Percutaneous Transhepatic Cholangiography: Experience with 54 Cases

G. W. RITCHIE, M.D.,* D. C. JACKSON, M.B., Ch.B., F.F.R., M.R.C.P., F.R.C.P.[C] and H. EAGLESHAM, M.D., *St. Boniface, Man.*

THE first successful radiological visualization of the biliary tree was achieved at Hamburg, Germany, by Burckhardt and Müller[1] in 1920. They injected contrast into the gallbladder by extraperitoneal puncture through the liver, so that percutaneous demonstration of the biliary tree preceded both the oral and intravenous methods. Their work was not continued, probably owing to the development in 1924 of a safer and easier method, i.e. cholecystography, by Graham and Cole.[2] The actual forerunner of the present-day technique was described in 1937 by Huard and Do-Xuan-Hop[3] of Indo-China who introduced Lipiodol percutaneously into the liver. Another method of outlining the biliary system was advanced in 1942 by Royer, Solari and Lottero-Lanari,[4] who punctured the gallbladder under direct vision through a peritoneoscope. In 1952, Carter and Saypol[5] published the first report of percutaneous transhepatic cholangiography in the English literature. However, this technique has only recently been accorded its proper place as a valuable procedure in the differential diagnosis of jaundice. In the last 10 years there has been an increasing number of reports in the literature endorsing the use and value of percutaneous transhepatic cholangiography (PTC).

INDICATIONS

The indications for this procedure have been clearly stated by Kidd,[6] Kaplan *et al.*[7] and others:

(1) To differentiate obstructive from hepatocellular jaundice, particularly where a diagnosis cannot be made by other radiological procedures including angiography, or by liver scans using radioisotopes or by liver biopsy; any of these may be contraindicated or non-contributory.

(2) If obstruction is present, to attempt to determine its cause and site, viz.:

(a) calculi;

(b) intra- or extrahepatic carcinoma affecting the biliary tree;

(c) strictures—congenital or acquired;

(d) compression of the biliary tree by extrahepatic structures (non-malignant).

(3) To investigate the status of the biliary tree in suspected biliary atresia.

This procedure has been used to decompress the biliary system before an operation in patients with long-standing obstructive jaundice, although this is not an indication for its use.

TECHNIQUE

Preparation.—The prothrombin time must be as near normal as possible before the procedure is undertaken; if it is abnormal, treatment with phytonadione (vitamin K_1) is necessary. Tetracycline is given prophylactically, 250 mg. every six hours, starting 24 hours before the radiographs are to be taken. Half an hour before the procedure is begun, meperidine hydrochloride (Demerol) 50 to 100 mg. is given subcutaneously.

In the radiology department, the patient is placed supine on an x-ray table that ideally should be equipped with an image intensifier and a television monitor. The right upper quadrant is prepared and draped as a sterile field.

A puncture site is chosen just below the right costal margin in the midclavicular line where the abdominal wall and peritoneum are infiltrated with 1% lidocaine HCl (Xylocaine). A 15-cm., 20-gauge Teflon cannula and needle assembly with its stylet in position is then inserted to a depth of 12 cm. while the patient holds his breath in full inspiration. The needle is held at a 45° angle (to the feet) and directed slightly to the left. The stylet is then removed and the patient is allowed to breathe quietly. A small syringe is attached and gentle suction applied while the needle is slowly withdrawn. If bile is not aspirated during the removal of the cannula, the whole maneuver is repeated with the needle inserted at a slightly different angle. We usually limit our attempts to four punctures.

When a duct is entered, bile can be withdrawn; some is set apart for bacteriologic and cytologic examinations. Sodium diatrizoate (Hypaque) 50% is then introduced under fluoroscopic control, using approximately 10 to 60 c.c.; the size of the ducts determines the amount necessary because the injection can be discontinued as soon as obstruction is demonstrated or

*Associate Professor of Radiology, University of Manitoba, and Director, Department of Diagnostic Radiology, St. Boniface General Hospital, St. Boniface, Manitoba.

Reprint requests to: Dr. G. W. Ritchie, Director, Department of Radiology, St. Boniface General Hospital, St. Boniface 6, Manitoba.

when the opaque medium flows into the duodenum. Multiple spot films are taken during this time, using anteroposterior, lateral and both oblique projections. Occasionally upright films are also taken. At the conclusion of the procedure the needle is removed and tetracycline administration is continued for two days.

