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PANCREAS SCANNING - IS IT WORTH IT?

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Introduction

Ten years after its introduction into clinical medicine (3,6,8) pancreas scanning is still championed only by a few enthusiasts and distrusted by many who have either never used it or have abandoned the procedure after an early disappointing experience. Most practitioners of nuclear medicine either have not accumulated sufficient experience, or have not analyzed their experience well enough to know what may be expected from this procedure of limited, but definite value.

Purpose of Study

Unbiased by previous enthusiasm and sharing most of the general mistrust, we were still unwilling to abandon without a good clinical study one of the few radiologic procedures available in a field of great diagnostic difficulty. We therefore decided to re-analyze all our pancreatic scans with the object of establishing correlation between the appearance of the scan and the clinical outcome in order to assess the clinical value of the procedure.

Material and Methods

A total of 106 pancreas scans were performed at the University of Chicago from January 1966 until July 1, 1970. The examination did not include a special meal or any of the biologic and pharmacologic agents used by others

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DISCLAIMER

in an attempt to increase concentration of the radiopharmaceutical in the pancreas, but which had not proved to be clinically beneficial (5,6,9,11-16, 20, 22, 29 -41). We insisted, however, that our patients have breakfast, because starvation preferentially increases isotope uptake in the liver, since plasma protein synthesis has biologic priority over digestive enzyme synthesis in the pancreas (7,8).

After I.V. injection of 250 microcuries of ^{75}Se-selenomethionine*, the patient was placed supine under the Anger camera mounted with a 364 KEV parallel hole multiaperture collimator. The detector head was positioned over the mid-abdomen inclined 5-10 degrees towards the head in an attempt to "look under the liver."

Serial 10 minute anterior views were then taken, the patient being repositioned, if necessary, after the first view(Fig.1).The time of optimum visualization of the pancreas proved to be variable and different regions of the pancreas were best seen on different views. We firmly believe that this technique has been of essential value since it is the usual rather than occasional case in which the normal pancreas image is obtained by an amalgamation of the sequential views. The method, therefore, has a better chance of recording a diagnostic image than the one or two views that can be taken with the rectilinear scanner. Initially, the examination lasted for at least one hour. We analyzed these cases in an effort to establish optimum time of visualization, and found as will be seen in Table I, that the best view was obtained most often in the first 40 minutes. Even when it occurred later, the early pictures would have been adequate for diagnosis.

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*produced by Squibb by biosynthesis

It is therefore considered unnecessary to prolong the examination beyond 50 minutes.

TABLE I

ANALYSIS OF SEQUENTIAL VIEWS TECHNIQUE

Best View Obtained	No. Patients
10-20 minutes	9
20-30 minutes	17
30-40 minutes	12
40-50 minutes	4
50-60 minutes	3
later than 60	3
not visualized	13
Total	61

The normal variability of pancreatic shape has been the subject of much discussion (21,24,31,33,36). In our experience the decreased uptake at the junction of the head and body of the pancreas can cause more diagnostic difficulty. This is due to the underlying aorta, and when this organ complicates interpretation of the scan, we suggest a bolus nuclide injection to permit visualization of the aorta immediately following the last pancreas image. The patient should not be moved for this view so that the appearance of the aorta and pancreas can be correlated (See Fig. 2).

Liver overlap has always caused the greatest difficulty in the interpretation of pancreas scans because, although the uptake on a gram basis is less in the liver than in the pancreas, the mass of the liver is

so great that it accumulates three times more selenomethionine than the pancreas (1,2,7,8,26,36,42). Numerous methods of overcoming this difficulty have been tried, from simple lead shields (35) to sophisticated electronic subtraction methods (4,17,19,23,33). We have also used a 1600 channel-analyzer in conjunction with the gamma camera to subtract the liver image obtained with ^{99m}Tc sulfur-colloid from the combined liver-pancreas image produced by ^{75}Se selenomethionine. An example is shown in Fig. 3. Subsequent analysis of these cases (Table II) permitted us to assess the value of the subtraction technique. In our hands subtraction, although useful at times is almost never essential, and we believe that the absence of subtraction equipment should never discourage a physician from scanning the pancreas.

