic images (A2, B2, C2).

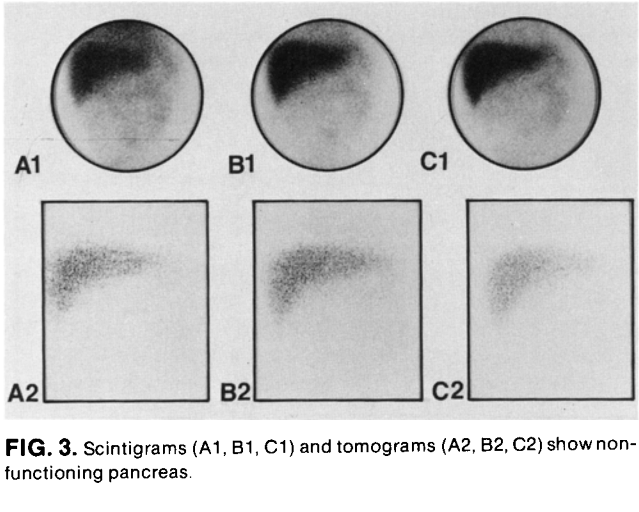

FIG. 3. Scintigrams (A1, B1, C1) and tomograms (A2, B2, C2) show nonfunctioning pancreas.

Results and Discussion

Twenty patients were referred to our department for study of such conditions as weight loss, elevated serum amylase, pancreatitis, hypercalcemia and elevated CEA, pseudocyst, and abdominal mass.

Seventy percent of the patients had normal pancreatic scans. Pancreatic scans were abnormal in six patients (30%). In 50% of the cases, the tomographic study was judged to be superior, equivalent in 35%, and poor in 15% when compared to the camera studies. Technical difficulties with the technique were encountered in the group that had tomographic scans of poor quality. The difficulties were attributed to improper selection of film intensity and image format size. These were determined to be technical errors by the operator and were most likely caused by lack of experience with our new imaging techniques.

Normal pancreatic scans obtained with both instruments (Fig. 1) demonstrate good localization throughout the gland with no focal abnormalities on either the scintigrams or tomograms. The pancreatic image on the tomograms appears to be more delineated or separated from the liver image, perhaps because of multiplane focusing.

Figure 2 demonstrates studies of the pancreas obscured by an enlarged left lobe of the liver. Superior images are again demonstrated in the tomographic scan—revealing decreased activity around the neck of the pancreas, which is not as apparent in the scintigram. An ultrasound examination performed in an attempt to clarify this finding was unremarkable.

The pancreatic scans (Fig. 3) failed to visualize any functioning pancreas, which correlated with the clinical diagnosis of multiple attacks of acute pancreatitis.

Our studies with the Pho/Con multiplane tomographic scanner indicate that this instrument is very useful in pancreatic imaging. Our comparison with scintillation camera studies revealed excellent correlation and, in most cases, equivalent-to-superior resolution. It is an excellent instrumentation choice to obtain a high quality image of the pancreas—with the added benefit of increasing the availability of a scintillation camera for other studies. Its ability to resolve radioconcentrations at various depths is another advantage in pancreatic imaging because the organ does not remain in the same plane throughout its longitudinal axis. Additionally, it is not necessary to use techniques of locating the pancreas for optimum visualization, i.e., Tc-99m sulfur colloid swallow. Considering the equivalent-to-improved resolution of the multiplane tomographic scanner—in addition to such other advantages as depth perception, visualization of regions obscured by the liver, and patient management—the multiplane tomographic scanner in our experience is the better instrument for pancreatic imaging.

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