RESULTS

At St. Boniface General Hospital in the last four years, 54 percutaneous transhepatic cholangiograms have been attempted (34 females and 20 males) (Table I). In 14 cases we failed

TABLE I

Final diagnosis	*Total*	*Correct*	*Incorrect*	*Technical failure*
Obstructive cases				
Pancreatic carcinoma	15	14		1
Biliary calculus	18	11	1	6
Ampullary stenosis	3	3		
Carcinoma of bile ducts	3	3		
Postoperative bile duct stricture	2	2		
Biliary cirrhosis	1			1
Pancreatitis	1	1		
Hepatocellular cases				
Hepatitis	5	2		3
Cirrhosis	2			2
Metastatic carcinoma of the liver	2	2		
Primary carcinoma of the liver	1			1
Cholangitis	1	1		
Total	54	39	1	14
Males	20 cases	Females		34 cases

to enter a bile duct and because of these technical failures no direct information was obtained about the biliary tree. In 39 of the 40 patients in whom the intrahepatic and extrahepatic bile ducts were demonstrated, the conclusions reached were either essentially correct or of clinical value (Fig. 10). In one case, distal obstruction was interpreted as due to carcinoma of the pancreas (Fig. 11). This diagnosis was said to have been confirmed at operation and a cholecystoduodenostomy was performed. The patient died 24 days later owing to destruction of the anastomosis, and at autopsy a calculus was found impacted in the lower end of the common duct. Even in retrospect, review of the films revealed no radiological features suggestive of a calculus.

In only 7 (16.3%) of the 43 patients who were subsequently proved to have obstructive jaundice were we unable to enter the bile ducts. However, in 6 (55%) of the 11 patients in whom hepatocellular disease was diagnosed, we were unsuccessful in introducing the needle into a duct.

Of the 14 cases of technical failure, seven were due to obstructive disease, six to biliary calculus and one to carcinoma. These results are not in accord with the statement by Drake and Beal[8] that failure to opacify the duct system means a 75% probability that the patient does not have extrahepatic biliary tract obstruction. In our hands an unsuccessful examination is inconclusive, since in half of our failures such extrahepatic obstruction was actually present.

In the five cases of hepatocellular disease in which we demonstrated a normal biliary tree, subsequent operation was avoided.

COMPLICATIONS

In this series of 54 cases the following complications were recorded: (a) bile peritonitis: generalized, two patients; localized, two patients; (b) intraperitoneal hemorrhage: generalized, one patient; localized, one patient. The majority of these complications could have been avoided had there been no delay in the subsequent operation. In a number of our cases operation was delayed, for a variety of reasons, for up to four days, and it is in these cases that complications develop insidiously and may be serious.

None of the patients developed septicemia; there were no deaths attributable to this procedure.

DISCUSSION

The radiologist may be able to diagnose either the presence or absence of obstruction. Where the procedure is successful and obstruction is present, most often he is able to identify the lesion as one of the following entities:

1. *Choledocholithiasis with distal obstruction* (Figs. 1, 2 and 3). This is the commonest finding, and the commonest problem is to differentiate obstruction due to calculi from that caused by carcinoma of the ampulla or of the head of the pancreas.

There are three main distinguishing features:

(a) Dilatation of the common duct is moderate compared to that seen in carcinoma (usually less than 1.5 cm.).

(b) Obstruction may be incomplete so that when the calculi are mobile within the duct a small amount of contrast passes around them into the duodenum.

(c) The distal end of the common duct has a concave or cupped appearance and outlines the superior portion of the obstructing stone.

2. *Carcinoma of the head of the pancreas* (Fig. 4). These patients usually present three distinct radiographic characteristics:

(a) A greatly dilated common duct, often angulated and/or tortuous. The duct is usually wider than 2 cm.