TABLE II

ANALYSIS OF SUBTRACTION RESULTS

Essential	1 case
Corroborative	20 cases
Not Contributory	26 cases
Total Subtractions	47 cases

Results

The scans were interpreted by one of us (A.G.) without recourse to either clinical data or the initial report. Only three diagnostic categories were used (Fig. 4): the normal pancreas, the not visualized pancreas; the partially or faintly visualized pancreas. Clinical correlation was obtained from autopsy, surgery, or clinical course. The series is shown in Table III,

and the results of this study are given in Tables IV - VI.

TABLE III

SUMMARY OF SCAN DATA

Scan Interpretation	No. cases	Lost to F/U	Adequate F/U
Normal visualization	52	4	48
Non-visualization	26	4	22
Abnormal or faint	28	4	24
Totals	106	12	94

TABLE IV

FINAL DIAGNOSIS IN PATIENTS WITH NORMAL VISUALIZATION OF THE PANCREAS

Diagnosis	Autopsy	Surgery	Clinical	Total
Normal pancreas	2	7	33	42 = 88%
Chronic pancreatitis	1	2	2	5 = 10%
Carcinoma	-	1	-	1 = 2%
Total				48

TABLE V

FINAL DIAGNOSIS IN PATIENTS WITH NON-VISUALIZATION OF THE PANCREAS

Diagnosis	Autopsy	Surgery	Clinical	Total
Carcinoma	2	5	2	9 = 41%
Chronic pancreatitis	1	4	4	9 = 41%
Diabetes	-	-	1	1 = 5%
Normal pancreas	1	2	-	3 = 13%
Total				22

TABLE VI

FINAL DIAGNOSIS IN PATIENTS WITH ABNORMAL AND FAINT VISUALIZATION

Diagnosis	Autopsy	Surgery	Clinical	Total
Chronic pancreatitis	-	4	9	13 = 54%
Carcinoma	1	5	-	6 = 25%
Diabetes	-	-	1	1 = 4%
Normal pancreas	-	-	4	4 = 17%
Total				24

Discussion

88% of our patients with a normal pancreas scan proved to have no detectable lesions in the organ. The remaining 12% were false negatives with pathological conditions unrevealed in the normal scan. Mild chronic pancreatitis may be expected to leave the pancreas with sufficient enzyme-secreting capacity to produce a normal selenomethionine uptake, and the pancreas scan, therefore will commonly miss these cases. In the patient with carcinoma

whose scan is shown in Fig. 5 there was an adenocarcinoma of the duodenum which invaded most of the head of the pancreas in its posterior aspect, but only 1 cm of the anterior aspect, and left the ampulla and the pancreatic duct uninvolved, thus retaining enough function and uptake of radionuclide in the gland to produce a normal scan. The grossly demonstrable area involved by carcinoma was therefore below the resolution limit of the scanning procedure, which is about one inch.

The vast majority of patients whose scans show either non-visualization or partial or faint visualization, will have significant impairment of the gland. Most of them will have either a carcinoma originating in or invading the pancreas, or chronic pancreatitis. The scan is unable to differentiate between these two lesions. Insulin-resistant diabetes has also been found to impair visualization of the pancreas (25,27), and this was substantiated in two of our cases. Our series contains fewer false positives than many series previously reported (10,28,33), probably because we use the technique of sequential imaging on the gamma camera.

TABLE VII

APPEARANCE OF SCAN IN PATIENTS INVESTIGATED FOR PANCREATIC DISEASE

Final Diagnosis	Normal Scan	Non-visualization	Abnormal	Total
Normal pancreas	42 = 86%	3 = 6%	4 = 8%	49
Chronic pancreatitis	5 = 18%	9 = 33%	13 = 48%	27
Diabetes	-	1	1	2
Carcinoma	1 = 6%	9 = 56%	6 = 37%	16
Totals	48	22	24	94

Table VII summarizes the appearance of the scan in patients examined for pancreatic disease by categorizing the scan readings according to the final diagnosis.

In conclusion, a normal pancreas scan has a high degree of reliability (88% in this series). When the scan is abnormal, it is difficult or impossible to distinguish reliably between various pathologic entities, especially between pancreatitis and carcinoma. Severe diabetes, starvation, (7,8) or post-operative states (28) will also cause non-visualization of the pancreas. Since the patency of the excretory ducts seems to be a crucial factor in determining visualization, small tumors not obstructing the duct system will therefore be missed when the lesion size is below the resolution limits of current imaging devices.

On the basis of these results, our own attitude to pancreas scanning has been revised. We believe that if the examination is used principally to establish normality or abnormality of the pancreas without attempting an etiologic diagnosis, the pancreas scan - done with sequential imaging - can be a useful diagnostic technique.

