Pancreatic and mesenteric arteriography

H. HERLINGER

Consultant Radiologist to the Leeds Hospitals

DIRECT radiological visualization of the pancreas is still imperfect and therefore complex and laborious. Arteriography is the mainstay of the investigation. Arteriographic changes are often subtle and the danger of over-diagnosis and of mis-diagnosis is ever present. In my opinion, the judicious combination of retro-peritoneal gas insufflation with arteriography adds more to the value of the examination than it does to its burden or to the patient's discomfort.

The two methods are complementary. Air study is at its best in the normal pancreas, and if successful, will exclude disease as far as radiology is capable. In malignancy of the pancreas, arteriography will usually produce the more positive information, but evidence from air study may tip the balance of diagnosis should arterial changes be in doubt. Air study is the more important factor in the radiology of pancreatitis or cyst formation, but arteriography should not be omitted as it may reveal an associated carcinoma.

The normal arterial anatomy can be made clear during adequate contrast study (Figs. 1 and 2). The main arteriographic changes in pancreatic carcinoma are irregular artery stenosis (Fig. 3) and the demonstration of pathological vessels (Fig. 4). The latter are often tiny but can usually be shown if basic radiography is meticulous. Tumour blush is infrequent but may be intense. Positive evidence of pancreatic carcinoma will be more consistently shown if arteriography is enhanced by photographic subtraction and followed by angiotomography. The exact placement of the catheter or the catheters is crucial and must depend on experience and a knowledge of the varied arterial anatomy of the area. Success in reaching the most elusive arterial branch is not necessarily in the interest of the examination.

Indications for pancreatography may be the following:

(1) To determine if the pancreas is normal when this is in doubt after a barium meal.

(2) To demonstrate a possible pancreatic carcinoma as a cause of obstructive jaundice,

pain of pancreatic character and in some instances of malabsorption or venous thrombosis.

(3) To outline a pancreatic tumour in hyperinsulinism or the Zollinger-Ellison syndrome.

(4) To provide information in cases of relapsing pancreatitis or pseudo-cyst formation (Fig. 5).

Mesenteric arteriography

Excepting ischaemic conditions, mesenteric arteriography undertaken to outline disease of the colon has not received the attention it appears to merit. In the absence, as yet, of published

FIG. 1. Normal head of pancreas. Catheter in coeliac axis and superior mesenteric artery but only coeliac injection. Pancreatico-duodenal arteries marked by asterisks (the posterior superior arising from the hepatic artery). Dorsal pancreatic artery from the coeliac indicated by arrow heads; its anastomotic connections with pancreatico-duodenal branches are a frequent site of the earliest changes in carcinoma of the head of the pancreas.

FIG. 2. Normal angiotomogram during midstream injection into the aorta. Arrows point to pancreatic magna artery which arises from the splenic. Arrow heads along the transverse pancreatic artery.

FIG. 3. Obstructive jaundice in man of 65 years. Serial film during midstream aortogram. Arrows indicate severe degree of irregular stenosis of the gastroduodenal artery. Inoperable carcinoma of the head of the pancreas.

FIG. 4. Male, 69 years. Increasing epigastric pain for 2 months, deepening jaundice for 2 weeks. (a) Coeliac and superior mesenteric catheterisation, only coeliac injection. Dorsal pancreatic artery (asterisks) and anterior superior pancreatico-duodenal artery feed an area which contains pathological vessels (arrows). (b) A dense tumour blush follows the arterial phase. A cholecysto-jejunostomy was performed. Tumour biopsy report: Partially anaplastic carcinoma of the pancreas.

FIG. 5. Female, aged 60. Drainage of a pancreatic cyst at a previous admission. Acute re-admission with epigastric pain. (a) Combined injection with coeliac catheter at dorsal pancreatic artery origin, the other in the superior mesenteric. Smaller arrows show widely separated and elongated branches of the dorsal pancreatic artery (asterisks over the posterior pancreaticoduodenal arcade). (b) AP tomogram after retroperitoneal pneumography shows a well delineated mass projecting forward from the body and tail of the pancreas. Recurrence of a pancreatic cyst.

data of a sufficient number of cases, it is necessary to correlate pre-operative findings with the injection study of resected or post-mortem specimens. This is still in an early phase and only a preliminary report can be made.

The selective catheterization of the superior and inferior mesenteric arteries is usually not difficult. In the normal, vasa recta arise from the final arcade at fairly regular distances from one another. Near the mesenteric border they divide into an anterior and posterior branch which taper gradually as they approach the anti-mesenteric side. Short vasa recta arise from the long vasa or from the final arcade and are normally too tiny to be seen *in vivo*. The bowel wall thickness can be measured in a faint capillary phase, normal values being up to 2 mm. Main draining veins become visible 10–14 sec after injection, but veins within the bowel wall are normally too faint to be seen. The superior mesenteric artery supplies thick branches to the jejunum and ileum, and these blot out the finer detail of the colon, particularly of the transverse colon. The sub-selective catheterization, by double catheter method, of the middle colic artery has been successfully accomplished twice in six attempts and is a complicated though worthwhile procedure (Fig. 6).