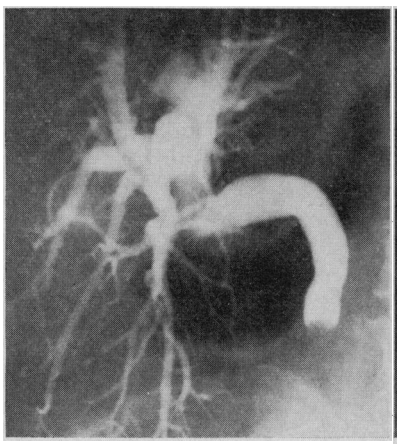

Fig. 1

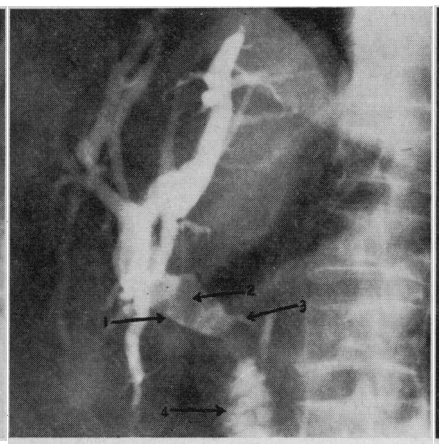

Fig. 2

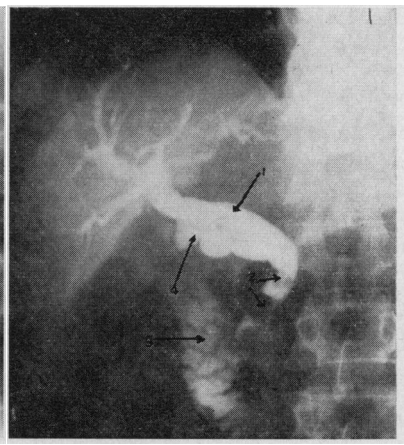

Fig. 3

Fig. 1.—Choledocholithiasis with a stone impacted in the distal common duct causing complete obstruction. **Fig. 2.**—Choledochoduodenostomy with postoperative stenosis of the anastomosis and secondary stone formation: (1) common duct, (2) stones, (3) distal stenosis of the common duct and (4) duodenum. **Fig. 3.**—Choledocholithiasis with partial obstruction: (1) common duct, (2) stones, (3) dilated cystic duct and (4) duodenum.

(b) Complete obstruction – no contrast medium enters the duodenum.

(c) A rounded or straight-line configuration at the distal end of the common duct. Variations are: a convex cut-off, a bulbous, notched or nipple-like projection.

3. *Ampullary carcinoma* (Fig. 5). This condition is usually characterized by:

(a) Complete obstruction.

(b) Marked ductal dilatation, usually not as marked as in carcinoma of the pancreas.

(c) The obstructed end may show either an uneven, ragged margin or a smooth, flat, shallow meniscus.

4. *Carcinoma of body of the pancreas.* The following changes may be observed:

(a) Partial obstruction.

(b) Marked ductal dilatation proximal to level of body of the pancreas.

(c) A small but patent distal common duct.

5. *Carcinoma of the bile ducts.* Transhepatic cholangiography is particularly valuable in those

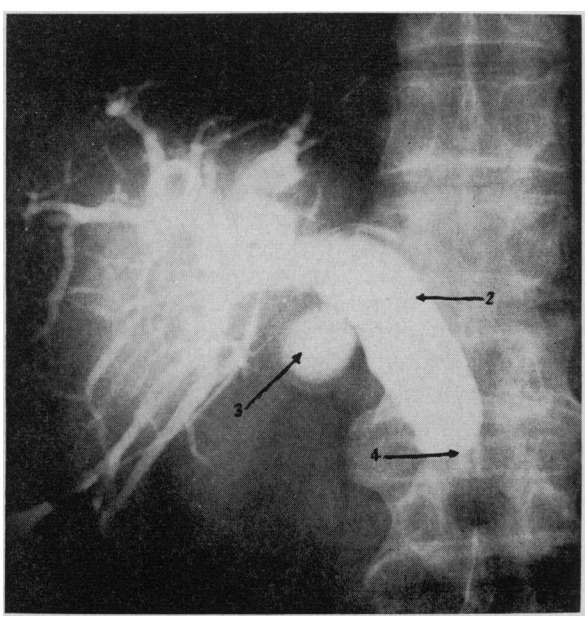

Fig. 4.—Carcinoma of the head of the pancreas: (1) Teflon cannula, (2) common duct, (3) gallbladder and (4) cut-off distal end of common duct.

