Ultrasound in the diagnosis of malignant pancreatic tumours

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SUMMARY Ultrasonic scanning of the upper abdomen is a valuable method in diagnosing malignant pancreatic tumours. A series of 12 patients is presented. The method also provides information about the size of the gallbladder and the condition of the liver parenchyma.

There is a lack of minor diagnostic procedures to visualize the pancreas. Two-dimensional ultrasonic scanning fulfils the conditions of such a screening method, and has proved to be valuable in diagnosing malignant lesions in the pancreas.

The results in a series of 12 patients with a malignant growth in the pancreas are presented.

Method

The apparatus used is a Picker ultrasonic laminograph (model MDU-661-BU) equipped with a Tektronix storage oscilloscope and a camera of Polaroid type to photograph the screen: transducer, 2 Mc, diameter 10 mm.

The scanning is performed manually in direct contact with the skin of the patient. Transverse sectional planes are recorded at intervals of 1.5 cm between the xiphoid and the umbilicus. For special purposes these sections can be supplemented by one or more sections in the longitudinal or oblique plane.

Patients and Results

The data for 12 patients with a malignant growth in the pancreas are summarized in the Table.

CASES 1 TO 10

The first 10 patients with previously unknown malignant disease are of special interest. Painless jaundice, itching, and weight loss were the major presenting symptoms.

Clinically, the liver was enlarged in six and the gallbladder palpable in five of them. Only two patients complained of upper abdominal pain radiating to the back. In one of them, this pain could be related to tumorous infiltration of the coeliac nerves; the other had a technically operable tumour without metastases.

Biochemical data were compatible with obstructive jaundice. Drug jaundice could be excluded by careful interrogation; none had gallstones and/or inflammatory biliary disease associated with the pancreatic tumour.

Two-dimensional sonography of the upper abdomen showed a tumour in the region of the head of the pancreas in all 10 patients (Figs. 1, 2, 3, and 5). The gallbladder was demonstrated to be enlarged in all the cases (Figs. 1, 3, 4, and 5). Sonographically, no liver metastases were found in seven cases, but there was strong suspicion of secondaries in the remaining three cases (Fig. 3). The sonographic findings were confirmed by laparotomy in nine and by necropsy in one case (Table).

Six of the 10 patients had an operable tumour without metastases. Radical surgery with duodeno-pancreatectomy was performed in four patients; they are in good health two to seven

Case No.	Sex	Age (yr)	Symptoms and Clinical Signs	Time between Onset of Symptoms and Diagnosis	Biochemical Data before Operation			Barium Meal
					Bilirubin (mg %)	SGPT (IU)	Alkaline Phosphatase (Bodansky units)	
1	F	61	Painless jaundice, itching; liver enlarged, gallbladder palpable, weight loss 3 kg	4 weeks	21	62	71	Normal
2	M	68	Painless jaundice, itching, liver slightly enlarged, gallbladder palpable, weight loss 3 kg	5 weeks	22	52	20	Normal
3	M	50	Painless jaundice, itching, liver enlarged, gallbladder not palpable, weight loss 4 kg	4 weeks	10	45	13	Normal
4	F	72	Nausea and vomiting, painless jaundice, no itching, normal liver, gallbladder palpable, weight loss 7 kg	5 weeks	10	110	26	Normal
5	M	65	Painless jaundice, itching, liver slightly enlarged, gallbladder not palpable, weight loss 3 kg	4 weeks	31	108	19	Normal
6	M	73	Occasional vomiting, painless jaundice, no itching, liver and gallbladder normal, no weight loss	8 weeks	14	39	19	Stenosis in third part of duodenum, mucosal pattern destroyed
7	F	75	Painless jaundice, no itching; liver enlarged, gallbladder palpable, no weight loss	8 weeks	17	24	15	Normal
8	F	60	Occasional vomiting, colicky upper abdominal pain radiating to the back; liver and gallbladder normal weight loss 4 kg	10 weeks	25	44	21	Normal (duodenography in hypotony: normal)
9	F	56	Pain in the back, then jaundice and itching; liver slightly enlarged with nodular surface, gallbladder palpable	8 weeks	16	35	8	Normal
10	M	79	Painless jaundice, no itching; liver slightly enlarged, gallbladder not palpable, weight loss 7 kg	11 weeks	11	75	24	Normal
11	F	58	Severe itching, no jaundice 7 mth after mastectomy for cancer; liver normal size, gallbladder not palpable, no weight loss	6 weeks	11	112	25	Not performed
12	F	70	Six mth previously palliative surgery for inoperable tumour in head of pancreas; now again jaundice and septicæmia		21	32	33	Not performed

Table Summarized data for 12 patients with malignant pancreatic tumours

Fig. 1a Transverse ultrasonic scan of the upper abdomen of case 7 showing a tumour in the head of the pancreas, enlarged gallbladder, no liver metastases (surgically confirmed).