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REFERENCES

1. Aronsen KF, Gynning I, Waldeskrog B: Evaluation of ^{75}Se-selenomethionine for visualization of the pancreas by scanning technique. Acta Chir Scand 129: 624-630, 1965

2. Awwad HK, Potchen EJ, Adelstein SJ, Dealy Jr JB: The regional distribution of Se^{75}-selenomethionine in the rat. Metabolism 15: 370-378, 1966

3. Bender M, Blau M: Pancreas scanning with ^{75}Se-selenomethionine. Scintillation Scanning in Clinical Medicine. Ed. by Quinn J, Philadelphia, Saunders 1964, 87-92

4. Blanquet PC, Beck CR, Fleury J, Palais CJ: Pancreas scanning with ^{75}Se-selenomethionine and ^{198}Au using digital-data processing techniques. Journal of Nuclear Medicine 9: 1968, 486-488

5. Blahd: Nuclear Medicine. pp. 298-302 McGraw-Hill, New York, 1965

6. Blau M: Biosynthesis of [^{75}Se] selenomethionine and [^{75}Se] selenocystine. Biochim. Biophys. Acta 49: 389-390, 1961

7. Blau M, Manske RF. The pancreas specificity of ^{75}Se-selenomethionine. Journal of Nuclear Medicine 2: 102-105, 1961

8. Blau M, Bender MA: Se^{75}-selenomethionine for visualization of the pancreas by isotope scanning. Radiology 78: 974, 1962

9. Brown PW: Scintillography in the diagnosis of pancreatic disease. Lancet, Vol I (1968) 160-163

10. Burke G, Goldstein MS: Radioisotope photoscanning in the diagnosis of pancreatic disease. Am J Rtg 92: 1156-1161, 1969

11. Burdine JA, Haynie TP: Diagnosis of pancreatic carcinoma by photoscanning. JAMA 194: 979-983, 1965

12. Colella AC, Pigorini F: Experiences in pancreas scanning using ^{75}Se-selenomethionine. Brit. J. Radiol 40: 662-669, 1967

13. Deininger HK: Vergleichende Untersuchungen zur Erkennung von morphologischen Pankreaserkrankungen mittels konventioneller Rontgendiagnostik und Szintigraphie. Rontgenblatter, 22: Jan 1969, 35-46

14. Deiniger HK, Sielaff HJ: Pankreasszintigraphie mit ^{75}Se-selenomethionin. Fortschr Roentgenstr 107: 353-360,1967

15. Diethelm L, Haacke W: Bisherige Erfahrungen mit der Isotopendiagnostik des Pankreas. Radiologe 5: 307-312, 1965

16. Eaton SB, Potsaid S, Lo HH, Beaulieu E: A potential method for increasing pancreatic accumulation of ^{75}Se selenomethionine. Radiology 89: 933, 1967

17. Eaton SB, Potsaid MS, Lo HH, Beaulieu E: Radioisotopic "subtraction" scanning for pancreas lesions. Radiology 89: 1033-1039, 1967

18. Ephraim KH: A new technique for scanning the pancreas. Medical Radioisotope Scintigraphy. Vienna, 1969 pp 721-736

19. Fink S, Ben-Porath M, Jacobson B, Clayton GD, Kaplan E: Current status of dual-channel pancreas scanning. J. of Nuclear Medicine 10: 78-82, 1969

20. Gros CH, Vrousos C, Soutter J, Chateau D: Scintigraphie pancreatique. J. de Radiologie et Electrologie 49: 838-841, 1968

21. Haynie TP: The pancreas Clinical Scintillation Scanning. ed. by Freeman and Johnson. Hoeber 1969. pp 384-396

22. Haynie TP, Svoboda AC, Zuidema GD: Diagnosis of pancreatic disease by photoscanning. J. of Nuclear Medicine 5: 90-94, 1964

23. Kaplan E. Ben-Porath M, Fink S, Clayton GD, Jacobson B: Elimination of liver interference from the selenomethionine pancreas scan. J of Nuclear Medicine 7: 807-816, 1966

24. King ER, Sharpe A, Grubb W, Brock JS, Greenberg L: A study of the morphology of the normal pancreas using Se^{75} methionine photoscanning. Amer J Rtg 96: 657-663, 1966

25. Lahdevirta J: Testing of exocrine function of pancreas in diabetes mellitus by use of ^{75}Se-methionine and of secretin. Acta Medica Scandinavica 182: 345-351, 1967

26. Lathrop KA, Harper PV, Malkinson FD: Human total-body retention and excretory routes of ^{75}Se from selenomethionine. Radioaktive Isotope in Klinik und Forschung, vol. VIII, 436-443, 1968.