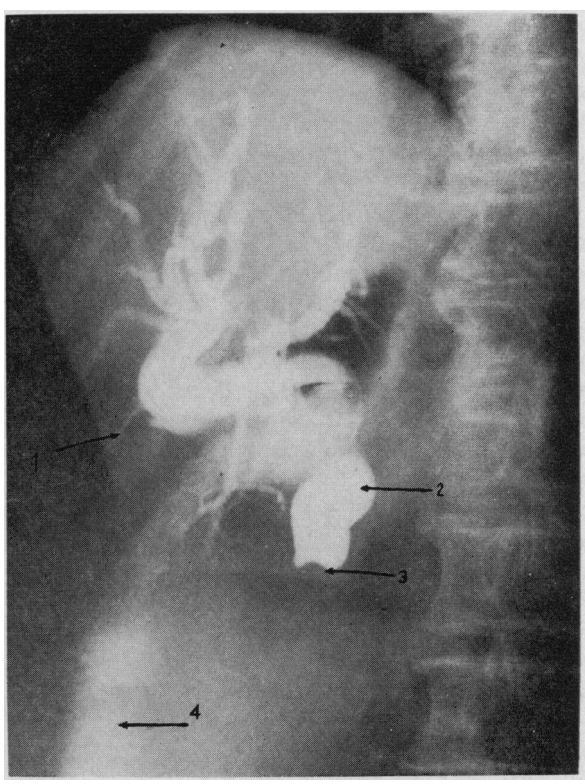

Fig. 5.—Ampullary carcinoma: (1) Teflon cannula, (2) common duct, (3) cut-off at level of tumour and (4) dilated gallbladder.

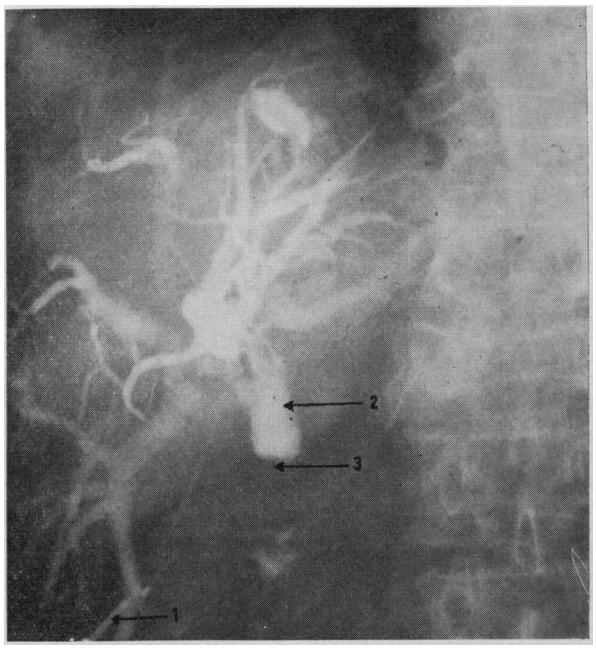

Fig. 6a

Fig. 6(a).—Postoperative biliary stricture. Intrahepatic bile ducts and common hepatic duct outlined following percutaneous cholangiography: (1) Teflon cannula, (2) common hepatic duct and (3) level of stricture. Fig. 6(b). —Postoperative biliary stricture. Common duct outlined from injection of a T-tube showing the segmental defect in the common duct: (1) Teflon cannula, (2) common hepatic duct, (3) common bile duct, (4) defect and (5) T-tube.

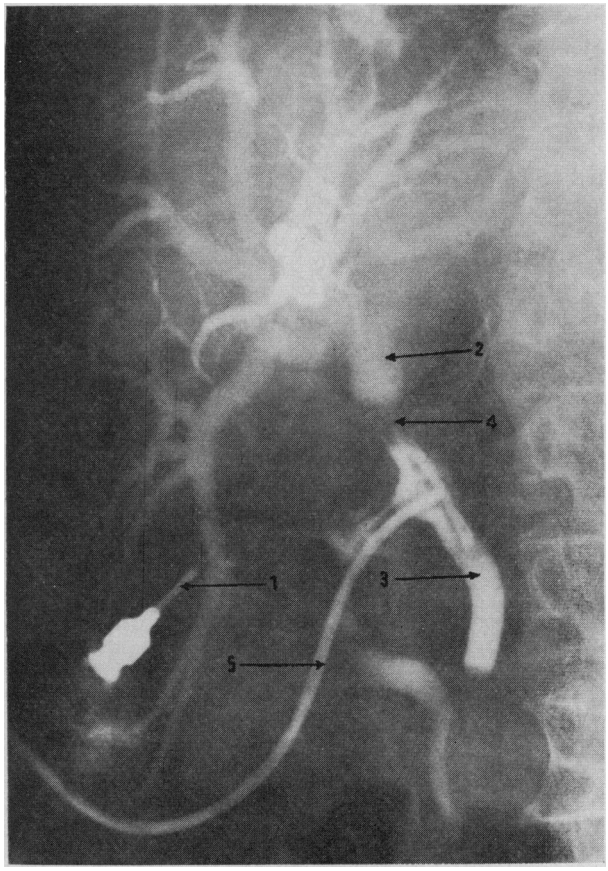

Fig. 6b

cases where the lesion is high in the ductal system and difficult to visualize at operation. If the obstruction is incomplete, the common duct will be visualized and a polypoid filling defect or a long, irregular, stenotic segment may be outlined.