In *ulcerative colitis*, vasa recta are more numerous per length of bowel than in the normal. They are tortuous, have a wide lumen, do not taper and often break up into coarse

FIG. 6. Normal middle colic arteriogram by double catheter method.

branches on the anti-mesenteric side (Fig. 7). The capillary phase is fairly intense and the bowel wall thicker than normal (Fig. 8). Venous return is accelerated, coiled mural veins are shown, and the density of main draining veins is increased (Fig. 9). During remissions, these changes are less intense though essentially the same. The delineation of the extent of the disease process is usually clear and fairly abrupt.

In *Crohn's disease*, we have found vasa recta to be of approximately normal number per length of bowel. There is an early and patchy

FIG. 7. Colectomy specimen, ulcerative colitis. Arterial injection of micropaque. Vasa recta numerous, wide, tortuous; they break up near the antimesenteric side.

increase of density within the bowel wall, and this obscures detail of the vasa recta themselves (Fig. 10). The examination of injected specimens has indicated that this density may be due to a considerable proliferation of the vasa recta brevia (Fig. 11). There is, once again, early and intensified venous return.

In *carcinoma* of the colon, the growth as a whole can be outlined and not only its effect on the colonic lumen. The appearances depend on the vascularity of the tumour. There may be many pathological vessels with an early and vigorous venous phase (Fig. 12). In the left side of the colon, a less vascular and more scirrhus type of tumour is usual. In these, only few pathological vessels are seen, mainly in the tumour periphery, and there is irregular stenosis of the terminal arcade at the edge of the tumour (Figs. 13 and 14).

Diverticulitis may give entirely normal appear-

ances or there may be a corkscrew pattern of the vasa recta at the mesenteric border (Fig. 15).

It is hoped that mesenteric arteriography may prove useful for the following purposes:

- (1) To differentiate between granulomatous colitis and ulcerative colitis.
- (2) To show evidence of complicating malignancy in ulcerative colitis, and to distinguish it from narrowing due to fibrosis.
- (3) To outline the extent of bowel involvement in ulcerative colitis.
- (4) To demonstrate a colonic carcinoma in circumstances where a barium enema may fail to do so (caecum, the geriatric patient).
- (5) To differentiate between diverticulitis and malignancy when barium enema findings are unhelpful (Fig. 16).
- (6) To investigate possible recurrence of colonic carcinoma after resection.

FIG. 8. Inferior mesenteric arteriogram in ulcerative colitis. (a) Late arterial phase. Sharp division (asterisks) between diseased bowel below and normal bowel above. Vasa recta numerous in the sigmoid, already partly obscured by an intensified capillary phase. (b) Subtraction film 4 sec after injection. Open arrows show thickened bowel wall in which coiled, wide veins are visible. Arrow heads mark drainage veins, that on the right projected near normal bowel still in its arterial phase.

FIG. 9. Inferior mesenteric arteriogram, ulcerative colitis. (a) Subtraction film of arterial phase in the descending colon. Many coiled vasa recta arise from the final arcade (marked by asterisks). (b) Accelerated, enhanced venous phase with dense intramural veins.

FIG. 10. Superior mesenteric arteriogram in Crohn's disease.

(a) Early arterial phase. Vasa recta tortuous, not increased numerically.

(b) Late arterial phase shows vasa recta almost hidden by an uneven parenchymal blush.

(c) Accelerated venous phase (drainage veins also from diseased area in terminal ileum).

FIG. 11. Resected specimen of Crohn's disease. Arterial injection of micropaque. Number of vasa recta not significantly increased. Marked accentuation of the vasa recta brevia pattern.

FIG. 12. Carcinoma of transverse colon shown by superior mesenteric arteriography in woman aged 74 years. A barium enema gave an inconclusive result due to ineffective bowel preparation and technical difficulty. (a) Late arterial phase. Pathological vessels and vigorous tumour blush. (b) Massive venous return.

FIG. 13. Resected carcinoma of the descending colon. Arterial injection shows a narrowed terminal arcade (arrow heads) and a few pathological vessels.

FIG. 14. Subtraction film of an inferior mesenteric arteriogram. Carcinoma of sigmoid. Arrow heads to narrowed terminal arcade. Long arrows mark pathological vessels at the tumour periphery.

FIG. 15. Sigmoid diverticulitis. Subtraction film, inferior mesenteric arteriogram. Long arrows indicate corkscrew pattern of the vasa recta at the mesenteric border. This may present even tighter turns and may give a misleading impression of pathological vascularity.

FIG. 16. Subtraction film in inferior mesenteric arteriogram series. The barium enema had shown hold-up in the mid-sigmoid with an indication of diverticular disease. The open arrow shows a narrowed terminal arcade. Pathological vessels are indicated by long arrows. An adenocarcinoma was resected.