27. McCarthy D M, Brown P: Measurement of duodenal activity and ^{75}Se-selenomethionine pancreatic scanning compared as tests of pancreatic function. J The British Soc of Gastroenterology, 10: 913-920, 1969

28. Riccobono XJ: Pancreatic scanning. Seminars in Roentgen. 3: 310-317, 1968

29. Rodriguez-Antunez A: Pancreatic scanning with selenium^{75}-methionine utilizing morphine to enhance contrast. Cleveland Clinic Quarterly 31: 213-218, 1964

30. Rodriguez-Antunez A: Use of morphine in pancreatic scanning with Se^{75} methionine. J Nucl Med 5: 729, 1964

31. Rodriguez-Antunez A: Potoscanning in diagnosis of carcinoma of the pancreas. Annals of Int Med 65: 730-757, 1966

32. Rodriguez-Antunez A: Photoscanning of the pancreas. JAMA 205: 347-348, 1968

33. Rodriguez-Antunez A, Alfidi RJ, Gill WM: Pancreas scanning. Critical Reviews in Radiological Sciences. 1: 25-46, 1970

34. Sodee B: Recent developments in pancreas scanning in Advances in Dynamic Radioactive Scanning. Ed. by Wang Y: Springfield, Thomas publisher, pp 101-111 1968

35. Sodee B: Radioisotope scanning of the pancreas with selenomethionine (Se^{75}). Radiology 83: 910-916, 1964

36. Sodee DB: Pancreatic Scanning. Clinical Scintillator 11:3C, 1967

37. Steinhoff H, Pabst HW: Bisherige Ergebnisse er pancreasszintigraphie mit ^{75}Se-Methionin. Schweizerische Medizinische Wochenschrift 98: 285-287, 1968

38. Tabern DL, Kearney J, Dolbow A: The use of intravenous amino acids in the visualization of the pancreas with seleno 75 methionine. J Nucl Med 6: 762-766, 1965

39. van Vaerenbergh Jr M, van Vaerenbergh PM,Demeulenaere L, Yvergneaux JP, Barbier F La pancreatographie par les isotopes radioactifs. Ann Radiol 9:593-601, 1966

40. Wagner: Principles of Nuclear Medicine pp 620, Philadelphia, Saunders, 1968

41. Yvergneaux JP, van Vaerenberg M: Interpretation de la scintigraphie pancreatique dans les pancreatites et dans les tumeurs. Acta Gastro-Enterologica Belgica 29:847-869, 1966

42. Zuidema GD, Kirsh M, Turcotte JG, Gaisford WD, Powers W, Kowalczyk RS: Pancreatic uptake of ^{75}Se-selenomethionine. Annals of Surgery 158: 894-897, 1963

Figure Legends

Fig. 1 -- Serial 10-minute anterior views in patient with normal pancreas. In general, the image is evaluated by an amalgamation of the several views, for example, the mid portion of the body is seen intact only on the first image; whereas the head is best seen on the 20-30 minute view.

Fig. 2 - - Example of area of decreased uptake in the neck of the pancreas (left) shown to correspond to the abdominal aorta on nuclide angiogram (right).

Fig. 3 - - Subtraction technique.

Upper left, routine scintiphotograph showing the pancreas obscured by the lower edge of the liver.

Upper right, Digital matrix representation of the same image with the 1600 channel analyzer.

Lower Left , Technetium-99m sulfur colloid image of liver and spleen with patient in the same position.

Lower right, Digital subtraction image of the technetium from the selenomethionine yielding a clearer view of the pancreas.

Fig. 4 Examples of diagnostic categories:

Upper left - Normal visualization

Upper right - Non-visualization (carcinoma)

Lower left - Faint visualization (chronic pancreatitis)

Lower right - partial visualization, the head is faint and deformed (carcinoma)

Fig. 5 - Apparent normal visualization of the pancreas in patient with adenocarcinoma of the duodenum invading part of the head posteriorly and not involving the excretory ducts. This is the only case of carcinoma in this series with a normal scan.