6. *Benign Strictures* (Figs. 6a, 6b, 7 and 8). These almost always occur (early or late) after operations on the biliary tract. Their appearance, of course, depends on the location and extent of the stricture; with ampullary stenosis, there is a regular smooth narrowing of the terminal portion of the common duct with moderate proximal dilatation.

The usual features found in postoperative strictures are:

(a) A localized, smooth-walled stenosis or narrowing.

(b) Lack of continuity of common duct.

(c) A spontaneous choledochoduodenal fistula.

7. *Metastatic lesions* (Fig. 9).—Metastatic deposits in the region of the porta hepatis usually produce complete obstruction, but a compressed and displaced common duct may be outlined. The usual pattern is very difficult to differentiate from that seen in a primary duct tumour

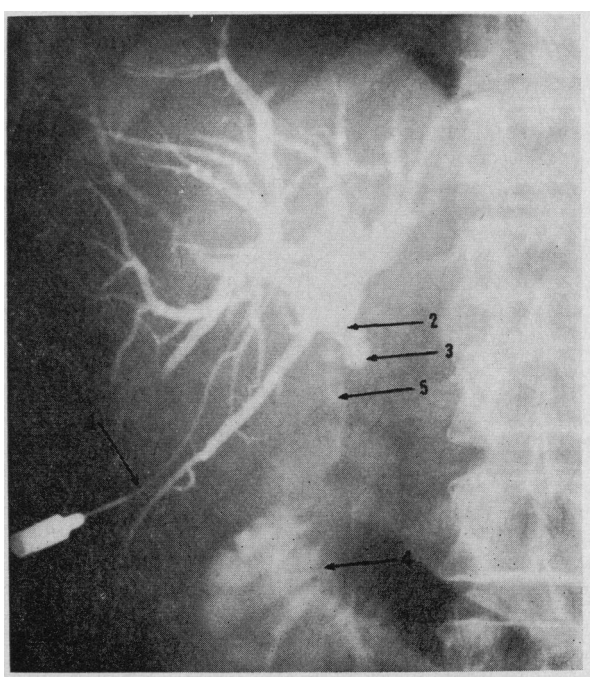

Fig. 7.—Postoperative common duct stricture with formation of a spontaneous choledochoduodenal fistula: (1) Teflon cannula, (2) common duct, (3) cut-off at the point of obstruction, (4) duodenum and (5) choledochoduodenal fistula.

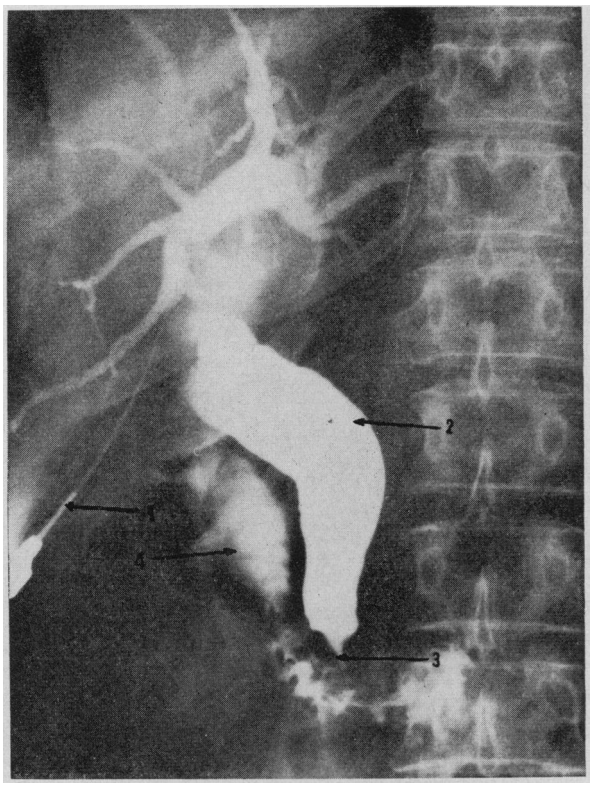

Fig. 8.—Ampullary stenosis: (1) Teflon cannula, (2) dilated common duct, (3) stenosis and (4) duodenum.

or carcinoma of the pancreas.

8. *Hepatocellular jaundice.*—This condition is difficult to identify because it is usually impossible to enter a normal-sized duct system by needling the liver. If the injection can be made, the diagnosis is suggested by the normal appearance of the biliary tree and the absence of obstruction.