Fig. 1b Transverse necropsy section of case 7. The inferior vena cava is thrombosed and the liver metastases are partly marked. (The key used here and in the other figures is on page 446.)

<i>Peritoneoscopy</i>	<i>Sonotomography of Upper Abdomen</i>	<i>Operation Necropsy</i>
Grossly enlarged gallbladder, no liver or peritoneal metastases	Tumour of head of pancreas, enlarged gallbladder 5 cm, no liver metastases	Tumour confirmed; duodeno-pancreatectomy, no metastases, patient well two months after operation
Grossly enlarged gallbladder, no metastases	Tumour of head of pancreas, enlarged gallbladder 4 cm, no liver metastases	Tumour confirmed; duodeno-pancreatectomy, no metastases, patient well 3 mth later
Gallbladder enlarged, no metastases	Tumour of head of pancreas, enlarged gallbladder 5 cm, no liver metastases	Tumour confirmed; duodeno-pancreatectomy, no metastases, patient well 3 mth after surgery
Gallbladder enlarged, no metastases	Tumour of head of pancreas, enlarged gallbladder 4 cm, no liver metastases	Tumour confirmed; duodeno-pancreatectomy, no metastases, patient well 3 mth after surgery
Gallbladder enlarged, no metastases seen	Tumour of head of pancreas, enlarged gallbladder 4 cm, strong suspicion of small liver metastases	Tumour confirmed, inoperable situation with regional and liver metastases; cholecystojejunostomy, patient well 4 months later
Not performed	Tumour of head of pancreas, enlarged gallbladder, small liver metastases	Pancreatic tumour and liver metastases confirmed; cholecysto-jejunostomy, patient well 2 mth later
Grossly enlarged gallbladder, no metastases	Tumour of head of pancreas, gallbladder enlarged, no liver metastases	First operation: pancreatic tumour confirmed, no metastases found, cholecysto-jejunostomy performed. Second operation: 4 weeks later inoperable situation with diffuse small liver metastases. Diagnosis confirmed at necropsy
Gallbladder enlarged, no metastases seen	Tumour of head of pancreas, gallbladder enlarged, no liver metastases. Control 6 mth later: pancreatic tumour much bigger, liver metastases	First operation: cholecystostomy. Second operation, 10 days later: tumour confirmed, no metastases found; choledocho-jejunostomy performed
Liver and peritoneal metastases, ascites, gallbladder enlarged	Tumour of head of pancreas, gallbladder enlarged, liver metastases	Diagnosis confirmed at necropsy
Gallbladder enlarged, no metastases	Tumour of head and body of pancreas, gallbladder enlarged, no metastases	Big tumour of head and body of pancreas confirmed; inoperable situation with regional metastases; no liver metastases; cholecysto-jejunostomy performed
One metastatic growth in each lobe of liver, gallbladder enlarged	Tumour in head of pancreas, enlarged gallbladder, suspicion of one metastatic nodule in right lobe of liver	Operation showed metastatic growth in head of pancreas with obstruction of bile duct, liver metastases; cholecysto-jejunostomy performed
Not performed	Tumour of head and body of pancreas, enlarged gallbladder, liver metastases	No necropsy performed

Table—continued

Fig. 2a Transverse ultrasonic sections of upper abdomen showing a tumour of the head of the pancreas (case 8) in the preoperative situation, but no liver metastases (surgically confirmed).

Fig. 2b Follow up six months after palliative surgery showing markedly increased pancreatic tumour (case 8).

Fig. 3 Top left: transverse ultrasonic scan of the upper abdomen in case 9 showing tumour of the head of the pancreas, enlarged gallbladder, liver metastases. Bottom left: dorsal view of liver, gallbladder, pancreatic tumour, and great abdominal vessels at necropsy. Top and bottom right: transverse ultrasonic scan and corresponding necropsy section through the pancreatic tumour. The metastases are partly marked.