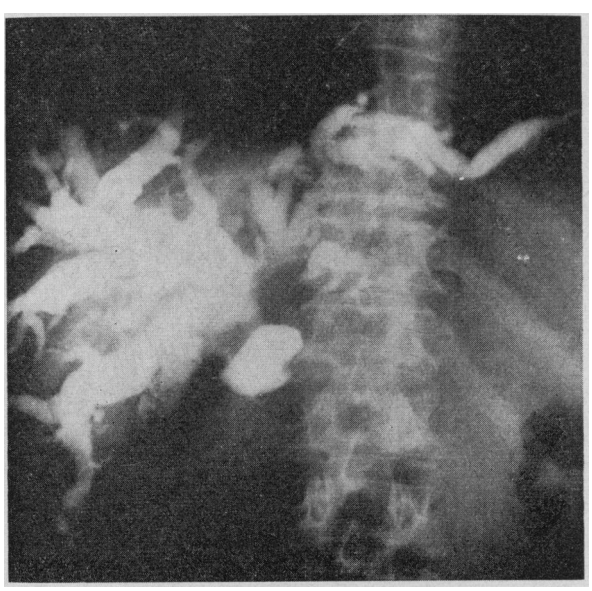

Fig. 9.—Secondary deposits in the porta hepatis.

From our study of percutaneous transhepatic cholangiography (PTC), as well as from the experience of others, we find that it is the only method at present available by which it is possible, without a laparotomy, to demonstrate the site and nature of the pathology in, or exterior to, the biliary tree in a jaundiced patient.

Obstructive jaundice always presents a difficult problem in diagnosis and management. The patients are frequently in the older age groups and are relatively poor operative risks. Furthermore, despite the numerous liver function tests and the availability of duodenal drainage and needle biopsy, an accurate diagnosis of the cause of obstructive jaundice is often impossible, especially in long-standing cases. Percutaneous transhepatic cholangiography is a safe, valuable technique that will provide in these cases specific and definitive information which can be gained in no other way, if contraindications to its use are not present. The most important contraindication is the failure of the prothrombin time to reach normal levels after adequate doses of phytonadione.

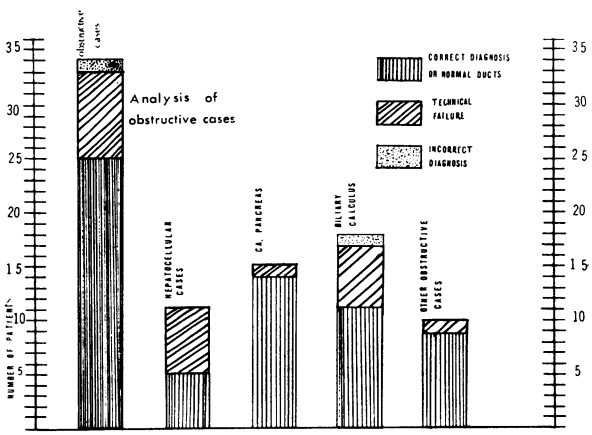

Fig. 10.—Analysis of interpretations.

The hazard of biliary leakage or of hemorrhage is minimal if: (a) the procedure is performed by an experienced radiologist; (b) the patient is prepared for immediate operation if this should prove necessary, and (c) a close watch is kept for signs of peritoneal irritation and internal hemorrhage.

The information provided by PTC will obviate the need for an unnecessary and difficult surgical exploration and can save precious time both in the patient's preoperative evaluation and at operation, with possible reduction in mortality and morbidity. Intelligent planning of the operation becomes possible and the type of by-pass procedure which is feasible will be indicated.

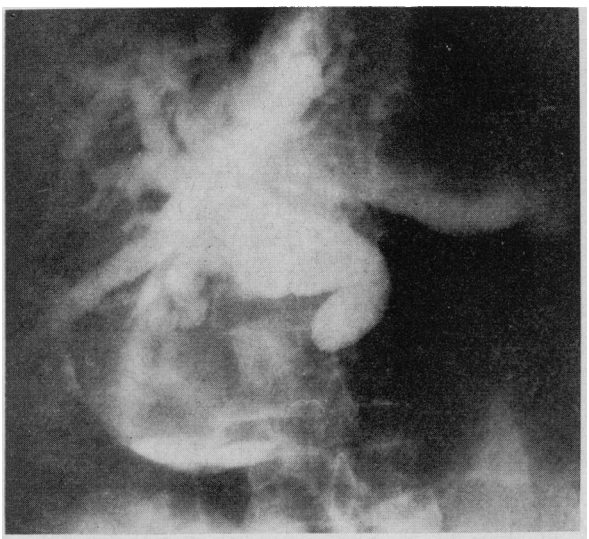

Fig. 11.—Radiological findings interpreted as carcinoma of the pancreas. Surgeon concurred at operation. Postmortem examination showed calculus impacted in the lower end of the common duct.

This is especially true for postoperative strictures. PTC will usually enable an experienced radiologist to differentiate carcinoma of the pancreas from calculus obstruction of the bile ducts. The preoperative knowledge as to the type of case he is dealing with can be of inestimable value to the surgeon if it makes possible the avoidance of a prolonged and difficult dissection.

The limitations of PTC should be understood. It usually should be performed only in patients with obstructive jaundice in whom corrective surgery is planned within the next few hours, as it is basically a preoperative procedure, or reserved for cases of long-standing jaundice where the diagnosis is in considerable doubt.

If operation is found to be contraindicated following the procedure, careful continuous observation of the patient is necessary to detect the development of complications.

CONCLUSIONS

Percutaneous transhepatic cholangiography is a simple, safe and valuable technique that will provide specific and definitive information in patients with obstructive jaundice. It is not a substitute for oral cholecystography or intravenous cholangiography and should be done only when these methods are inapplicable owing to a high serum bilirubin.

The chances of a successful examination are tripled in the presence of a dilated biliary tree, and the examination should be attempted only in those patients with either a well-supported working diagnosis of obstructive jaundice or in those in whom the diagnosis is in considerable doubt.

The complications of bile peritonitis and internal hemorrhage are best avoided by restricting the study to the immediate preoperative period. Failure of the procedure to demonstrate the bile ducts is of no value in distinguishing obstructive from hepatocellular jaundice in our experience. In approximately half of the unsuccessful cases in our series the subsequent course of events demonstrated that the common duct was blocked by either calculi or carcinoma. It cannot be concluded, therefore, that because the bile ducts have not been demonstrated, the most likely cause of jaundice is hepatocellular disease.

This relatively high failure rate in obstructive disease no doubt could be lowered if the examination were restricted to those patients whose preliminary clinical and laboratory workup clearly points to obstruction as the cause of the jaundice.

We believe that within approximately 10 years PTC has followed the usual course of most of the special procedures in diagnostic radiology. We have adapted the graph of Williams[9] to show this response to percutaneous transhepatic cholangiography (Fig. 12).

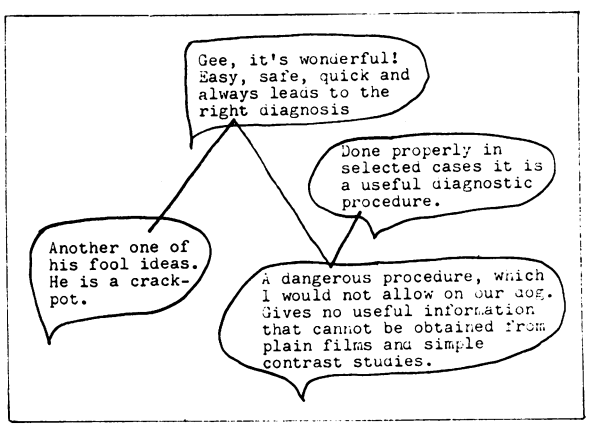

Fig. 12.—Modified chart from Williams, showing reaction to a new drug adapted to the evolution of special procedures in diagnostic radiology. This illustrates the response to transhepatic cholangiography in the past 10 years.

Summary Fifty-four cases of jaundice were studied by percutaneous transhepatic cholangiography. Satisfactory visualization of the biliary tree was obtained in 40 cases (75%). The examination was successful in 36 of the 43 cases (84%) of obstructive jaundice and in 5 of the 11 cases (45%) of hepatocellular disease.

A correct diagnosis was made in 39 out of 40 successful cases. Fifty per cent of the 14 failures subsequently proved to have extrahepatic obstruction (six cases of biliary calculus and one case of

Canad. Med. Ass. J.
Jan. 18, 1969, vol. 100

carcinoma). Complications occurred in six cases (four cases of bile peritonitis and two cases of hemorrhage) but there were no fatalities; these can be avoided if PTC is used just before laparotomy.

Résumé Nous avons étudié 54 cas d'ictère au moyen de cholangiographie transhépatique par voie percutanée. Dans 40 cas, (75%) nous avons obtenu une image satisfaisante de l'arbre biliaire. L'examen a été couronné de succès dans 36 des 43 cas (84%) d'ictère par rétention et dans 5 des 11 cas de maladie hépatocellulaire (45%).