L=liver, G=gallbladder, D=duodenum, ST=stomach, T=tumour, VC=vena cava inf., A=aorta, V=vertebral column, RL and LL=right and left lobes of liver, RK= right kidney, RI=rib, PR=pancreatic region, AM=art. mesent. sup, SH=shadow caused by stomach, MR=Mm recti abdominis, TH or Tb=tumour of head or body, M=midline, m=metastases.

Fig. 4a

Fig. 4b

Fig. 4c

Fig. 5a

Fig. 5b

Fig. 5c

Fig. 4 Transverse ultrasonic sections of upper abdomen at intervals of 5 cm in case 3: (a) enlarged gallbladder and right lobe of liver; (b) and (c) grossly enlarged gallbladder beyond the edge of the liver.

Fig. 5a, b, and c Different examples of carcinoma of the head and body of the pancreas (cases 12, 1, 10). Arrow = streaking effect (artefact). The gallbladder is enlarged.

Fig. 6 Top left and right: *transverse sections of the body through intervertebral disc Th_{XII}-L₁ and vertebra L_{II}, showing the topography of the pancreatic gland.* Bottom left: *normal transverse ultrasonic scan corresponding to the section outlined (top left).* Bottom right: *line drawing of the scan (bottom left).*

months after operation. One of the remaining two patients had at first a biliary drainage operation because of poor general condition and showed four weeks later, when radical surgery was planned, diffuse small liver metastases which were not present before (Fig. 1). The other patient, mentally ill, was operated on in another hospital where a choledoch-jejunostomy was done. This patient is still alive one year later, and repeated sonographic examinations show that the pancreatic tumour is increasing in size (Fig. 2). Four patients showed an inoperable tumour and only palliative surgery was done (liver metastases in three, extensive lymph node infiltration in one patient).

CASES 11 AND 12

Case 11 presented with severe itching seven months after mastectomy for cancer. The sonograms showed a tumour in the region of

the head of the pancreas and a liver metastasis in the right lobe. At operation, there was a metastatic growth in the head of the pancreas and the liver metastasis was also confirmed; there was another secondary at the edge of the left liver lobe which was missed sonographically. Case 12 underwent operation for total biliary obstruction due to a tumour in the pancreas in another hospital, where a cholecysto-jejunostomy was done. Six months later the patient presented again with jaundice, ascending cholangitis, and septicaemia. The sonogram showed a grossly enlarged gallbladder and a big tumour in the region of the pancreas (Fig. 5a). The patient died in septic shock; no necropsy was performed.

Discussion

The advantages of ultrasonic scanning are that it

is a useful screening method and gives reliable results (Blauenstein, 1969). There is no distress for the patient. The apparatus is easy to handle, transportable, and therefore useful for bedside diagnosis. The investigation can be done by one person and is not time-consuming. It can easily be repeated and used for followup studies. One ultrasonic scan is performed within five to 10 seconds and is therefore not disturbed by respiratory movements, especially in a conscious patient who can hold his breath for such a short time.

The difficulties of the method are that the position of the pancreas is most unfavourable for access by ultrasound (Holm and Mortensen, 1968). Structures which reflect or absorb ultrasonic waves lie all around the gland: the thoracic wall, stomach, liver hilus, and duodenal loop from the ventral and right lateral side, the duodeno-jejunal and colonic flexures from the left side and the vertebral column, and the muscles and retroperitoneal structures from the posterior surface of the body. In the normal case, the many vessels and ducts closely connected to the pancreas give a mosaic pattern (Fig. 6) to the echo structure which allows of no clear identification of pancreatic tissue (Holmes, 1966; Holmes and Howry, 1963). On the other hand, a tumour presents as a typical and largely echo-free zone of varying size which can easily be attributed to the pancreatic region if the surrounding anatomical structures, mainly

the lower surface of the liver, aorta, and vertebral column, are clearly visible. In 50 other cases, investigated mainly for liver metastases or cirrhosis, there was never such an echo-free zone in the pancreatic region. The smallest tumour found and resected in this series measured 1.8 cm in diameter (Table, case 2).

The enlarged gallbladder, as it was found in all the cases of this series, gives a picture of a round, echo-free zone with sharp contours beyond the edge of the liver or of a half-moon-like structure on the lower surface of the liver (Fig. 4).

In addition, ultrasonic scanning of the upper abdomen allows an exact determination of the size of the liver and answers the question whether or not metastases are present. It is possible to localize secondaries by this technique with great accuracy and to biopsy them percutaneously (Blauenstein, Engelhart, and Müller, 1969).

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