Le diagnostic a été trouvé exact dans 39 des 40 cas d'examens réussis. Dans la moitié des 14 échecs diagnostiques, on a constaté par la suite qu'il s'agissait d'occlusion extrahépatique (six cas de calculs biliaires et un cas de cancer). Il y eut des complications dans six cas (quatre cas de péritonite biliaire et deux cas d'hemorragie), mais aucun décès. Ces complications peuvent être évitées à condition de procéder à la cholangiographie transhépatique percutanée juste avant la laparotomie.

REFERENCES

1. BURCKHARDT, H. AND MÜLLER, W.: *Deutsch. Z. Chir.*, **168**: 161, 1921.
2. GRAHAM, E. A. AND COLE, W. H.: *J. A. M. A.*, **82**: 613, 1924.
3. HUARD, P. AND DO-XUAN-HOP: *Bull. Soc. Med. Chir. Indoch.*, **15**: 1090, 1937.
4. ROYER, M., SOLARI, A. V. AND LOTTERO-LANARI, R.: *Arch. argent. de enferm. d. ap. digest. y de la nutricion*, **17**: 368, 1942.
5. CARTER, R. F. AND SAYPOL, G. M.: *J. A. M. A.*, **148**: 253, 1952.
6. KIDD, H. A.: *A.M.A. Arch. Surg.*, **72**: 262, 1956.
7. KAPLAN, A. A. *et al.*: *Ann. Intern. Med.*, **54**: 856, 1961.
8. DRAKE, C. T. AND BEAL, J. M.: *Arch. Surg. (Chicago)*, **91**: 558, 1965.
9. WILLIAMS, R. H.: *J. A. M. A.*, **156**: 127, 1954.

Obliterative Intimal Fibrosis in Kidneys of Dialyzed Patients

G. TOLNAI, M.D.,* K. SARKAR, M.B., B.S.,†
Z. F. JAWORSKI, M.D., F.R.C.P.[C], F.A.C.P.‡ and
A. H. IRVINE, M.D., F.R.C.P.[C], F.A.C.S.,§ *Ottawa, Ont.*

PERIODIC dialysis as a form of treatment in cases of chronic renal failure was first reported in 1960[1] and is now a widely accepted procedure which has achieved considerable clinical success. There is, however, no indication that the progression of the underlying renal disease and the resultant morphological distortion of the renal parenchyma are effectively reversed or even arrested by dialysis. This paper presents a hitherto unrecorded change in the vascular morphology of kidneys of dialyzed patients.[14] The two major divisions of the main-stem renal artery and their subsequent branches and subbranches within the renal parenchyma undergo a moderate to severe form of obliterating intimal fibrosis. Obliterative fibrotic intimal change of such widespread distribution is not seen in non-dialyzed endstage kidneys, which suggests that this development is due to prolongation of the survival of the patient with dialysis.

From the Departments of Pathology and Medicine, Ottawa General Hospital, the Department of Urology, Ottawa Civic Hospital; Faculty of Medicine, University of Ottawa, Ottawa, Ontario.
This work was supported by a grant from the Medical Research Council of Canada.
*Pathologist, Ottawa General Hospital and Assistant Professor of Pathology, University of Ottawa.
†Fellow of the Medical Research Council of Canada, Department of Pathology, University of Ottawa.
‡Department of Medicine, Ottawa General Hospital and Associate Professor of Medicine, University of Ottawa.
§Department of Urology, Ottawa Civic Hospital and Assistant Professor, Department of Urology, University of Ottawa.
Reprint requests to: Dr. G. Tolnai, Department of Pathology, University of Ottawa, Ottawa 2, Ontario.

MATERIALS AND METHODS

Kidneys from 10 patients with chronic renal failure were available for this study. These patients were treated by dialysis in the Renal Metabolic Units of the Ottawa General and Ottawa Civic Hospitals between 1964 and 1967. Four out of 10 patients died in the course of conservative treatment. The other six cases had bilateral nephrectomy as a preliminary procedure for renal transplantation, and of these, four eventually died with or without renal transplantation. Postmortem examinations were done on four non-surgical and three post-surgical cases. Kidneys from eight non-dialyzed patients dying of chronic renal failure were examined as controls. These cases were from the autopsy files of the Ottawa General Hospital between 1963 and 1968; five patients had chronic pyelonephritis and the other three had chronic glomerulonephritis.

Specimens were fixed in 10% neutral formalin. Sections from paraffin-embedded tissues were examined with hematoxylin-phloxin-saffron, periodic acid-Schiff, Masson trichrome, elastic tissue and reticulin stains.